

FACILITATING IDEA GENERATION IN A TEAM CONTEXT: THE EFFECTS OF
TECHNIQUE, PERCEIVED ORGANIZATIONAL SUPPORT, INDIVIDUAL
DIFFERENCES AND SATISFACTION WITH IDEA GENERATION

by

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Dissertation submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

Psychology

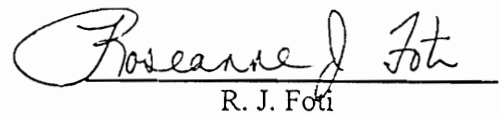
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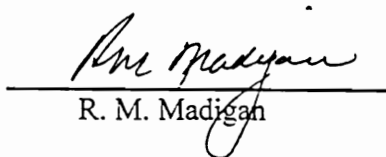
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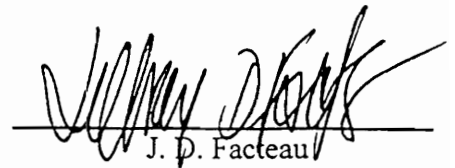
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April 3, 1996

Blacksburg, Virginia

KEY WORDS: IDEA GENERATION, TEAMS, INNOVATION, BRAINSTORMING,
CREATIVITY

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(ABSTRACT)

The current study examines the effects of idea generation technique (IGT), perceived organizational support (POS), associative problem-solving style (APS), bisociative problem-solving style (BPS), need for cognition (NFC) and satisfaction with idea generation (SIG) on idea generation in a team context. Previous brainstorming research has shown that more ideas are generated when a nominal group IGT is employed, when compared to an interactive IGT. However, the innovation literature suggests the opposite - that more ideas will be generated in an interactive context. To address this theoretical discrepancy, a strong inference approach was used to test competing hypotheses. Results suggest the interactive IGT is optimal for facilitating idea generation. Past research suggests that POS is positively related to idea generation. While the current study predicted this relationship, results indicated that there is a negative relationship between the two. Based on the literature, it was hypothesized that APS would be negatively related to idea generation, while BPS would have a positive affect on idea generation. Results partially supported this pattern in that the role of APS was supported while the effect of BPS was not significant. Past research has found that NFC is positively related to idea generation. This finding was not supported in the current

study. NFC literature also suggests that NFC will have a positive effect on satisfaction with idea generation, as idea generation is a cognitive activity. Current results do not support this prediction. The current study also predicted that APS, BPS and NFC would indirectly affect idea generation through POS. Current results partially support this prediction as APS had a negative indirect effect on idea generation through POS. Past research suggests that SIG is significantly related to idea generation and that SIG will be greater for the interactive IGT, when compared to its nominal counterpart. Current findings only support this latter prediction as idea generators reported being more satisfied with the interactive IGT than with the nominal IGT. Current results indicate that SIG is not related to idea generation. Possible explanations for current results, implications for past research, caveats for application and suggestions for future research are discussed.

ACKNOWLEDGMENTS

My deepest gratitude is extended to Neil Hauenstein. As I prepare to embark on my career in the “real world” I am confident that I will succeed. I attribute this confidence to Neil. As my mentor, Neil always was there to offer his advice, perspective and support during my professional development. As my friend, Neil was there to offer his advice, perspective and support during my personal development. I will always be grateful for this.

I would also like to thank Roseanne Foti, Sigrid Gustafson, Jeff Facticeau and Robert Madigan for serving on my committee and offering valuable suggestions for making this document a stronger one. Thanks also go to Bethany and Andrea for serving as expert raters during this research.

Recognition also goes to John Muffo. John has facilitated my professional development by ensuring that my tenure at the Academic Assessment Office was a learning experience. The knowledge and skills I have acquired from this experience are invaluable and will continue to be so during my career progression.

My friends also deserve a special thanks. These friends have kept my feet on the ground and provided much needed diversions from academia.

I would also like to extend my appreciation to my two families, the Ahrens’ and the Morgans, who have provided unconditional support throughout my academic endeavors. Special recognition goes to my parents, Bill and Eileen Morgan, who have stood behind me through good times and bad and are responsible for me being where and what I am today.

Lastly and most importantly, I offer my thanks to Andrea Morgan, my wife, best friend, and companion on our life-long adventure. It is impossible to articulate what Andrea means to me. Without her, this work would not have come to fruition. Indeed, if it was allowed, I would have placed her name on the title page next to mine. It is to Andrea that I dedicate this work and all my work to come.

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INTRODUCTION

In order to be competitive in a rapidly changing environment, organizations need to be able to adapt to the dynamic economic, social, and political factors present in the system in which they operate (West & Wallace, 1991). One method by which organizations address this adaptation need is by innovating. Because the pace and complexity of environmental change limits the effectiveness of individual innovation, organizations are turning to teams as potential agents for innovation and creative change. While many organizations (e.g., Xerox) and researchers (e.g., Garvin, 1993) advocate the use of teams as sites for innovation and creativity, little empirical research exists which examines the process of generating innovative ideas within a team context (Burningham & West, 1995). The current research will examine this process.

Idea Generation

The innovation process has been defined as: the intentional *introduction* and *application*, within a group or organization, of ideas, processes, products, etc., new to the adopting agent and designed to benefit the organization (West & Farr, 1990); the *development* and *implementation* of new ideas by individuals who, over time, engage in transactions within an institution (Van de Ven, 1986); and, the successful *implementation* of creative ideas *generated* within an organization (Amabile, 1988). As evidenced by the preceding definitions, there is a general consensus in the literature that the innovation process consists of two major phases: *idea generation* and idea implementation.

Regardless of which definition or conceptualization of innovation one espouses, a ubiquitous theme throughout is that the starting point of the innovation process is the initial innovative idea. Innovation in organizations is the product of multiple factors yet is always initiated by the creativity of ideas generated by individual members. As such, innovation is triggered by an “idea generator’s” (Galbraith, 1982) recognition of a new opportunity, which, consequently, initiates the process of departing from the organization’s established routines (i.e., innovation) (Kanter, 1988).

This focus on idea generation is also stressed in the creativity literature. Creativity researchers have long respected the complexity of creativity while recognizing the importance of idea generation to the process (e.g., Nicholls, 1972). Many creativity researchers operationalize creativity as idea generation. For example, Amabile (1988) defines creativity as the production of useful ideas by an individual or small group of individuals working together. Woodman, Sawyer, and Griffin (1993) define organizational creativity as the creation of a valuable idea by individuals working together in a complex social system. These researchers view creativity as a subset of the broader domain of innovation, with innovation defined as the successful implementation of creative ideas within an organization. Hence, creativity is equivalent to the idea generation stage of innovation. Because of the fundamental importance of idea generation to innovation and creativity, the current study will concentrate its focus on the idea generation process.

As emphasized by the innovation and creativity literature, idea generation is not an individual process - it is a collective achievement. Once an idea is presented, over time a wide array of people with diverse perspectives become involved in the ideation process. These diverse perspectives, in turn, facilitate the proliferation of the one idea into multiple ideas. Hence, although an idea may be voiced by a single individual, the idea is actually a product of previous transactions with other team members. Thus, within a team context, ideas are generated, discussed, and fine-tuned so that they evolve into *team ideas*. These ideas are then exported for potential organizational implementation.

In short, the traditional view of the innovation process assumes that the building block of innovation, the innovative idea, will surface, evolve, and flourish in a team context. However, this assumption that idea generation will thrive in a team context is suspect for two reasons. First, the large body of research on brainstorming and idea generation techniques indicates that idea generation is actually *compromised* in an interactive or team context. Second, as Kanter (1988) suggests, micro processes, such as idea generation, are often affected by both macro conditions within the organization (e.g., organizational support for innovation) as well as micro conditions such as *perceptions* of organizational support for innovation, and individual differences among team members (e.g., problem-solving style; need for cognition) (Woodman, Sawyer, & Griffin, 1993). The current study will focus on both these micro conditions as antecedents to idea generation as well as the optimal technique for facilitating idea generation.

Idea Generation Technique

Brainstorming is widely recognized as a useful technique for idea generation in organizations. *Interactive group brainstorming* is the process of generating ideas in a group with an emphasis on generating as many ideas as possible. As put forth by Osborn (1957), the guidelines for this interactive process are: to be uncritical of others; to state any idea that comes to mind, no matter how wild; to build on the ideas of others; and, to aim for a large quantity of ideas. Osborn assumed that generating a large *quantity* of ideas would stimulate ideas of high *quality* as well. Empirical evidence from brainstorming research supports this assumption in that quantity measures have been found to be highly correlated with quality measures in a number of studies (e.g., Diehl & Stroebe, 1987; Dennis & Valacich, 1994). In these studies, experimental manipulations were found to affect the number of ideas generated but not the average quality of ideas generated.

Those advocating this interactive group procedure presume, based on associationistic principles, that others' generated ideas stimulate novel associations for those exposed to the ideas. Specifically, the more ideas expressed, the greater the likelihood of new associations. These associationistic principles are in line with the aforementioned assumption that idea generation will thrive in a synergistic team context. There is wide support for the use of teams in organizational contexts, and some evidence from research on innovation in organizations that collaboration or information exchange may be related to more effective or innovative performance (e.g., Brown & Duguid, 1991).

As discussed above, it has traditionally been presupposed that interactive brainstorming is more efficient than individual idea generation (e.g., the “more heads are better than one” adage). However, research comparing interactive brainstorming groups with similar members of individuals brainstorming alone (i.e., *nominal groups*) has consistently demonstrated that nominal groups outperform their interactive counterparts (e.g., Diehl & Strobe, 1991; Paulus, Larey, & Ortega, 1995). Results generally indicate that nominal groups produce about twice as many ideas as interactive groups (see Mullen, Johnson, & Salas, 1991, for a review). Studies of collaborative knowledge teams have also provided no clear evidence that collaboration provides benefits beyond those achieved by isolated workers (King & Anderson, 1990).

Possible explanations for the performance difference between interactive and nominal groups include: social psychological factors such as evaluation apprehension (concern for what others will think of ideas); procedural constraints such as production blocking (difficulty expressing ideas while others are talking or forgetting ideas while waiting for others to present theirs) (Diehl & Strobe, 1991); and economic factors such as social loafing (due to not being accountable for individual performance) (Shepperd, 1993). Whatever the explanation, the generally poor performance of interacting brainstorming groups presents a major challenge to the assumption that idea generation benefits from a team context.

It should be noted that some researchers (e.g., Paulus, Brown, & Ortega, in press) argue that existing evidence of the superiority of nominal techniques over interactive techniques is suspect because of the experimental tasks used to compare the two. As Paulus et al. (in press) point out, most studies comparing the two idea generation techniques used a brainstorming task of little personal relevance to the participants' lives (e.g., finding uses for an extra thumb). This provides a stark contrast to idea generation in organizations which involves team members brainstorming about a problem that has personal relevance to them and the organization. When confronted with an irrelevant, non-engaging task there may be little interactive idea generation because individuals feel they have an adequate pool of ideas to address the problem, thereby negating the need to draw on other team members' knowledge. Conversely, when confronted with a relevant and engaging task, individuals may be more motivated to search for novel solutions (as they will have a positive impact on their lives) and perceive others as providing needed stimulation for idea generation. Paulus et al. (in press) thus suggest that if a meaningful, relevant brainstorming task is employed, results may challenge those previously documented. To examine this possibility, the current study will use relevant brainstorming tasks that directly impact the participants' lives.

Because idea generation is fundamental to innovation and other creative endeavors, it is critical to determine which idea generation technique is the most effective in an organizational context. In other words, is it appropriate to assume that idea generation

and innovation will optimally evolve in a natural team context (i.e., relying on the interactive technique)? Or, would the idea generation process be expedited via the use of the nominal group technique? The former technique assumes associationistic stimulation will facilitate idea generation. The latter technique assumes the reduction of group inhibitory factors will facilitate idea generation. The current study will examine which idea generation technique is best suited for expediting idea generation. Specifically, it is predicted that technique will affect the quantity of ideas. Moreover, consistent with Osborn's assumption and empirical evidence documenting the relationship between quantity and quality, technique is not predicted to affect the relative quality of the ideas generated.

Perceived Organizational Support

One micro-level condition that may affect idea generation is perceived organizational support for innovation/idea generation. Assuming that individuals are capable of generating ideas, their willingness to engage in the process may be tempered by perceptions regarding the consequences of such actions in a given environment (Mumford & Gustafson, 1988). Advocates of psychological climate theory contend that individuals respond to cognitive representations of the environment (i.e., perceptions) rather than the actual environment itself. Thus, the organizational climate emits signals that workers interpret regarding organizational expectations for behavior and potential outcomes of behavior (Scott & Bruce, 1994). For example, organizations that show disinterest

towards innovation or that over-emphasize maintaining the status quo may create a climate in which the evolution of creative ideas may be suppressed. In the same vein, if an organization supports the maintenance of routine instead of supporting the change associated with innovation, idea generators may feel it is inappropriate or even risky to voice ideas. As Schein (1993) emphasizes, the organization must create a climate of psychological safety - employees must feel it is "safe" to ideate. Other authors also stress the importance of organizational support for innovation (e.g., Fleishman & Zaccaro, 1992; Henderson, 1994; Henkin, Davis, & Singleton, 1993).

Empirical studies also support the role of perceived organizational support in the innovation process. In a recent study, Burningham and West (1995) found that perceived support for innovation was significantly related to and the primary predictor of team innovativeness. Likewise, in a study of health care teams, West and Wallace (1991) found that perceived organizational support for innovation was a major predictor of innovation. Specifically, norms for diversity accounted for 42 per cent of the variance in team innovation. Other researchers (e.g., Abbey & Dickson, 1983; Siegel & Kaemmerer, 1978) also offer empirical support for the effects of perceived organizational support on innovation. Thus, both theoretical and empirical research support the notion that organizational support facilitates team innovation. However, to date, little research has directly examined the effects of perceived organizational support on idea generation. The current study will address this issue.

Individual Differences

Individual differences among team members may also play a key role in idea generation. Creativity researchers are in general agreement that cognitive factors (e.g., Carrol, 1985) and personality factors (e.g., Eyesenck, 1994) are related to creativity. The present study will expand on this school of thought by modeling representative cognitive and personality factors, that theoretically have implications for the idea generation process, as antecedents of idea generation. Specifically, the effects of *problem-solving style* (a cognitive factor) and *need for cognition* (NFC; Cacioppo & Petty, 1982) (a personality factor) on idea generation will be delimited.

Problem-solving or cognitive style has received increased recognition as a precursor to innovative behavior (e.g., Jabri, 1991; Kirton, 1976). Kirton's (1976) Adaption-Innovation theory suggests that individuals have a cognitive style (i.e., preferred mode of tackling problems at various stages of the problem-solving process) which is independent of intellectual capacity. The scores from this inventory are used to derive a rating along an adaption-innovation continuum. The adaptor is characterized as reliable, efficient, methodological, disciplined, and conforming. The innovator is characterized as undisciplined, tangential, and as approaching tasks from unsuspected angles (Kirton, 1987). Moreover, while adaptors strive to maintain harmony in a team, innovators often promote conflict with their maverick ideas. With regard to the innovation process, adaptors are apt to be more influential in the idea implementation

phase as they are more likely to be congenial. Innovators, on the other hand, may be more influential in the idea generation phase as they are more likely to challenge the status quo and voice innovative ideas.

Whereas Kirton places problem-solving style on a continuum, Jabri (1991) conceptualizes it as composed of two independent modes of thinking: associative and bisociative. Jabri suggests that the KAI is limited in that the summation of sub-scores may mask important profile differences. To address this limitation, Jabri's (1991) associative/bisociative index does not sum sub-scores, but treats them as independent sub-scales.

“Associative thinking” is based on habit (following set routines), rule conformity, and use of rationality and logic. The associative problem-solver is likely to generate conventional ideas or solutions to problems, and is thus similar to Kirton's adaptor.

“Bisociative thinking” is characterized by non-habitual thought, combining separate domains of thought simultaneously, a lack of attention to rules, and an emphasis on imagery and intuition (Scott & Bruce, 1994). The bisociative thinker is more likely to process cross-paradigm information simultaneously; and, therefore, is more apt to generate innovative ideas or problem solutions. Hence, the bisociative thinker parallels Kirton's innovator.

As alluded to above, neither problem-solving style (associative or bisociative) should be viewed as a generally preferred style as the utility of a given style is a function

of the fit between problem-solving style and the problem or task at hand (Payne, Lane, & Jabri, 1990). For example, during the idea generation phase of the innovation process the bisociative style may be preferred, while during the implementation stage, the associative style may be preferred. Since the current study will focus on idea generation, it is predicted that a bisociative style will be positively related to idea generation, while an associative style will be negatively related to idea generation.

The construct of need for cognition (NFC) is based on the proposition that there are individual differences in the predisposition towards mental laziness or mental engagement (Petty & Cacioppo, 1986). Thus, the need for cognition is the tendency for an individual to engage in and enjoy thinking. Thompson, Chaiken, and Hazlewood (1993) describe need for cognition as “*motivation based on intrinsic enjoyment of effortful cognitive activity*” (p. 988, emphasis added). The conceptualization of need for cognition as intrinsic motivation to cognate suggests that need for cognition may be an antecedent to idea generation. Since the current study will focus on idea generation, an effortful cognitive activity, it is predicted that need for cognition will be positively related to idea generation. Furthermore, since need for cognition is based on intrinsic enjoyment of effortful cognitive activity, and idea generation affords the opportunity to cognate, it is also predicted that need for cognition will be positively related to satisfaction with idea generation.

Of further interest to the current investigation are the effects of individual differences on perceptions of organizational support. Many climate researchers (e.g., James, James, & Ashe, 1990) argue that individual values, personalities, and cognitive characteristics affect climate perceptions. James et al. (1990) propose that individuals interpret the environment by referencing internal values or standards. These internal values or standards are related to the concept of needs which, in turn, help determine the value of environmental phenomena to individuals (James, Hater, Gent, & Bruni, 1978). Thus, these needs, such as the need for cognition, make aspects of the environment, such as organizational support for innovation (a cognitive activity), more salient (Scott & Bruce, 1994). The results of two recent empirical studies also suggest that cognitive style is significantly related to climate perceptions (Scott & Bruce, 1994; Wooten, Barner, & Silver, 1994).

To gain a more comprehensive view of the idea generation process, the current study will address two research issues related to the effects of individual differences on idea generation. First, the direct effects of problem-solving style and need for cognition on idea generation will be examined. Second, the indirect effects of these individual difference variables through perceived organizational support for innovation will be examined. As the latter issue has received scant attention in the literature, no specific directional hypotheses will be made regarding perceived support for innovation as a mediator.

Satisfaction with Idea Generation

Also of interest to the current investigation is the impact of idea generation technique on satisfaction with idea generation. Many researchers and practitioners believe that the reason interactive brainstorming continues to be widely used in organizations (despite the fact that it appears to be less efficient than nominal brainstorming) is that positive affective responses (e.g., satisfaction) to interactive brainstorming create an illusion of team effectiveness despite objective effectiveness. Empirical research supports this belief in that participants in both interactive and nominal groups perceive interactive group brainstorming as more productive - the “illusion of productivity” (Paulus et al., 1993; Paulus, et al., 1995), regardless of the evidence. Moreover, the brainstorming literature indicates that, while nominal groups are better at idea generation, interactive teams consistently report that they are more satisfied with idea generation.

In terms of the effects of satisfaction with idea generation on idea generation, Paulus et al. posit that the illusion of productivity may lead to interactive team members being prematurely satisfied with their performance, thereby leading to a reduction in their motivation to continue generating ideas. Thus, as satisfaction with idea generation increases, idea generation decreases.

The above relationship between satisfaction and idea generation documented in the brainstorming literature and by Paulus and his colleagues contradicts Isen's research (e.g., Estrada, Isen, & Young, 1994; Isen, Niedenthal, & Cantor, 1992) on affect and creativity. Isen and her colleagues, in a series of experiments, found that participants in whom they induced positive feelings (e.g., by watching an extract of a comedy film) performed better at tasks requiring creative solutions than control groups. Isen's work implies that if interactive contexts foster more positive affect (greater satisfaction), teams will be *more* creative and generate *more* ideas. This is a direct challenge to Paulus et al.'s (in press) contention that premature satisfaction is *negatively* related to idea generation. Thus, another goal of the current study is to examine the effects of satisfaction with idea generation on idea generation to gain a better understanding of the idea generation process and address this theoretical discrepancy.

Overview of the Study

To gain a more comprehensive view of the idea generation process in a team context, the following factors are examined: idea generation technique, perceived organizational support, problem-solving style, need for cognition, and satisfaction with idea generation. All factors are examined to test predictions about their effects on idea generation.

The first factor, idea generation technique, will be investigated to determine which technique is optimal for facilitating idea generation. Innovation literature suggests that the

interactive technique is optimal for facilitating idea generation, whereas brainstorming literature suggests the nominal technique is optimal. To address this theoretical discrepancy, a strong inference methodology (Platt, 1964) will be used to test competing hypotheses. Moreover, since the existing evidence of the superiority of nominal techniques over interactive techniques (see Mullen et al., 1991, for a review) documented in the brainstorming literature may be suspect due to a task effect (i.e., the tasks not being relevant to the participants), the current study will employ tasks that are relevant and germane to the participants. Consistent with Osborn's assumption and empirical evidence documenting the relationship between quantity and quality, technique is not predicted to affect the relative quality of the ideas generated.

Perceived organizational support will be examined to delineate its role in the idea generation process. Past research suggests that there will be a positive relationship between perceived support and idea generation (e.g., Burningham & West, 1995; West & Wallace, 1991).

To gain a more comprehensive view of the idea generation process, the current study will address two research issues related to the effects of individual differences on idea generation. First, the direct effects of problem-solving style and need for cognition on idea generation will be examined. Second, the indirect effects of these individual difference variables through perceived organizational support for innovation will be examined. As the latter issue has received scant attention in the literature, no specific

directional hypotheses will be made regarding perceived support for innovation as a mediator.

With regard to problem-solving style, both associative thinking and bisociative thinking will be assessed to provide a more comprehensive picture of the idea generation process. Associative thinking is characterized as conventional and conforming, whereas bisociative thinking is characterized as processing cross-paradigm information simultaneously. Thus, it is predicted that associative thinking will be negatively related to idea generation while bisociative thinking is predicted to be positively related to idea generation.

Need for cognition is also predicted to be related to idea generation. The conceptualization of need for cognition as intrinsic motivation to cognate suggests that it will be positively related to idea generation (a cognitive activity). Moreover, since need for cognition is also based on intrinsic enjoyment of effortful cognitive activity, it is also predicted that it will be positively related to satisfaction with idea generation.

Satisfaction with idea generation is the final factor investigated as having an effect on idea generation. Isen's research on affect and creativity (e.g., Isen et al., 1992) suggests that satisfaction will be positively related to idea generation. This is a direct challenge to Paulus et al.'s (in press) contention that premature satisfaction is *negatively* related to idea generation. Thus, the current study will examine the effects of satisfaction on idea

generation to gain a better understanding of the innovative process and address this theoretical discrepancy.

The current study will also delineate the impact of technique on satisfaction with idea generation. Concordant with the brainstorming literature and Paulus et al.'s (in press) illusion of productivity, it is predicted that idea generators will be more satisfied with the interactive technique when compared to the nominal technique.

IDEA GENERATION: A LITERATURE REVIEW

In order to be competitive in a rapidly changing environment, organizations need to be able to adapt to the dynamic economic, social, and political factors present in the system in which they operate (West & Wallace, 1991). One method by which organizations address this adaptation need is by innovating. Because the pace and complexity of environmental change limits the effectiveness of individual innovation, organizations are turning to teams as potential agents for innovation and creative change. While many organizations (e.g., Xerox, Motorola, GE) and researchers (e.g., Garvin, 1993; Cannon-Bowers, Oser, & Flanagan, 1992) advocate the use of teams as sites for innovation and creativity, little empirical research exists which examines the process of generating innovative ideas within a team context (Burningham & West, 1995).

Role in Innovation and Creativity

Innovation. The innovation process has been defined as: the intentional *introduction* and *application*, within a group or organization, of ideas, processes, products, etc., new to the adopting agent and designed to benefit the organization (West & Farr, 1990); the *development* and *implementation* of new ideas by individuals who, over time, engage in transactions within an institution (Van de Ven, 1986); and, the successful *implementation* of creative ideas *generated* within an organization (Amabile, 1988). As evidenced by the preceding definitions, there is a general consensus in the literature that

the innovation process consists of two major phases: *idea generation* and idea implementation.

Others offer a more comprehensive view of the innovation process. For example, Van de Ven (1986) delineates five stages of the innovation process: idea appreciation; articulation; adoption; institutionalization; and, decay. Kanter (1988) posits that there are four major tasks in the process of innovation: idea generation; coalition building; idea realization; and, transfer or diffusion. Kanter suggests that these tasks are carried out at the micro-level by individuals and teams within an organization, with these micro processes facilitated or impeded by both micro- and macro-level conditions. Amabile (1983) presents a five-stage description of the innovation process: task presentation; preparation; idea generation; idea validation; and, outcome assessment. Rosen and Servo (1991) postulate the following formula for innovation: innovation = conception + invention + exploitation. Ancona and Caldwell (1990) propose that teams follow the following pattern of innovation: creation of ideas; development of ideas; and, diffusion/exportation of ideas.

Regardless of which definition, process model, or conceptualization of innovation one espouses, a ubiquitous theme throughout is that the starting point of the innovation process is the initial innovative idea. Innovation in organizations is the product of multiple factors yet is always initiated by the creativity of ideas generated by individual members. As such, innovation is triggered by an “idea generator’s” (Galbraith, 1982)

recognition of a new opportunity (i.e., Van de Ven's "appreciation), which, consequently, initiates the process of departing from the organization's established routines (i.e., innovation) (Kanter, 1988).

Creativity. The focus on idea generation is also stressed in the creativity literature. Creativity researchers have long respected the complexity of creativity while recognizing the importance of idea generation to the process (e.g., Nicholls, 1972). As Mumford and Gustafson (in press: 4) admonish: "[i]n recognizing the complex nature of the creative act..., one must not lose sight of a fundamental point. Ultimately creativity requires the generation of useful new ideas. Unless one can explain how people go about generating useful new ideas, it is impossible to develop a truly comprehensive model of the creative act".

Many creativity researchers offer a more product-oriented operational definition of creativity. For example, Amabile (1988) defines creativity as the production of useful ideas by an individual or small group of individuals working together. Woodman, Sawyer, and Griffin (1993) define organizational creativity as the creation of a valuable idea by individuals working together in a complex social system. These researchers view creativity as a subset of the broader domain of innovation, with innovation defined as the successful implementation of creative ideas within an organization. Hence, creativity is equivalent to the idea generation stage of innovation. Because of the fundamental

importance of idea generation to innovation and creativity, the current study will concentrate its focus on the idea generation process.

In a Team Context

As emphasized by the innovation and creativity literature in general, and Van de Ven (1986) in particular, idea generation is not an individual process - it is a collective achievement. Once an idea is presented (i.e., Van de Ven's "articulation"), over time a wide array of people with diverse perspectives become involved in the ideation process. These diverse perspectives, in turn, facilitate the proliferation of the one idea into multiple ideas. Hence, although an idea may be voiced by a single individual, the idea is actually a product of previous transactions with other team members. Thus, within a team context, ideas are generated, discussed, and fine-tuned so that they evolve into *team ideas*. These ideas are then exported for potential organizational implementation.

In short, the traditional view of the innovation process assumes that the building block of innovation, the innovative idea, will surface, evolve, and flourish in a team context. However, as will be discussed shortly, the assumption that idea generation will thrive in a team context is suspect for two reasons. First, the large body of research on brainstorming and idea generation techniques indicates that idea generation is actually *compromised* in an interactive or team context. Second, as Kanter (1988) suggests, micro processes, such as idea generation, are often affected by both macro conditions within the organization (e.g., organizational support for innovation) as well as micro conditions such

as *perceptions* of organizational support for innovation, and individual differences among team members (e.g., problem-solving style; need for cognition) (Woodman, Sawyer, & Griffin, 1993). The current study will focus on both these micro conditions as antecedents to idea generation as well as the optimal technique for facilitating idea generation.

Technique

Interactive Group. Brainstorming is widely recognized as a useful technique for idea generation in organizations. Interactive group brainstorming is the process of generating ideas in a group with an emphasis on generating as many ideas as possible. As put forth by Osborn (1957), the guidelines for this interactive process are: to be uncritical of others; to state any idea that comes to mind, no matter how wild; to build on the ideas of others; and, to aim for a large quantity of ideas. Osborn assumed that generating a large *quantity* of ideas would stimulate ideas of high *quality* as well. Empirical evidence from brainstorming research supports this assumption in that quantity measures have been found to be highly correlated with quality measures in a number of studies (e.g., Diehl & Stroebe, 1987; Dennis & Valacich, 1994). In these studies, experimental manipulations were found to affect the number of ideas generated but not the average quality of ideas generated.

Advocates of the interactive procedure presume, based on associationistic principles, that others' generated ideas will stimulate novel associations for those exposed

to the ideas. Specifically, the more ideas expressed, the greater the likelihood of new associations. Likewise, the greater the breadth of ideas expressed, the greater the likelihood of novel associations. Nagasundaram and Dennis (1993) also stress the importance of the experiential variety a team environment creates for improving the potential for idea generation. These associationistic principles are in line with the aforementioned assumption that idea generation will thrive in a synergistic team context.

In the same vein, Nystrom (1979) delineates four general assumptions for the superiority of interactive idea generation over individual idea generation: a) by joining together people with different skills and knowledge, interactive groups represent a broader range of competence and interests, than single individuals; b) comparisons and confrontations between different points of view take place more easily in an interactive context, than in the mind of an individual; c) groups usually have less fixed and more complex criteria for acceptable solutions than individuals; and, d) in interactive problem-solving, ideas have to be more clearly expressed to facilitate communication among members, than in individual problem-solving. There is wide support for the use of teams in organizational contexts, and some evidence from research on innovation in organizations that collaboration or information exchange may be related to more effective or innovative performance (e.g., Brown & Duguid, 1991; Burnside, 1990; Payne, 1990).

Nominal Group. As discussed above, it has traditionally been presupposed that interactive brainstorming is more efficient than individual idea generation (e.g., the “more

heads are better than one” adage). However, research comparing interactive brainstorming groups with similar members of individuals brainstorming alone (i.e., nominal groups) has consistently demonstrated that nominal groups outperform their interactive counterparts (e.g., Diehl & Strobe, 1987; Diehl & Strobe, 1991; Mullen, Johnson, & Salas, 1991; Paulus, Dzinet, Poletes, & Comacho, 1993; Paulus, Larey, & Ortega, 1995). Results generally indicate that nominal groups produce about twice as many ideas as interactive groups (see Mullen, Johnson, & Salas, 1991, for a review). Studies of collaborative knowledge teams have also provided no clear evidence that collaboration provides benefits beyond those achieved by isolated workers (King & Anderson, 1990).

Possible explanations for the performance difference between interactive and nominal groups include: social psychological factors such as evaluation apprehension (concern for what others will think of ideas); procedural constraints such as production blocking (difficulty expressing ideas while others are talking or forgetting ideas while waiting for others to present theirs) (Diehl & Strobe, 1991); and economic factors such as social loafing (due to not being accountable for individual performance) (Shepperd, 1993). The mental imagery and manipulation common to the early idea generation stages of creativity may also be hampered by social interaction (Freyd, 1994). Whatever the explanation, the generally poor performance of interacting brainstorming groups presents a major challenge to the assumption that idea generation benefits from a team context.

It should be noted that some researchers (e.g., Paulus, Brown, & Ortega, in press) argue that existing evidence of the superiority of nominal techniques over interactive techniques is suspect because of the experimental tasks used to compare the two. As Paulus et al. (in press) point out, most studies comparing the two idea generation techniques used a brainstorming task of little personal relevance to the participants' lives (e.g., finding uses for an extra thumb; finding uses for a paperclip). This provides a stark contrast to idea generation in organizations which involves team members brainstorming about a problem that has personal relevance to them and the organization (Paulus, Larey, & Ortega, 1995). When confronted with an irrelevant, non-engaging task there may be little interactive idea generation because individuals feel they have an adequate pool of ideas to address the problem, thereby negating the need to draw on other team members' knowledge. Conversely, when confronted with a relevant and engaging task, individuals may be more motivated to search for novel solutions (as they will have a positive impact on their lives) and perceive others as providing needed stimulation for idea generation. Paulus et al. (in press) thus suggest that if a meaningful, relevant brainstorming task is employed, results may challenge those previously documented. To examine this possibility, the current study will use relevant brainstorming tasks that impact the participants' lives.

Because idea generation is fundamental to innovation and other creative endeavors, it is critical to determine which idea generation technique is the most effective in an

organizational context. In other words, is it appropriate to assume that idea generation and innovation will optimally evolve in a natural team context (i.e., relying on the interactive technique)? Or, would the idea generation process be expedited via the use of the nominal group technique (i.e., having team members generate ideas in isolation)? The former technique assumes associationistic stimulation will facilitate idea generation. The latter technique assumes the reduction of group inhibitory factors such as social loafing, blocking, and evaluation apprehension will facilitate idea generation. The current study will examine which idea generation technique is best suited for expediting idea generation. Specifically, it is predicted that technique will affect the quantity of ideas. Moreover, consistent with Osborn's assumption and empirical evidence documenting the relationship between quantity and quality, technique is not predicted to affect the relative quality of the ideas generated.

Perceived Organizational Support

One micro-level condition that may affect idea generation is perceived organizational support for innovation/idea generation. Assuming that individuals are capable of generating ideas, their willingness to engage in the process may be tempered by perceptions regarding the consequences of such actions in a given environment (Mumford & Gustafson, 1988). Advocates of psychological climate theory contend that individuals respond to cognitive representations of the environment (i.e., perceptions) rather than the actual environment itself. Thus, the organizational climate emits signals that workers

interpret regarding organizational expectations for behavior and potential outcomes of behavior (Scott & Bruce, 1994). For example, organizations that show disinterest towards innovation or that over-emphasize maintaining the status quo may create a climate in which the evolution of creative ideas may be suppressed. If it is perceived that an organization does not encourage idea generation among employees or is apathetic towards any innovative ideas, why should employees and their teams put forth the effort? In the same vein, if an organization supports the maintenance of routine instead of supporting the change associated with innovation, idea generators may feel it is inappropriate or even risky to voice ideas. As Schein (1993) emphasizes, the organization must create a climate of psychological safety - employees must feel it is "safe" to ideate. This emphasis on climate complements Rogers' (1961) contention that individual creativity may be expected to increase when the individual experiences greater psychological safety and psychological freedom. Schein suggests some ways for an organization to project a climate psychological safety and support for innovation: give employees opportunities for practice; let employees know it is okay to make mistakes; reward efforts in the direction of innovation; and, create norms that support idea generation and experimentation. Other authors also stress the importance of organizational support for innovation (e.g., Brown, 1991; Fleishman & Zaccaro, 1992; Henderson, 1994; Henkin, Davis, & Singleton, 1993; Tyre & Orlinowski, 1993; Zuboff, 1991).

Empirical studies also support the role of perceived organizational support for innovation in the innovation process. In a recent study, Burningham and West (1995) found that perceived support for innovation was significantly related to and the primary predictor of team innovativeness (as measured by external ratings). Eisenberger, Fasolo, and Davis-LaMastro (1990) also reported a positive relationship between perceived organizational support and innovation (operationalized as the constructiveness of anonymous employee ideas to aid the organization), even in the absence of anticipated direct reward or recognition. In a meta-analysis of the relationships between organizational innovation and its potential determinants, Damanpour (1991) found a statistically significant association between managerial support for change and innovation (operationalized as the rate of adoption of innovations). Likewise, in a study of health care teams, West and Wallace (1991) found that perceived organizational support for innovation was a major predictor of innovation (measured via independent ratings of innovative practices). Specifically, norms for diversity accounted for 42 per cent of the variance in team innovation. Other researchers (e.g., Abbey & Dickson, 1983; Paolillo & Brown, 1978; Siegel & Kaemmerer, 1978) also offer empirical support for the effects of perceived organizational support on innovation. Thus, both theoretical and empirical research support the notion that organizational support facilitates team innovation. However, to date, little research has directly examined the effects of perceived organizational support on idea generation. The current study will address this issue.

Individual Differences

Individual differences among team members may also play a key role in idea generation. Creativity researchers are in general agreement that cognitive factors (e.g., Carrol, 1985) and personality factors (e.g., Eyesenck, 1994; Runco & Albert, 1990) are related to creativity. The present study will expand on this school of thought by modeling representative cognitive and personality factors, that theoretically have implications for the idea generation process, as antecedents of idea generation (see Figure 1). Specifically, the effects of *problem-solving style* (a cognitive factor) and *need for cognition* (NFC; Cacioppo & Petty, 1982) (a personality factor) on idea generation will be delimited.

Problem-Solving Style. Problem-solving or cognitive style has received increased recognition as a precursor to innovative behavior (e.g., Jabri, 1991; Kirton, 1976). Kirton's (1976) Adaption-Innovation theory suggests that individuals have a cognitive style (i.e., preferred mode of tackling problems at various stages of the problem-solving process) which is independent of intellectual capacity. The Kirton Adaption-Innovation Inventory (KAI; Kirton, 1987) is a self-report instrument comprised of three sub-scales which purport to measure three dimensions: a) fluency; b) efficiency; and, c) rule conformity. The scores from these scales are summated to derive a single rating along an adaption-innovation continuum. The adaptor is characterized as reliable, efficient, methodological, disciplined, and conforming. The innovator is characterized as

undisciplined, tangential, and as approaching tasks from unsuspected angles (Kirton, 1987). Moreover, while adaptors strive to maintain harmony in a team, innovators often promote conflict with their maverick ideas. With regard to the innovation process, adaptors are apt to be more influential in the idea implementation phase as they are more likely to be congenial. Innovators, on the other hand, may be more influential in the idea generation phase as they are more likely to challenge the status quo and voice innovative ideas.

Whereas Kirton places problem-solving style on a continuum, Jabri (1991) conceptualizes it as composed of two independent modes of thinking: associative and bisociative. Jabri suggests that the KAI is limited in that the summation of sub-scores may mask important profile differences. To address this limitation, Jabri's (1991) associative/bisociative index does not sum sub-scores, but treats them as independent sub-scales.

“Associative thinking” is based on habit (following set routines), rule conformity, and use of rationality and logic. The associative problem-solver is likely to generate conventional ideas or solutions to problems, and is thus similar to Kirton's adaptor.

“Bisociative thinking” is characterized by non-habitual thought, combining separate domains of thought simultaneously, a lack of attention to rules, and an emphasis on imagery and intuition (Scott & Bruce, 1994). The bisociative thinker is more likely to process cross-paradigm information simultaneously; and, therefore, is more apt to

generate innovative ideas or problem solutions. Hence, the bisociative thinker parallels Kirton's innovator. Bisociative thinking also parallels Kanter's (1991) notion of "kaleidoscope thinking". Kanter offers kaleidoscope thinking as an essential and prerequisite skill for idea generation. Kaleidoscope thinking involves "taking an existing array of data, phenomena, or assumptions and being able to twist them, shake them, look at them upside down or from another angle or from a new direction - thus permitting an entirely new pattern and consequent set of actions to take place" (p. 54). As such, bisociative thinkers are not specialists who stay within their conventional boundaries. Rather, they are generalists who move across boundaries and bypass what everyone else is looking at.

As alluded to above, neither problem-solving style (associative or bisociative) should be viewed as a generally preferred style as the utility of a given style is a function of the fit between problem-solving style and the problem or task at hand (Payne, Lane, & Jabri, 1990). For example, during the idea generation phase of the innovation process the bisociative style may be preferred, while during the implementation stage, the associative style may be preferred. Since the current study will focus on idea generation, it is predicted that a bisociative style will be positively related to idea generation, while an associative style will be negatively related to idea generation.

Need for Cognition. The construct of need for cognition (NFC) is based on the proposition that there are individual differences in the predisposition towards mental

laziness or mental engagement (Petty & Cacioppo, 1986). Thus, the need for cognition is the tendency for an individual to engage in and enjoy thinking. Thompson, Chaiken, and Hazlewood (1993) describe need for cognition as “*motivation based on intrinsic enjoyment of effortful cognitive activity*” (p. 988, emphasis added). The conceptualization of need for cognition as intrinsic motivation to cognate, coupled with Amabile’s (1988) componential model of creativity and innovation in organizations, suggests that need for cognition may be an antecedent to idea generation.

Amabile’s (1988) model suggests that there are three “components” which influence innovation and creativity: a) intrinsic motivation to do the task (e.g., generate ideas); b) skills in the task domain; and, c) skills in creative thinking (e.g., problem-solving style). Amabile warns that intrinsic motivation is the component most neglected by innovation researchers, even though it may be the most important component. For, no amount of skill in the task domain or in creative thinking can compensate for a lack of motivation to perform an activity. Using the current study as an example, if an individual or team has extensive knowledge in the problem area (e.g., freshmen transitions) and is skilled in a given brainstorming technique, it is all for naught if there is not a desire to engage in the effortful cognitive activity of idea generation. In a recent study, Scudder, Herschel, and Crossland (1994) reported that groups with lower NFC scores (as measured by the NFC Scale; Cacioppo & Petty, 1982) were less effective at group brainstorming than groups with higher average NFC scores. Scudder et al. suggest that it

might be prudent to avoid forming groups consisting primarily of low-NFC members; or, further, that efforts be taken to enhance the motivational climate through increasing personal involvement and accountability, for example, in order to counteract low-NFC tendencies. Since the current study will focus on idea generation, an effortful cognitive activity, it is predicted that need for cognition will be positively related to idea generation. Furthermore, since need for cognition is based on intrinsic enjoyment of effortful cognitive activity, and idea generation affords the opportunity to cognate, it is also predicted that need for cognition will be positively related to satisfaction with the idea generation process.

Also of interest to the current investigation are the effects of individual differences on perceptions of organizational support for innovation/idea generation. Many climate researchers (e.g., Isaken & Kaufmann, 1990; James, James, & Ashe, 1990) argue that individual values, personalities, and cognitive characteristics affect climate perceptions. James et al. (1990) propose that individuals interpret the environment by referencing internal values or standards. These internal values or standards are related to the concept of needs which, in turn, help determine the value of environmental phenomena to individuals (James, Hater, Gent, & Bruni, 1978). Thus, these needs, such as the need for cognition, make aspects of the environment, such as organizational support for innovation (a cognitive activity), more salient (Scott & Bruce, 1994). The results of two recent

empirical studies also suggest that cognitive style is significantly related to climate perceptions (Scott & Bruce, 1994; Wooten, Barner, & Silver, 1994).

To gain a more comprehensive view of the idea generation process, the current study will address two research issues related to the effects of individual differences on idea generation. First, the direct effects of problem-solving style and need for cognition on idea generation will be examined. Second, the indirect effects of these individual difference variables through perceived organizational support will be examined. As the latter issue has received scant attention in the literature, no specific directional hypotheses will be made regarding perceived support as a mediator.

Satisfaction with Idea Generation

Also of concern to the current investigation is the impact of idea generation technique on satisfaction with idea generation. Many researchers and practitioners believe that the reason interactive brainstorming continues to be widely used in organizations (despite the fact that it appears to be less efficient than nominal brainstorming) is that positive affective responses (e.g., satisfaction) to interactive brainstorming create an illusion of team effectiveness despite objective effectiveness. Empirical research supports this belief in that participants in both interactive and nominal groups perceive interactive group brainstorming as more productive - the "illusion of productivity" (Paulus et al., 1993; Paulus et al., 1995), regardless of the evidence. Moreover, the brainstorming literature indicates that, while nominal groups are better at

idea generation, interactive teams consistently report that they are more satisfied with idea generation.

Paulus et al. (in press) provide some insights into the basis for this illusion of productivity documented in interactive brainstorming. One possibility is the tendency for individuals to cognitively appropriate ideas generated by other team members. In other words, individuals may “unconsciously plagiarize” and take credit for ideas generated by others (Paulus et al., 1993). A second basis for the illusion of productivity could be the “gestalt” of the interactive group product. The team product (sum of individual’s ideas) is inevitably going to be larger than that of individual performers. To determine the efficacy of team performance, the team product should be divided by the number of team members. However, individuals may not accurately perform this operation and the size of the team product may inflate perceptions. A third possibility is the fact that team members often enjoy the experience of working in teams and have more favorable mood states than individual performers (Diehl & Strobe, 1987; Paulus et al., 1993). A final basis for the illusion of productivity is that individuals have developed stereotypes about teams based on experience and cultural mores (Paulus et al., 1993). Cultural expectations about teamwork appear to be generally positive which may influence judgment about performance.

In terms of the effects of satisfaction with idea generation on idea generation, Paulus et al. posit that the illusion of productivity may lead to interactive team members

being prematurely satisfied with their performance, thereby leading to a reduction in their motivation to continue generating ideas. Thus, as satisfaction with idea generation increases, idea generation decreases.

The above relationship between satisfaction and idea generation documented in the brainstorming literature and by Paulus and his colleagues contradicts Isen's research (e.g., Estrada, Isen, & Young, 1994; Isen & Daubman, 1984; Isen, Daubman, & Nowicki, 1987; Isen, Johnson, Mertz, & Robinson, 1985; Isen, Niedenthal, & Cantor, 1992) on affect and creativity. Isen and her colleagues, in a series of experiments, found that participants in whom they induced positive feelings (e.g., by watching an extract of a comedy film) performed better at tasks requiring creative solutions than control groups. Specifically, participants in whom positive affect had been induced, relative to a control group, tended to: categorize stimuli more inclusively (Isen & Daubman, 1984); give more unusual first associates to neutral words (Isen et al., 1985); and, rate weak exemplars of trait categories as better members of the categories (Isen et al., 1992). These findings, taken as a whole, suggest that, under conditions of positive affect, individuals may recognize aspects of an idea or problem that they normally would not recognize in a neutral state; and, that cognitive context may be broader and more complex (e.g., bringing together apparently disparate material) - processes central to creativity and innovation. This series of studies also found that simple arousal (produced by exercise) and induced negative affect had no influence on the level of creative performance. Isen's work implies that if interactive

contexts foster more positive affect (greater satisfaction), teams will be *more* creative and generate *more* ideas, as the associationistic qualities of an interactive context will be amplified by the state of positive affect associated with the satisfaction with the interactive process.

Dunegan, Duchon, and Barton (1992) recently replicated the work of Isen in a field setting. Moreover, whereas previous experiments induced affect through mechanisms unrelated to the task at hand (e.g., the comedy clip), Dunegan et al. (1992) examined the effects of outcome-dependent affective reactions (Weiner, Russell, & Lerman, 1979). In other words, positive affect emerging from the perceived success of an event (in Dunegan et al.'s study this entailed affective responses to task feedback) was found to be positively related to creativity. According to Ajzen and Fishbein (1980; as cited in Dunegan et al., 1992), "the affect surrounding the task itself should have greater impact on decisions about that task and would, therefore, be a better predictor of subsequent behaviors" (p. 349). This is critical to the current study as satisfaction with the idea generation process is an outcome-dependent measure hypothesized to affect subsequent behavior (i.e., idea generation). The combined work of Isen and her colleagues and Dunegan et al. (1992) suggests that satisfaction emerging from the perceived success of the idea generation process should foster more "innovative thinking" (e.g., making unconventional associations, adopting new perspectives, etc.) and thus be *positively* related to idea generation. This is a direct challenge to Paulus et al.'s (in press) contention

that premature satisfaction is *negatively* related to idea generation. Thus, another goal of the current study is to examine the effects of satisfaction on idea generation to gain a better understanding of the idea generation process and address this theoretical discrepancy.

Hypotheses

Since the current study involves the examination of theoretical discrepancies present in the innovation/brainstorming/creativity bodies of literature, it is necessary that competing hypotheses be devised to address these discrepancies. To do this, Platt's (1964) "strong inference" methodology is used. Strong inference consists of applying the following steps: 1) devising alternative hypotheses; 2) devising an experiment with alternative possible outcomes, each of which will exclude one of the hypotheses; and, 3) conducting the experiment as to get a clean result. This method is used to identify the optimal idea generation technique (Technique Hypothesis 1 vs. Technique Hypothesis 2) and to elucidate the role of satisfaction in the idea generation process (Process Hypothesis 8 vs. Process Hypothesis 9).

Between Technique.

Technique Hypothesis 1. Consistent with associationistic and group synergy principles and the innovation literature, there will be a larger quantity of ideas generated in an interactive team context relative to a nominal team context. Also, concordant with Osborn's assumption and documented evidence of the relationship between idea quantity

and quality, while the quantity of ideas will be greater in the interactive context, there will be no decrement in quality. Thus, the relative quality of ideas generated will be equivalent between techniques.

Technique Hypothesis 2. As documented in the brainstorming literature, there will be a process loss associated with the interactive context. Thus, there will be a larger quantity of ideas generated in the nominal team context relative to the interactive team context. Additionally, congruent with Osborn's assumption and evidence of the relationship between idea quantity and quality, while the quantity of ideas will be greater in the nominal context, the quality of ideas will not be compromised. Thus, the relative quality of ideas generated will be equivalent between techniques.

Satisfaction Hypothesis 1. As evidenced in the brainstorming literature and in line with Paulus et al.'s (in press) illusion of productivity, there will be more satisfaction with idea generation in the interactive technique relative to the nominal group technique.

Within Technique.

A secondary set of hypotheses will be tested to elucidate the *process* of idea generation. Recognizing that a potential group effect (i.e., correlated dependent measures within a team) in the interactive context may compromise interpretation, all Process Hypotheses will be tested only within the nominal technique. Additionally, for all Process Hypotheses, idea generation refers to the quantity of ideas generated since process variables are not predicted to affect idea quality.

Process Hypothesis 1. The degree to which there is perceived organizational support will be positively related to idea generation.

Process Hypothesis 2. The degree to which problem-solving style is bisociative will be positively related to idea generation.

Process Hypothesis 3. The degree to which problem-solving style is associative will be negatively related to idea generation.

Process Hypothesis 4. Problem-solving style will be indirectly related to idea generation through its effect on perceptions of organizational support.

Process Hypothesis 5. Since idea generation is an effortful cognitive activity, need for cognition will be positively related to idea generation.

Process Hypothesis 6. Need for cognition will be indirectly related to idea generation through its effect on perceptions of organizational support .

Process Hypothesis 7. Since need for cognition is based on intrinsic enjoyment of effortful cognitive activity, and idea generation affords the opportunity to cognate, need for cognition will be positively related to satisfaction with idea generation.

Process Hypothesis 8. Consistent with the brainstorming literature and Paulus et al.'s (in press) contention that premature satisfaction leads to a decrease in the motivation to generate ideas, satisfaction with idea generation will be negatively related to idea generation.

Process Hypothesis 9. Research on affect and creativity suggests that a positive mood state leads to greater creativity. Thus, satisfaction with idea generation will be positively related to idea generation.

METHOD

Participants

Ninety freshmen students (50 women and 40 men) from a large southeastern university served as participants in the current investigation. Participants reported to the experiment in groups of six (15 groups).

Design

Each of the 15 six-person groups were randomly divided into two three-person teams (for a total of 30 teams). Teams were then randomly assigned to conditions so that one team used the interactive technique first, followed by the nominal group technique, while the other team used the nominal technique first, followed by the interactive technique. As such, the study utilized a 2 (idea generation technique: interactive; nominal) level repeated measure design with technique serving as a within-subjects factor (30 teams per cell). The gender composition of the teams was not controlled.

Experimental Task

To address the possibility raised by Paulus, et al. (in press) that the superiority of nominal techniques (in terms of idea quantity) over interactive techniques is an artifact of the brainstorming task, the current study employed brainstorming tasks that were relevant and germane to the participants. Two brainstorming problems were devised by experts (e.g., associate dean of Arts and Sciences; other freshmen; the experimenter) in the task domain of the group to be tested (freshmen). These problems were relevant to the

teams' interests and goals and had multiple potential solutions. Thus, the brainstorming problems met the four criteria identified by Mumford and Gustafson (in press) as indicative of creative problems: a) ill-defined (problem can be construed in different ways and markedly different approaches can be used in problem-solving); b) novel (participants must apply their knowledge in new ways); c) complex (problems permit a number of alternative solutions); and, d) demanding (there is no single right or wrong answer). The use of relevant and meaningful brainstorming tasks also increased the psychological fidelity of the brainstorming task environment. A task environment has psychological fidelity to the extent that it is designed to give the opportunity for relevant KSAs to be demonstrated (Goldstein, 1993). Therefore, even though the current study was conducted in the laboratory, the task environment paralleled that of an organizational setting in that it afforded similar opportunities for relevant idea generation KSAs to surface. This task environment with its direct organizational complement allows for generalizability across settings (laboratory to organization).

Task Development. Because idea generation technique was a within-subjects factor, two brainstorming tasks had to be developed in order to avoid potential order effects which may have surfaced if the same task was used. To further ward against order effects, the order of techniques and the order of brainstorming tasks were counterbalanced, with half the participants randomly assigned to the interactive technique

first, and the other half assigned to the nominal technique first; and, half the participants randomly assigned Task One first, and the other half assigned Task Two first.

It was also necessary that the two brainstorming tasks be equivalent in terms of idea generation so as to avoid a potential task effect. To insure that the tasks were equivalent with regard to idea generation, a pilot study was conducted in which participants were administered both tasks within a given context. To assess task equivalency, repeated measures analyses were conducted using task as a within-subjects variable and the various dimensions of idea generation (i.e., number of ideas generated, and the two usability indices: feasibility of ideas and outcome of implementation) as well as the usability composite score (i.e., sum of two usability indices) as dependent variables. These analyses indicated that task was not a significant source of variance for number of ideas generated $F(1,18) = .01, p >.05$; feasibility of ideas $F(1,18) = 1.73, p >.05$; outcome of implementation $F(1,18) = .30, p >.05$; or the usability composite score $F(1,18) = .46, p >.05$. Specifically, there was no significant difference in number of ideas generated between Task One ($M = 9.53, SD = 2.01$) and Task Two ($M = 9.58, SD = 3.50$); no significant difference in feasibility between Task One ($M = 3.83, SD = .53$) and Task Two ($M = 3.94, SD = .44$); no significant difference in outcome of implementation between Task One ($M = 3.90, SD = .37$) and Task Two ($M = 3.87, SD = .37$); and, no significant difference in overall usability between Task One ($M = 7.73, SD = .84$) and

Task Two ($M = 7.80, SD = .73$). As such, it was concluded that the two brainstorming tasks were equivalent in terms of idea generation.

The two brainstorming tasks developed and used were as follows. Participants were asked to generate ideas/ solutions the university could implement to address two transition issues facing incoming freshmen. Task One entailed asking participants to “Please generate suggestions for how the university could help ease the transition to college in terms of academic issues (not related to social issues)”. Task Two entailed asking participants to “Please generate suggestions for how the university could help ease the transition to college in terms of social issues (not related to academics)”. All participants performed each brainstorming task in either the interactive group or nominal group context. Before engaging in the two experimental tasks, participants were given a three-minute “warm-up” brainstorming task. For the warm-up task participants were asked to “Please generate suggestions for ways the class registration process could be improved”. To familiarize participants with both the brainstorming techniques and to ward against differing practice between techniques, participants performed this warm-up exercise using both the interactive and nominal techniques, with half the teams performing the interactive warm-up first followed by the nominal warm-up, and the other half performing the nominal warm-up first, followed by the interactive.

Procedure

Screening Session. Participants showed up for this session in large groups (10-15). The experimenter explained to the participants that they would be completing a questionnaire and that, based on their questionnaire responses, they may be invited back to participate in a follow-up session targeting the freshmen experience (see Appendix A for a complete protocol). Participants were then asked to complete a consent form (see Appendix B), a duplicate consent form, a questionnaire (see Appendix C), and a confirmation of debriefing form (see Appendix D). Each questionnaire contained relevant items to assess problem-solving style, need for cognition, and perceived organizational support for innovation. When completed, the experimenter collected all forms and the questionnaire. Before excusing participants, the experimenter reminded them that they may be contacted and invited to participate in the follow-up session.

Idea Generation Session. Participants showed up for this follow-up session in groups of six. The experimenter randomly divided the group in half, seating participants around a large rectangular table, with three participants at one end, and three at the other. The experimenter explained that the purpose of the session was to examine the freshman experience, specifically the transition that is a necessary part of being a freshman (see Appendix E for a complete protocol). Participants were then asked to complete a consent form (see Appendix F) and a duplicate consent form. Participants were informed that the two three-person groupings would serve as teams for the session. Participants

were then asked to introduce themselves to their two teammates. The experimenter explained to the participants that each team would be using two techniques to brainstorm about the two transition issues. Next, participants were given a copy of the brainstorming rules and were asked to read them along with the experimenter (see Appendix G).

Warm-up Session. The experimenter then informed the participants that they would engage in two three-minute warm-up exercises to familiarize themselves with each of the brainstorming techniques. The experimenter gave a brief overview of the procedure for each technique. The experimenter explained to the participants that, for one of the techniques (interactive), they would be brainstorming interactively with their team members and that they were to follow the brainstorming rules (see Appendix G) and voice any ideas that they may have. Whereas, for the other technique (nominal), they would be brainstorming on their own in separate rooms, with their ideas to be later combined with the other team members. Once again, they were instructed to follow the brainstorming rules and to write down any ideas that they may have on a form provided by the experimenter. The experimenter then answered any questions participants had about the process in either technique. Participants were then given a copy of the warm-up brainstorming task and asked to read the task while the experimenter read it aloud. The participants then engaged in the two three-minute warm-up brainstorming exercises

to familiarize themselves with both techniques. The experimenter monitored the exercises to ensure that all participants understood the respective processes.

Experimental Sessions. After the warm-up sessions, participants reconvened around the table and were given a copy of the first brainstorming task. Participants were asked to read the task while the experimenter read it aloud. Both the brainstorming rules and the statement of the problem (i.e., brainstorming task) remained with the participants during idea generation. The participants were told that they would have 15 minutes to brainstorm about each issue. Participants were asked to refrain from speaking until the experimenter gave the signal to begin brainstorming. The experimenter then randomly assigned one team to the interactive technique, and the other to the nominal technique. Participants on the team chosen for the nominal condition were placed in three separate, sound-proofed rooms so that each could generate ideas in isolation. Participants on the team in the interactive condition remained positioned around the table so that they were able to view their other two teammates. When all participants were situated, the experimenter gave the signal to begin. After 15 minutes, the experimenter gave the signal to stop. All six participants were then asked to reconvene around the table to complete a short questionnaire designed to assess satisfaction with idea generation (see Appendix H). After collecting the questionnaire and copy of the first brainstorming task, participants were given a copy of the second brainstorming task. The procedure for the second task was identical to that of the first brainstorming task with the exception that those who

used the interactive technique for Task One used the nominal group technique for Task Two, and those that used the nominal group technique for Task One used the interactive technique for Task Two. After completing the second satisfaction questionnaire, participants were given a debrief form (see Appendix I) and a copy of a letter written by the associate dean of Arts and Sciences, thanking them for their input (see Appendix J). Participants were then excused.

Independent Measures

Idea Generation Technique. In the interactive context, participants brainstormed interactively with the other two team members. Participants were seated around a rectangular table with the chairs positioned so that all three team members were facing each other. The experimenter transcribed the interactive session, recording the ideas and which members voiced them. A tape recorder, positioned in the middle of the team, served as a backup to the transcriber.

In the nominal group context, participants brainstormed in isolation. Participants were seated separately in sound-proofed rooms and were not able to observe the other team members. Participants were asked to write down their ideas on a form provided by the experimenter (see Appendix K for a sample form). Participants were told that their ideas would later be compiled with those of other team members.

Perceived Organizational Support. Perceived organizational support for innovation was measured using a modified version of the Siegel Scale of Support for

Innovation (SSSI; Siegel & Kaemmerer, 1978). This 24 item scale (see Appendix C, items 1 - 24) is a shortened version of the original 61 item scale tailored to the university as an organization. These 24 items (e.g., “creativity is encouraged at Virginia Tech”) all load highly on a “support of creativity” factor identified by Siegel and Kaemmerer. This factor represents the extent to which organizational members (i.e., students) perceive the organization (i.e., Virginia Tech) as supporting independent functioning in pursuit of innovative ideas. It also includes the perception that the organization is open and adaptive to change. Participants rated each item based on a six point Likert-type scale anchored by: 1 = “strongly agree” and 6 = “strongly disagree”, with items 10 and 22 reverse-scored. The total score on the SSSI scale served as a measure of perceived organizational support for innovation, with the range of possible scores being 24 - 144. A pilot study of this measure yielded a mean score of 98 with a standard deviation of 12.23 ($N = 53$).

Scott and Bruce (1994) reported an alpha reliability of .92 for their SSSI sub-scale, providing evidence of the reliability of the scale. For the current sample, alpha was .91. West and Wallace (1991) advocate the use of the SSSI, reporting that the measure was able to correctly classify (innovative work teams or traditional work teams) 93 per cent of their sample via discriminant analysis. The results of Siegel and Kaemmerer’s original validation study on nearly 2,000 students from a variety of schools led them to conclude that the measure is a “reliable and apparently valid tool that may prove useful in

identifying organizations perceived as innovative” (p. 561). Orpen (1990) recently provided some additional evidence of the validity of the SSSI in an organizational setting, reporting significant positive relationships between SSSI scores and job satisfaction, work motivation, and job involvement.

Problem-Solving Style. Problem-solving style was assessed using the two sub-scales of Jabri’s (1991) associative/bisociative index. Associative problem solving style was measured using the ten item (e.g., “being methodological and consistent in the way I tackle problems”) associative scale (see Appendix C, items 43, 44, 48, 50, 51, 54, 56, 57, 58, 59), and bisociative problem-solving style was measured using the nine item (e.g., “spending time tracing relationships between disparate areas of work”) bisociative scale (see Appendix C, items 45, 46, 47, 49, 52, 53, 55, 60, 61). Participants rated items from both scales based on a seven point Likert-type scale anchored by: 1 = “likely to enjoy” and 7 = “unlikely to enjoy”. The total score for each scale served as a measure of the relevant problem-solving style. The range of scores on the associative measure was 10 - 70; the range on the bisociative measure was 9 - 63.

Jabri reported that measures of internal consistency (coefficient alpha) and test-retest correlations show high evidence of reliability for the two scales. Alpha coefficients for the associative and bisociative scales for the current sample were .91 and .83, respectively. Scott and Bruce (1994) likewise reported high internal-consistency (.90 for the associative scale; .91 for the bisociative scale) estimates of reliability. In addition,

Jabri reported that high correlations between individual's self-ratings of problem-solving style and their supervisor's ratings (.94 for the associative scale; .69 for the bisociative scale) provide some evidence for concurrent validity. Further, the content of the two scales is very similar in content to the more widely accepted, but less accessible KAI (Scott & Bruce, 1994). The correlation between the two scales for the current study was .01, providing some evidence of the independence of the scales.

Need for Cognition. Need for cognition was assessed using Cacioppo, Petty, & Kao's (1984) Need for Cognition Scale (NFC Scale). Based on Cohen's (1957; Cohen, Stotland, & Wolfe, 1955) early work, the NFC Scale differentiates individuals who prefer activities, both intellectual and social, which require high cognitive effort from individuals who prefer activities low in cognitive effort. Participants were asked to indicate the degree of agreement or disagreement with each of 18 items (e.g., "I prefer my life be filled with puzzles that I must solve") (see Appendix C, items 25 - 42). Items were rated based on a nine point Likert-type scale anchored by: -4 = "very strong disagreement"; -3 = "strong disagreement"; -2 = "moderate disagreement"; -1 = "slight disagreement"; 0 = "neither agreement nor disagreement"; +1 = "slight agreement"; +2 = "moderate agreement"; +3 = "strong agreement"; +4 = "very strong agreement", with items 27, 28, 29, 31, 32, 33, 36, 40, and 41 reverse-scored. The total score for the NFC scale served as a measure of need for cognition. The response format of -4 to +4 was recoded as 1 to 9,

so that the range of scores on this measure was 18 - 162, with a higher score indicating a greater need for cognition.

Sadowski (1993), Scudder et al. (1994) and Cacioppo, Petty, and Kao (1984) reported alpha reliabilities of .86, .89, and .90, respectively, providing evidence of the reliability of the scale. The current sample yielded an alpha of .84. Thompson, Chaiken, and Hazlewood (1993) and Tolentino, Curry, and Leak (1990) offer construct-related evidence of validity supporting the notion that the NFC scale taps motivation for effortful cognitive processing. In addition to predicting brainstorming productivity (Scudder et al., 1994), the NFC Scale has also predicted the extent of cognitive processing in a number of other areas including: formation of attitude judgments (Axsom, Yates, & Chaiken, 1987); engagement in issue-relevant thinking (Axsom et al., 1987); and, recall of message arguments (Cacioppo, Petty, & Morris, 1983). Cacioppo and Petty (1982) also discuss a series of studies which provide reliability as well as both construct- and criterion-related evidence of the validity of the NFC scale. Sadowski (1993) also found that men and women were similar on all indicators of scale performance, indicating that the 18 item NFC Scale is essentially gender neutral.

Dependent Measures

Satisfaction with Idea Generation. Satisfaction with idea generation was assessed using a measure based on items used by Dennis and Valacich (1992). Participants were asked to indicate their level of satisfaction with each of three items (e.g., “How do you

feel about the process by which you generated ideas?") (see Appendix H). Dimensions were rated on a seven point scale anchored by: 1 = "very dissatisfied" and 7 = "very satisfied". The sum of these three items served as a measure of overall satisfaction with idea generation. The possible range for this measure was 3 - 21.

Dennis and Valacich (1992) reported an alpha reliability of .88 for a comparable measure. Coefficient alpha for the overall satisfaction with idea generation measure for the current sample was .75.

Idea Generation. As previously discussed, the consistent finding that measures of idea quantity are highly correlated with measures of idea quality has lead many researchers to focus on quantity as the sole measure of idea generation and as a surrogate for idea quality. Supporting this narrow view of idea generation, Dennis and Valacich even suggest that "quality measures are probably not worth the extra effort in the calculation" (p. 733).

However, for purposes of the current investigation, it was decided not to adopt this narrow focus of idea generation. There were two reasons for this decision. First, a richer and more complex presentation of idea generation, focusing on both quantitative and qualitative dimensions, was desired. Second, there was the possibility that the documented relationship between idea quantity and idea quality may not hold due to the use of relevant and engaging brainstorming tasks. To ward against this possibility, idea generation was operationally defined using both quantitative and qualitative dimensions.

Quantitatively, number of ideas generated served as a dimension. Qualitatively, idea generation was assessed using two usability indices derived by experts in the task domain (i.e., associate dean of Arts and Sciences; the experimenter).

The first usability index was feasibility. Feasibility was assessed using four criteria. First, does the suggestion address the transition problem? Second, does Virginia Tech have the resources to implement the suggestion? Third, is the suggestion non-controversial? Finally, does Virginia Tech have the control/ ability to implement the suggestion?

The second usability index was outcome of implementation. This index was also assessed using four criteria derived by experts. First, are freshmen likely to support/ use the resource? Second, will the implemented suggestion have an impact on the transition problem? Third, will implementing this suggestion not lead to any other problems arising as a result of implementation? Finally, are non-freshmen (e.g., other classes, faculty, staff, etc.) likely to support implementation?

For both usability indices, each item was individually rated on a five-point scale, where a “5” indicated all four criteria were met; a “4” reflected three out of four criteria were met; a “3” indicated two out of four criteria were met; a “2” reflected one out of four criteria being met; and, a “1” indicated that none of the criteria had been met. Usability indices were then derived by calculating the mean idea rating. In addition to the two base

usability indices, a usability composite score was also calculated. The composite score was derived by summing the two usability indices.

Three expert raters were employed to rate the three dimensions. All raters were given extensive training by the experimenter and were blind to conditions. Raters individually scored the dimensions. The decision rules used to consolidate ratings were as follows. For all dimensions a “majority rules” procedure was utilized. Specifically, ratings from all three raters were compared. If all three raters agreed on the dimension score, this number was used as the final rating. If two out of three raters agreed on the dimension score, and the third rater was only one unit away, the number agreed upon by the two raters was used as the final rating. If there was more than a one unit discrepancy among any of the raters, ratings were discussed until a consensus was reached. The three raters only had to discuss approximately 20 out of 2690 ratings, indicating high inter-rater agreement (99%).

RESULTS

The various hypotheses were tested to assess the validity of the proposed theoretical model of idea generation in a team context (see Figure L-1).

Between Technique

All Between Technique hypotheses were assessed using repeated measures analyses with idea generation technique (interactive, nominal) serving as the within-subjects factor. Following the rationale of Rosnow and Rosenthal (1989), omnibus tests on all dependent variables (i.e., MANOVAs) were not conducted as a preliminary analytical step. Rather, specific predictions were tested on an individual basis (see Rosnow & Rosenthal, 1989, for a complete discourse of the logic behind this approach). For Technique Hypotheses 1 and 2, number of ideas generated, feasibility of ideas, outcome of implementation, and the usability composite served as dependent measures in separate analyses. For Satisfaction Hypothesis 1, overall satisfaction with idea generation served as the dependent variable.

Before interpreting repeated measures analyses attempts were made to test the sphericity assumption (see Stevens, 1992). However, this test was not possible as there was only one pair of repeated measures (i.e., the techniques). Not being able to test this assumption was not viewed as a concern, however, since when treatments are randomized (as technique was in the current study), compound symmetry (a stronger condition than sphericity) is usually found (Schulman, personal communication, 1992).

Technique Hypotheses 1 and 2. Technique Hypothesis 1 predicted that there would be a greater quantity of ideas generated in the interactive context, relative to the nominal context. Technique Hypothesis 2 predicted that there would be a greater quantity of ideas generated in the nominal context, relative to the interactive context. Both hypotheses did not predict differences between techniques in the quality of ideas generated.

In terms of quantity, the repeated measures analysis yielded a main effect for technique $F(1,89) = 4.54, p < .05$ (see Table L-2). Examination of the means (see Table L-2), revealed that a significantly greater quantity of ideas was generated in the interactive context ($M = 8.00, SD = 3.66$) when compared to the nominal context ($M = 6.94, SD = 3.84$).

In terms of quality, repeated measures analyses indicated that technique was not a significant source of variance for any of the quality dimensions, including: feasibility of ideas $F(1,89) = 2.37, p > .05$; outcome of implementation $F(1,89) = 2.21, p > .05$; or, the usability composite $F(1,89) = 2.35, p > .05$ (see Table L-2). Specifically, there was no significant difference in feasibility of ideas between the interactive ($M = 4.08, SD = .67$) and nominal ($M = 3.89, SD = .88$) techniques; no significant difference in outcome of implementation between interactive ($M = 3.96, SD = .66$) and nominal ($M = 3.78, SD = .88$); and, no significant difference in overall usability of ideas between the interactive technique ($M = 8.04, SD = 1.31$) and the nominal technique ($M = 7.67, SD = 1.74$). These

results provide further support for Osborn's assumption (and the current hypothesis) that changes in idea quantity do not compromise the average quality of generated ideas.

Taken as a whole, and couching in terms of strong inference methodology (i.e., supporting Technique Hypothesis 1 and not Technique Hypothesis 2), these results suggest that the interactive technique is optimal for facilitating idea generation; as this technique leads to a greater quantity of ideas of equivalent quality being generated.

Satisfaction Hypothesis 1. Satisfaction Hypothesis 1 predicted that satisfaction with idea generation would be greater in the interactive team context when compared to the nominal team context. This hypothesis was supported in that the repeated measures analysis revealed a main effect for technique $F(1,89) = 32.20, p < .05, \eta^2 = .27$, indicating that idea generators were more satisfied with the interactive technique ($M = 17.44, SD = 2.17$) than with the nominal technique ($M = 15.26, SD = 3.00$).

Within Technique

Recognizing that a potential group effect (i.e., correlated dependent measures within a team) in the interactive context may have jeopardized interpretation, all Process Hypotheses were tested only within the nominal technique. Process Hypotheses (graphically displayed in Figure L-3) were tested by estimating a series of path analyses using ordinary least squares regressions. As posited by Wright (1921; as cited in Pedhauer, 1982), in cases where causal relations are uncertain, the method of path analysis is optimally suited for finding the logical consequences of any particular

hypothesis with regard to them. The specific procedure for testing the various Process Hypotheses was as follows. First, perceived organizational support (POS) was regressed on associative problem-solving style (APS), bisociative problem-solving style (BPS) and need for cognition (NFC) (Process Hypotheses 4 and 6, respectively). Next, satisfaction with idea generation (SIG; measured as overall satisfaction with the *nominal* technique) was regressed on NFC (Process Hypothesis 7). Finally, idea generation (IG; measured as number of ideas generated in the *nominal* context) was regressed on all model variables (i.e., SIG; POS; APS; BPS and NFC) (Process Hypotheses 8, 9, 1, 3, 2 and 5, respectively). Note that idea generation was measured using only the quantitative dimension as no predictions were made regarding the quality of ideas generated. Descriptive statistics and correlations among all model variables are reported in Table L-4. The model variables accounted for 24% of the variance in idea generation.

Process Hypothesis 1. Process Hypothesis 1 predicted that perceived organizational support would be positively related to idea generation. This hypothesis was not supported as perceived organization support had an unexpected and significant *negative* direct effect on idea generation $\beta = -.341$, $p < .05$ (see Figure L-5). This finding suggests that higher perceptions of organizational support lead to a decrease in the number of ideas generated.

Process Hypothesis 2. Process Hypothesis 2 predicted that bisociative problem-solving style would be positively related to idea generation. This hypothesis was not

supported as bisociative problem-solving style did not have a significant direct effect on idea generation $\beta = -.034, p > .05$ (see Figure L-5). This finding suggests that the degree to which problem-solving style is bisociative does not affect the number of ideas generated.

Process Hypothesis 3. Process Hypothesis 3 predicted that associative problem-solving style would be negatively related to idea generation. This hypothesis was supported as associative problem-solving style had a significant negative direct effect on idea generation $\beta = -.268, p < .05$ (see Figure L-5). This finding suggests that the degree to which problem-solving style is associative has a negative impact on the number of ideas generated.

Process Hypothesis 4. Process Hypothesis 4 predicted that problem-solving style would be indirectly related to idea generation through its effects on perceptions of organizational support. This hypothesis was partially supported. Following the convention of considering an indirect effect significant only if its constituent direct effects are significant (Cohen & Cohen, 1983), bisociative problem-solving style did not have a significant indirect effect on idea generation through perceptions of organizational support $\beta = .058 (-.171 * -.341)$ (see Figure L-5). Associative problem-solving style, however, did have a significant indirect effect on idea generation through perceptions of organizational support $\beta = -.117 (.342 * -.341)$ (see Figure L-5). These findings suggest that the degree to which problem-solving style is bisociative does not affect the number of

ideas generated indirectly through perceptions of organization support, while the degree to which problem-solving style is associative does. This latter finding (as well as all other findings pertaining to perceived support as a mediator) should be interpreted with caution, however, as the negative relationship between perceived support and idea generation awaits further examination.

Process Hypothesis 5. Process Hypothesis 5 predicted that need for cognition would be positively related to idea generation. This hypothesis was not supported as need for cognition did not have a significant direct effect on idea generation $\beta = -.025$, $p > .05$ (see Figure L-5). This finding suggests that need for cognition does not affect the number of ideas generated.

Process Hypothesis 6. Process Hypothesis 6 predicted that need for cognition would be indirectly related to idea generation through its effects on perceptions of organizational support. This hypothesis was not supported as need for cognition did not have a significant indirect effect on idea generation through perceptions of organizational support $\beta = -.059$ (.174 * -.341) (see Figure L-5). This finding suggests that need for cognition does not affect the number of ideas generated indirectly through perceptions of organization support.

Process Hypothesis 7. Process Hypothesis 7 predicted that need for cognition would be positively related to satisfaction with idea generation. This hypothesis was not supported as need for cognition did not have a significant direct effect on satisfaction $\beta =$

.151, $p > .05$ (see Figure L-5). This finding suggests that need for cognition does not impact satisfaction with idea generation.

Process Hypotheses 8 and 9. Process Hypothesis 8 predicted that satisfaction with idea generation would be negatively related to idea generation. Process Hypothesis 9 predicted that satisfaction with idea generation would be positively related to idea generation. Neither hypothesis was supported as satisfaction did not have a significant direct effect on idea generation $\beta = .077$, $p > .05$ (see Figure L-5). This finding suggests that satisfaction with idea generation does not affect the number of ideas generated.

As mentioned earlier, it was recognized that, in the interactive context, a potential group effect (i.e., correlated dependent measures within a team) may have compromised interpretation. Nevertheless, it was desired to see if similar correlations emerged among model variables when interactive data were used so that generalizations could be made about the idea generation in a team context, irrespective of technique.

To accomplish this end while addressing the potential problem of group effects, deviation scores were calculated for the idea generation and satisfaction measures in the interactive context. Deviation scores were calculated by subtracting each participant's three-person team mean for a given measure from his or her observed score. In essence, deviation scores hold group effects at a constant, as everything becomes relative to the team. These interactive technique deviation scores were then correlated with the other model variables and compared to the correlations among model variables when nominal

data were used as input (see Table L-4). As illustrated by Table L-4, the similar pattern of correlations in columns five and six (nominal data) when compared to columns seven and eight (interactive data) suggests that it is safe to generalize the model of idea generation in a team context across technique.

DISCUSSION

The goal of the present study was to gain a more comprehensive view of the idea generation process in a team context. To accomplish this goal, the current research delineated the effects of technique, perceived organizational support, associative problem-solving style, bisociative problem-solving style, need for cognition, and satisfaction with the process on idea generation. Although not all hypotheses were supported as originally stated, several conclusions may be drawn based on the pattern of obtained results.

Results clearly indicate that the interactive technique, when compared to the nominal group technique, is optimal for facilitating idea generation. Specifically, the interactive technique yielded a greater *quantity* of ideas generated, relative to its nominal counterpart. Moreover, idea *quality* was not compromised for quantity, as average idea quality did not differ between techniques. This finding regarding the relationship between quantity and quality provides further empirical support for Osborn's assumption that generating a large quantity of ideas stimulates ideas of high quality as well. This finding is of particular importance in the current study as it suggests that the relationship between idea quantity and quality holds even when a relevant and engaging task is employed.

With regards to the relationship between technique and idea quantity, results are of great significance as they provide empirical support for what has been heretofore presumption in the innovation literature. Indeed, while innovation researchers (e.g., Brown & Duguid, 1991; Garvin, 1993; Galbraith, 1992; Rosenfeld & Servo, 1991) offer a

great deal of conjecture for why the interactive technique *should* facilitate idea generation (e.g., associationistic and group synergy principles), little empirical evidence has been proffered. The current findings provide this much needed empirical support.

Conversely, this pattern of results challenges the large body of empirical brainstorming research which documents a process loss associated with the interactive technique and posits that the nominal technique is optimal for idea generation. A possible explanation for this pattern of obtained results, which challenges those previously documented in the brainstorming literature, may reside in the experimental tasks used to compare the two techniques.

Some researchers (e.g., Paulus et al., in press) argue that existing evidence of the superiority of nominal techniques over interactive techniques is suspect because of the experimental tasks used to compare the two. To be sure, most studies that have compared the two idea generation techniques used a brainstorming task of little personal relevance to the participants' lives (e.g., finding uses for an extra thumb; finding uses for a paperclip). This provides a stark contrast to the idea generation environment in the current study which entailed freshmen team members brainstorming about freshmen transition problems, problems both relevant and directly impacting their lives. When confronted with an irrelevant, non-engaging task there may be little interactive idea generation because individuals feel they have an adequate pool of ideas to address the problem, thereby negating the need to draw on other team members' knowledge.

Antithetically, as in the present study, when confronted with a relevant and engaging task, individuals may be more motivated to search for novel solutions (as they would have a positive impact on their lives) and perceive others as providing needed stimulation for idea generation.

Future research might further explore the degree to which “task-relevance” or “task-engagingness” moderates the relationship between technique and idea generation. This could be done by including task-relevance as an additional within-subjects factor and examining its effects on idea generation within each technique. However, for purposes of the current study, since the task environment was constructed to maximize psychological fidelity and parallel that of an organizational setting (i.e., employing tasks highly relevant to the individual and organization), the conclusion remains the same: the interactive technique is optimal for facilitating idea generation in a team context.

In terms of the effects of technique on satisfaction with idea generation, results distinctly reveal that idea generators are more satisfied with the interactive technique, when compared to the nominal group technique. This finding supports the hypothesis and is consistent with the brainstorming literature. However, Paulus et al.’s (in press) illusion of productivity was also proposed in support of the hypothesized relationship between technique and satisfaction. It should be noted that attributing results to this “illusion” may be inappropriate for two reasons. First, this “illusion” may be a misnomer as interactive idea generators were, in actuality, *more* productive. Second, the lack of a

significant relationship between satisfaction and idea generation ($r = .06$, see Table L-5) suggests that idea generation productivity, illusory or real, may not be related to satisfaction. However, a caveat is in order regarding this latter relationship (or lack thereof) between satisfaction and idea generation.

The failure of a significant relationship surfacing between satisfaction and idea generation was surprising given the large bodies of research supporting either a positive (e.g., Isen et al., 1992) or negative (e.g., Paulus et al., 1995) relationship between the two. One potential reason for why this effect failed to emerge may have to do with the measurement of satisfaction in the current study.

Satisfaction was proposed and modeled as an *antecedent* to idea generation (see Figure L-3). However, the actual measurement of satisfaction occurred *after* idea generation. It is possible that the role of satisfaction as an antecedent to idea generation was not accurately captured by this post-hoc measure. This possibility should be addressed before discounting the role of satisfaction in the idea generation process. This could be done by assessing satisfaction during idea generation rather than afterwards.

If future research, in which satisfaction is assessed *during* idea generation, suggests that satisfaction is not related to idea generation, it may be beneficial to shift the focus away from productivity aspects towards other technique-specific factors when examining why idea generators are more satisfied with the interactive technique when compared to the nominal technique. For example, there is evidence that group members

enjoy the experience of working in groups and have more favorable mood states than individual performers (e.g., Diehl & Stroebe, 1987; Paulus & Dzindolet, 1993). Perhaps individuals simply enjoy the experience of generating ideas in an interactive social context as opposed to generating in isolation, irrespective of performance. In short, it may be more appropriate to view satisfaction as a by-product of the technique rather than as a cause or effect of idea generation; although, future research, in which satisfaction is measured during idea generation, is recommended before this conclusion is drawn.

Taken as a whole, technique findings indicate that the interactive technique is optimal for both facilitating idea generation as well as satisfaction with idea generation. Furthermore, technique appears to independently affect each of these variables. For purposes of organizational application, it would appear beneficial to stress the interactive component in idea generation sessions. When suggesting such organizational applications for findings regarding idea generation, however, it is critical to delineate the boundary conditions related to the idea generation task, as task characteristics may affect the role of various factors during idea generation.

In his seminal work, Steiner (1972) offered a task typology based on ways tasks permit group members to combine their individual products. The four basic types of tasks are as follows: a) disjunctive tasks, which require the group to select one member's contribution; b) conjunctive tasks, in which the criterion of success is based on the group member who does least well (e.g., the weakest link of a chain); c) additive tasks, in which

member contributions can be summed to make a group output; and, d) discretionary tasks, in which group members can combine their input in any manner they wish. In addition to how members combine input, tasks may also differ based on the goal to be achieved: a) maximization, in which success is a function of how much or how rapidly something is done and b) optimization, in which success is a function of how closely the group approximates a “correct” outcome.

Based on Steiner’s (1972) typology, the current idea generation tasks, as well as most of the brainstorming tasks used in traditional brainstorming research, are additive and maximizing. Moreover, as discussed earlier, the tasks used in the current study were engaging. It is important to qualify current results and their application within the boundaries of additive, maximizing and engaging tasks. While organizations frequently use these types of tasks for team idea generation (and thus can benefit from the current research), by no means is this the only type of task used. Hence, when generalizing these results it is only appropriate to do so to a similar task situation. Future research might investigate idea generation when different task types are used.

Results also suggest that idea generators are sensitive to organizational support for change/innovation. However, contrary to the large body of innovation literature and the proposed hypothesis, it appears as though higher perceptions of organizational support have a *negative* effect on idea generation. There are three possible explanations for why these unexpected and contradictory results surfaced.

One possibility has to do with the measure of perceived support. In the present study, idea generators were freshmen in their fifth month at Virginia Tech. It is conceivable that these students may not have had sufficient time to formulate confident macro-level perceptions of the organization (i.e., Virginia Tech). Hence, their responses to the questionnaire which assessed perceived organizational support (see Appendix C, items 1-24) may have been driven by other underlying individual difference variables.

A second possibility has to do with the nature of the perceived organizational support variable. It is plausible that, the more the organization was perceived as change-oriented, the more likely idea generators assumed that there were higher standards for change related ideas (the law of supply and demand). In turn, idea generators may have been hesitant to voice ideas for fear of meeting standards.

In the same vein, the more idea generators perceived the organization as change-oriented, the less urgency there would be associated with change-related ideas. In other words, since the organization is already managing change on its own, there is not as much personal responsibility for generating ideas since, chances are, ideas will be generated somewhere else in the system.

Taking this line of thought a step further, it is possible that the relationship between perceived support and idea generation is not linear. That is, at the lower end of the perceived support continuum, there may be a positive relationship between perceptions of support and idea generation; however, after a certain threshold point is

reached, a negative relationship may surface. In terms of the current research, since the distribution of perceived organizational support scores was concentrated at the upper end of the continuum ($M = 106$ out of 144), this curvilinear function may have been truncated, resulting in only the negative relationship surfacing. Cross-organizational research needs to be conducted using organizations where average perceived support varies, to address this possibility.

A third possibility for why current results run contrary to the large body of innovation literature lies in the nature of the idea generation variable. Past research has focused almost exclusively on the *idea implementation* phase of innovation rather than on *idea generation*. For example, West and Wallace (1991) looked at ratings of innovative practices introduced over a two-year period. Damanpour (1991) operationalized innovation as the rate of adoption of innovations. Scott and Bruce (1994) defined innovation using a composite score of which idea generation was only one of six parts.

Indeed, only one study focused exclusively on idea generation; and, in this case a qualitative measure (constructiveness of anonymous employee ideas to aid the organization) was used (Eisenberger et al., 1990). Eisenberger et al. (1990) reported that perceived support was correlated .19 with this measure. When operationalized qualitatively in the current study (i.e., the usability composite), a similar pattern emerges ($r = .12$). The contradictory results which surfaced in the current study, coupled with the innovation literature's focus on implementation, suggests that the role of perceived

support may vary during the innovation process. Longitudinal research which traces the role of perceived support through both idea generation and idea implementation is warranted.

In terms of individual difference variables, results suggest that being a highly associative problem-solver appears to inhibit idea generation. As hypothesized, the disciplined and conforming associative problem-solving style has a negative effect on idea generation both directly and indirectly through perceptions of organizational support. Applying these results to an organizational setting, it may be prudent to avoid selecting individuals high in associative problem-solving style when forming a group for the purpose of idea generation. Or, if you have an intact team, identify those high in associative problem-solving style and provide special training to help them to lower the degree to which they employ this style (e.g., rule conformity) during idea generation.

Bisociative problem-solving style does not appear to affect idea generation either directly or indirectly through perceptions of support. One possibility for why bisociative problem-solving effects failed to emerge may have to do with the idea generation tasks employed in the current study. It is possible that the idea generation tasks were not conducive to capturing the role of bisociative problem-solving style during idea generation. Specifically, idea generators were asked to generate suggestions for how Virginia Tech could help ease the transition to college in terms of academic (social) issues. Yet, it was not stressed that these suggestions be unique and/or innovative. In short,

these tasks did not require, and thus may not have elicited, the divergent thinking associated with bisociative problem-solving style. If idea generators were explicitly told that their suggestion should reflect a new direction for dealing with the problem then this factor may have emerged as an important variable during idea generation. Further research should examine this possibility.

Overall, findings with regard to problem-solving style are also significant in that they provide further support for Jabri's (1991) conceptualization that the two problem-solving variables operate independently of one another ($r = .01$, see Table L-4). This independence suggests that an individual may use a given style or combination of styles in a given situation. For idea generation (and the current task) it appears as though a low associative style is optimal. Further research should be conducted which delineates the optimal combinations of these styles during other aspects of the innovation or creativity processes.

Results indicate that need for cognition is not related to idea generation either directly or indirectly through perceptions of organizational support. Moreover, need for cognition does not impact satisfaction with the process. One possibility for why need for cognition effects failed to emerge has to do with its motivational nature. Thompson, Chaiken, and Hazlewood (1993) describe need for cognition as "*motivation based on intrinsic enjoyment of effortful cognitive activity*" (p. 988, emphasis added). Past research (in which non-engaging tasks were used) suggested that the motivational

component of need for cognition had a positive impact on idea generation. However, in the current study, efforts were taken to ensure that the idea generation tasks were relevant and *engaging*. Hence, the tasks themselves may have put a ceiling on the motivational effects of need for cognition. To address this possibility, further research should be conducted which manipulates the “engagingness” of tasks. This can be done as previously discussed under the rubric of technique.

Future Research

The research provided here provides a strong starting point for modeling the effects of various factors during idea generation in a team context. Though the results reported here shed some light on the process of idea generation, they also pose interesting questions regarding idea generation in particular and innovation in general. How does the degree to which the task is engaging moderate the effects of technique and need for cognition on idea generation? Does the role of perceived support vary both along the perceived support continuum and during the different stages of innovation? Do the optimal combinations of problem-solving styles change during the innovation process? These questions should be addressed in future research.

More and more, organizations are turning to teams as potential agents for innovation and creative change in order to be competitive in a rapidly changing environment. As this emphasis on idea generation in a team context becomes critical, so too does the research in this area become critical.

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APPENDICES

APPENDIX A:

EXPERIMENTAL PROTOCOL: SCREENING SESSION

SCREENING SESSION

Hi, my name is Steve Morgan. Thank-you for participating in tonight's experiment. The purpose of this experiment is to select participants for a follow-up study on the "freshman experience". To do this, you will be asked to complete a questionnaire. Based on your responses to the questionnaire, some of you will be invited to participate in the follow-up session. You will receive one extra credit point for today's session and a second extra credit point if you participate in the follow-up session. Are there any questions?

HAND OUT FORMS AND PENCILS

Before we get started, I need you to read and sign a consent form and a debriefing form as well as complete an extra credit form. On the extra credit form, fill in your ID # and corresponding circles.

COLLECT FORMS WHEN FINISHED

HAND OUT OP-SCANS

Please fill in your name, ID # and corresponding circles on this form. Also, in the "pledge" box write your phone number and your availability between 4 p.m. and 7 p.m Monday through Friday. This information will be used to schedule the follow-up session.

WRITE INFORMATION ON BOARD

HAND OUT QUESTIONNAIRES

The instructions for the questionnaire are as follows. Using a pencil, answer all questions by filling in the appropriate circle on the op-scan. Do not write on the questionnaire. When you are done, bring all materials to the front and you may be excused. You will be contacted within a few days if you have been selected to participate in the follow-up session. Are there any questions?

APPENDIX B:
CONSENT FORM: SCREENING SESSION

INFORMED CONSENT FORM

TITLE OF EXPERIMENT: Screening for Freshmen Experiences Study EXP. # _____

INVESTIGATOR: Steven C. Morgan

I. PURPOSE OF EXPERIMENT:

You are invited to participate in a screening session for a follow-up study on the “freshman experience”. This study involves completing a short questionnaire .

II. PROCEDURES TO BE FOLLOWED IN THE STUDY:

To accomplish the goals of the study, you will be asked to complete a short questionnaire. The experiment will last less than a half hour.

III. DISCOMFORTS AND RISKS FROM PARTICIPATING IN THE STUDY:

There are no apparent risks to you from participating in this study.

IV. EXPECTED BENEFITS OF THIS PROJECT:

Your participation in the project will provide useful information that may be helpful for increasing our understanding of problems facing freshmen. This information may be used to develop support programs for freshmen. No promise of benefits has been made to encourage you to participate.

V. ANONYMITY OF PARTICIPANTS AND CONFIDENTIALITY OF RESULTS:

The results of this study will be kept strictly confidential. At no time will the researchers release your results to anyone without your written consent. The information you provide will not include your name and only a subject number will identify you during analyses and any write-up of the research.

VI. COMPENSATION:

For participating in the study you will receive 1 extra credit point. You will receive an additional extra credit point if you participate in the follow-up session. Check with your professor to see how extra credit will impact course grade and what alternative ways are available to earn credit..

VII. FREEDOM TO WITHDRAW:

You are free to withdraw from participation in this study at any time without penalty of reduction in points or grade in course. You are also free not to answer any questions or respond to any experimental situations without penalty.

VIII. APPROVAL OF RESEARCH:

This research project has been approved, as required, by the Institutional Review Board for Research Involving Human Subjects at Virginia Polytechnic Institute and State University and by the Department of Psychology.

IX. SUBJECT'S RESPONSIBILITIES:

I voluntarily agree to participate in this study.

X. SUBJECT'S PERMISSION:

I have read and understand the Informed Consent and conditions of this project. I have had all of my questions answered. I hereby acknowledge the above and give my voluntary consent for participation in this project.

If I participate, I may withdraw at any time without penalty. I agree and abide by the rules of this project.

Signature

Date

Should I have any questions about this research or its conduct, I may contact:

PRIMARY INVESTIGATOR: Steven C. Morgan
FACULTY ADVISOR: Neil M. A. Hauenstein
CHAIR, IRB: Ernest R. Stoudt

PHONE:231-4581
PHONE:231-5716
PHONE:231-9359

APPENDIX C:
QUESTIONNAIRE

SCREENING QUESTIONNAIRE

For the following items, please indicate the degree to which you agree or disagree with each statement about Virginia Tech. Specifically, how do you perceive Virginia Tech's role in supporting your academic and social efforts. Please fill in the appropriate circle on the **op-scan** where **1** = "Strongly Disagree (SD)" and **6** = "Strongly Agree (SA)". **PLEASE DO NOT WRITE ON QUESTIONNAIRE!**

- | | | | | | | |
|--|---------|---|---|---|---|---------|
| 1. Students' ability to function creatively is respected by the administration at Virginia Tech. | 1
SD | 2 | 3 | 4 | 5 | 6
SA |
| 2. Virginia Tech can be described as flexible and continually adapting to change. | 1
SD | 2 | 3 | 4 | 5 | 6
SA |
| 3. Virginia Tech is always moving towards the development of new answers. | 1
SD | 2 | 3 | 4 | 5 | 6
SA |
| 4. Around here students are allowed to try to solve the same problem in different ways. | 1
SD | 2 | 3 | 4 | 5 | 6
SA |
| 5. Creativity is encouraged at Virginia Tech. | 1
SD | 2 | 3 | 4 | 5 | 6
SA |
| 6. The role of the administration at Virginia Tech can best be described as supportive. | 1
SD | 2 | 3 | 4 | 5 | 6
SA |
| 7. At Virginia Tech, we students sometimes reexamine our most basic assumptions. | 1
SD | 2 | 3 | 4 | 5 | 6
SA |
| 8. People at Virginia Tech are always searching for fresh, new ways of looking at problems. | 1
SD | 2 | 3 | 4 | 5 | 6
SA |
| 9. The way we do things seems to fit with what we're trying to do. | 1
SD | 2 | 3 | 4 | 5 | 6
SA |
| 10. The administration acts as if we students are not very creative. | 1
SD | 2 | 3 | 4 | 5 | 6
SA |
| 11. The methods used by Virginia Tech seem well suited to its stated goals. | 1
SD | 2 | 3 | 4 | 5 | 6
SA |
| 12. Assistance in developing new ideas is readily available. | 1
SD | 2 | 3 | 4 | 5 | 6
SA |
| 13. New ideas can come from anywhere at Virginia Tech and be equally received. | 1
SD | 2 | 3 | 4 | 5 | 6
SA |

14. Students are always trying out new ideas.	1 SD	2	3	4	5	6 SA
15. Students are encouraged to develop their own interests, even when they deviate from those of Virginia Tech.	1 SD	2	3	4	5	6 SA
16. Students at Virginia Tech feel encouraged by the administration to express their opinions and ideas.	1 SD	2	3	4	5	6 SA
17. Students at Virginia Tech realize that in dealing with new problems and tasks, frustration is inevitable; therefore, it is handled constructively.	1 SD	2	3	4	5	6 SA
18. At Virginia Tech, the way things are taught is as important as what is taught.	1 SD	2	3	4	5	6 SA
19. Virginia Tech is open and responsive to change.	1 SD	2	3	4	5	6 SA
20. The role of the administration here is to encourage and support individual students' development.	1 SD	2	3	4	5	6 SA
21. Individual independence is encouraged at Virginia Tech.	1 SD	2	3	4	5	6 SA
22. Creative efforts are usually ignored at Virginia Tech.	1 SD	2	3	4	5	6 SA
23. People at Virginia Tech try new approaches to tasks, as well as tried and true ones.	1 SD	2	3	4	5	6 SA
24. I mostly agree with how we do things here.	1 SD	2	3	4	5	6 SA

For the following items, please indicate the degree to which you agree or disagree with each statement. Please circle the appropriate response where **-4 = "Very Strong Disagreement" (VSD)** and **+4 = "Very Strong Agreement" (VSA)**.

25. I would prefer complex to simple problems.	-4 VSD	-3	-2	-1	0	+1	+2	+3	+4 VSA
26. I like to have the responsibility of handling a situation that requires a lot of thinking.	-4 VSD	-3	-2	-1	0	+1	+2	+3	+4 VSA

27. Thinking is not my idea of fun.	-4 VSD	-3	-2	-1	0	+1	+2	+3	+4 VSA
28. I would rather do something that requires little thought than something that is sure to challenge my thinking abilities.	-4 VSD	-3	-2	-1	0	+1	+2	+3	+4 VSA
29. I try to anticipate and avoid situations where there is a likely chance I will have to think in depth about something.	-4 VSD	-3	-2	-1	0	+1	+2	+3	+4 VSA
30. I find satisfaction in deliberating hard and long for hours.	-4 VSD	-3	-2	-1	0	+1	+2	+3	+4 VSA
31. I only think as hard as I have to.	-4 VSD	-3	-2	-1	0	+1	+2	+3	+4 VSA
32. I prefer to think about small, daily projects to long-term ones.	-4 VSD	-3	-2	-1	0	+1	+2	+3	+4 VSA
33. I like tasks that require little thought once I've learned them.	-4 VSD	-3	-2	-1	0	+1	+2	+3	+4 VSA
34. The idea of relying on thought to make my way to the top appeals to me.	-4 VSD	-3	-2	-1	0	+1	+2	+3	+4 VSA
35. I really enjoy a task that involves coming up with new solutions to problems.	-4 VSD	-3	-2	-1	0	+1	+2	+3	+4 VSA
36. Learning new ways to think doesn't excite me very much.	-4 VSD	-3	-2	-1	0	+1	+2	+3	+4 VSA
37. I prefer my life to be filled with puzzles that I must solve.	-4 VSD	-3	-2	-1	0	+1	+2	+3	+4 VSA
38. The notion of thinking abstractly is appealing to me.	-4 VSD	-3	-2	-1	0	+1	+2	+3	+4 VSA
39. I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.	-4 VSD	-3	-2	-1	0	+1	+2	+3	+4 VSA
40. I feel relief rather than satisfaction after completing a task that required a lot of mental effort.	-4 VSD	-3	-2	-1	0	+1	+2	+3	+4 VSA
41. It's enough for me that something gets the job done; I don't care how or why it works.	-4 VSD	-3	-2	-1	0	+1	+2	+3	+4 VSA
42. I usually end up deliberating about issues even when they do not affect me personally.	-4 VSD	-3	-2	-1	0	+1	+2	+3	+4 VSA

For the following items, please indicate the degree to which you would be likely to enjoy or unlikely to enjoy each statement. Please circle the appropriate response where 1 = “Unlikely to Enjoy” (UE) and 7 = “Likely to Enjoy” (LE).

43. Being methodological and consistent in the way I tackle problems.	1 UE	2	3	4	5	6	7 LE
44. Being precise and exact about production of results and reports.	1 UE	2	3	4	5	6	7 LE
45. Spending time tracing relationships between disparate areas of work.	1 UE	2	3	4	5	6	7 LE
46. Searching for novel approaches not required at the time.	1 UE	2	3	4	5	6	7 LE
47. Making unusual connections about ideas even if they are trivial.	1 UE	2	3	4	5	6	7 LE
48. Adhering to the well-known techniques, methods, and procedures of my area of work.	1 UE	2	3	4	5	6	7 LE
49. Being confronted with a maze of ideas which may, or may not, lead me somewhere.	1 UE	2	3	4	5	6	7 LE
50. Adhering carefully to the standards of my area of work.	1 UE	2	3	4	5	6	7 LE
51. Being strict on the production of results, as and when required.	1 UE	2	3	4	5	6	7 LE
52. Struggling to make connections between apparently unrelated ideas.	1 UE	2	3	4	5	6	7 LE
53. Being “caught up” by more than one concept, method, or solution.	1 UE	2	3	4	5	6	7 LE
54. Following well-trodden ways and generally accepted methods for solving problems.	1 UE	2	3	4	5	6	7 LE
55. Linking ideas which stem from more than one area of investigation.	1 UE	2	3	4	5	6	7 LE
56. Being fully aware beforehand of the sequence of steps required in solving problems.	1 UE	2	3	4	5	6	7 LE
57. Adhering to the commonly established rules of my area of work.	1 UE	2	3	4	5	6	7 LE
58. Paying strict regard to the sequence of steps needed for the completion of a job.	1 UE	2	3	4	5	6	7 LE
59. Accepting readily the usual and generally proven methods of solution.	1 UE	2	3	4	5	6	7 LE

60. Pursuing a problem, particularly if it takes me into areas I don't know much about.	1 UE	2	3	4	5	6	7 LE
61. Being fully occupied with what appear to be novel methods of solution.	1 UE	2	3	4	5	6	7 LE

**DID YOU ANSWER ALL 61 QUESTIONS?
IF YES, YOU ARE DONE
TURN IN QUESTIONNAIRE AND OP-SCAN TO EXPERIMENTER**

APPENDIX D:

CONFIRMATION OF DEBRIEFING: SCREENING SESSION

CONFIRMATION OF DEBRIEFING

PLEASE READ THE FOLLOWING AND SIGN BELOW:

I understand that the purpose of the study was to select people to participate in a follow-up study of the “freshman experience”. I will receive one extra credit point for participating, and an additional extra credit point if I participate in the follow-up study. If I am selected for the follow-up, the experimenter will contact me by telephone to schedule a session.

Most importantly, I realize that my questionnaire responses and my identity will remain strictly confidential. All data is coded and analyzed by number.

I understand that any discussion of this research with other students in my class could lead to contamination of the results of this research, and I agree to refrain from discussing this research for at least 3 months.

SIGNED _____

DATE _____

APPENDIX E:

EXPERIMENTAL PROTOCOL: IDEA GENERATION SESSION

IDEA GENERATION SESSION

ARRANGE PARTICIPANTS AROUND TABLE (3 AT EACH END)

Thank you for agreeing to participate in this follow-up session. The goal of this session is to examine the freshman experience, specifically the transition that is a necessary part of being a freshman.

Before we get started, I need you to read and sign a consent form and complete an extra-credit form.

HAND OUT FORMS

COLLECT FORMS

The freshman year at the university has a number of distinct characteristics but is generally viewed as a time of great transition. These transitions involve changing from a high school to a college environment, moving from relative dependence to increased independence, leaving old friendships and forming new acquaintances, and moving from a home into an oftentimes noisy dormitory. While this phase of your life is a time of great excitement and opportunity, a number of individuals also experience considerable stress and discomfort as a result of the changes.

As you, members of the freshman class, are most affected by such transitions, I request your assistance in helping me develop a support system which will be more effective in easing the time of transition for the students at Virginia Tech. Specifically, I ask that you generate suggestions for ways the university could help ease the transition in two major areas of change.

To address these transition issues, you will be divided into two three-person teams. Your team members will be the two persons seated closest to you. At this time I'd like you to introduce yourselves to your team members by giving your name and your home town.

WAIT FOR INTRODUCTIONS

Your team will be using two brainstorming techniques to address the two transition issues, one issue per technique.

HAND OUT B.S. RULES

Before we continue, I want to review some rules for brainstorming: 1) state any idea that comes to mind; 2) aim for a large quantity of ideas; 3) build on other ideas; and, 4) don't be critical of ideas.

Before we start, we'll have a couple of warm-up sessions to familiarize you with each of the techniques. The procedure for each technique is as follows. For one technique, called the interactive technique, you will remain seated around this table and brainstorm interactively with your team members. You will follow the brainstorming rules and **voice** any ideas you may have. I will be nearby, writing down your comments. A tape recorder will back me up in case I miss anything. For the other technique, called the non-interactive technique, you will brainstorm on your own in separate cubicles, with your ideas to be combined later with your team members. Once again, you are to follow the brainstorming rules and **write down** any ideas you may have on a form I will give you.

SHOW FORM

Are there any questions about either technique?

WRITE WARM-UP TASK ON THE BOARD

The warm-up task will be as follows.

READ WARM-UP TASK

You will use each technique for three minutes. This team will use the interactive technique first, while this team will use the non-interactive technique first. After three minutes you will switch techniques.

POSITION TEAMS (AROUND TABLE OR IN CUBICLES)

HAND OUT IG FORMS TO NOMINAL GROUP

GIVE SIGNAL TO START & MONITOR PROCESS

AFTER THREE MINUTES, STOP & REPOSITION TEAMS

COLLECT IG FORMS & HAND OUT IG FORMS TO NEW NOMINAL GROUP

GIVE SIGNAL TO START & MONITOR PROCESS

AFTER 3 MINUTES, STOP & HAVE EVERYONE RECONVENE AT TABLE

WRITE FIRST TASK ON BOARD

Now that you're familiar with the brainstorming techniques we'll begin. The first task is as follows.

READ TASK

Your team will have 15 minutes to brainstorm about this issue. Please refrain from speaking until I give the signal to begin.

POSITION TEAMS (AROUND TABLE OR IN CUBICLES)

HAND OUT IG FORMS TO NOMINAL GROUP

START RECORDER & GIVE SIGNAL TO START

TRANSCRIBE INTERACTIVE COMMENTS

AFTER 15 MINUTES, GIVE SIGNAL TO STOP & TURN OFF RECORDER

ASK PARTICIPANTS TO RECONVENE & COLLECT IG FORMS

HAND OUT SATISFACTION QUESTIONNAIRE

Please answer the following questions regarding the brainstorming session you just completed. Please fill in your Id number and circle the "I" if you were in the interactive technique or the "N" if you were in the non-interactive technique.

COLLECT QUESTIONNAIRES

*****REPEAT PROCEDURE (SWITCH TASK & TECHNIQUES)*****

HAND OUT DEBRIEF FORM & DEAN'S LETTER

We thank you for your effort and appreciate your input in helping to develop this system. Please read and sign this debrief form and read this thank-you letter from the dean. You may then be excused

APPENDIX F:

CONSENT FORM: IDEA GENERATION SESSION

INFORMED CONSENT FORM

TITLE OF EXPERIMENT: Freshmen Experiences

EXPERIMENT # _____

INVESTIGATOR: Steven C. Morgan

I. PURPOSE OF EXPERIMENT:

You are invited to participate in a study about your experiences as a freshman. This study involves generating suggestions the university can use to address two problems facing freshmen .

II. PROCEDURES TO BE FOLLOWED IN THE STUDY:

To accomplish the goals of the study, you will be asked to generate ideas with other freshmen about your experiences as a freshman. You will be asked to generate ideas in a group context and on an individual basis. The experiment will last about one hour.

III. DISCOMFORTS AND RISKS FROM PARTICIPATING IN THE STUDY:

There are no apparent risks to you from participating in this study.

IV. EXPECTED BENEFITS OF THIS PROJECT:

Your participation in the project will provide useful information that may be helpful for increasing our understanding of problems facing freshmen. This information may be used to develop support programs for freshmen. No promise of benefits has been made to encourage you to participate.

V. ANONYMITY OF PARTICIPANTS AND CONFIDENTIALITY OF RESULTS:

The results of this study will be kept strictly confidential. At no time will the researchers release your results to anyone without your written consent. The information you provide will not include your name and only a subject number will identify you during analyses and any write-up of the research. Portions of the session will be recorded on audio tape. Any comments recorded will remain anonymous and tapes will be erased after they have been transcribed.

VI. COMPENSATION:

For participating in the study you will receive 1 extra credit point. Check with your professor to see how extra credit will impact course grade and what alternative ways are available to earn credit..

VII. FREEDOM TO WITHDRAW:

You are free to withdraw from participation in this study at any time without penalty of reduction in points or grade in course. You are also free not to answer any questions or respond to any experimental situations without penalty.

VIII. APPROVAL OF RESEARCH:

This research project has been approved, as required, by the Institutional Review Board for Research Involving Human Subjects at Virginia Polytechnic Institute and State University and by the Department of Psychology.

IX. SUBJECT'S RESPONSIBILITIES:

I voluntarily agree to participate in this study.

X. SUBJECT'S PERMISSION:

I have read and understand the Informed Consent and conditions of this project. I have had all of my questions answered. I hereby acknowledge the above and give my voluntary consent for participation in this project.

If I participate, I may withdraw at any time without penalty. I agree and abide by the rules of this project.

Signature

Date

Should I have any questions about this research or its conduct, I may contact:

PRIMARY INVESTIGATOR: Steven C. Morgan

PHONE: 231-4581

FACULTY ADVISOR: Neil M. A. Hauenstein

PHONE: 231-5716

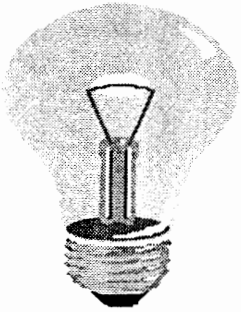
CHAIR, IRB: Ernest R. Stoudt

PHONE: 231-9359

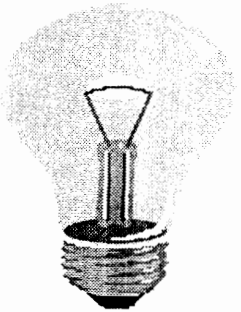
APPENDIX G:
BRAINSTORMING RULES

BRAINSTORMING RULES

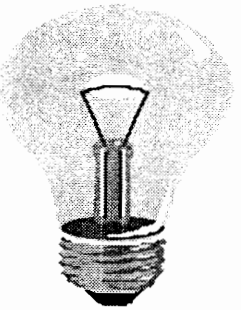
While brainstorming, please keep these brainstorming rules in mind:



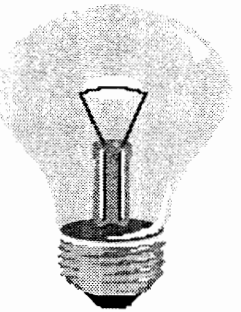
**STATE ANY IDEA THAT COMES TO MIND, NO
MATTER HOW WILD**



BUILD ON OTHER IDEAS



DON'T BE CRITICAL OF IDEAS



AIM FOR A LARGE QUANTITY OF IDEAS

APPENDIX H:
SATISFACTION QUESTIONNAIRE

POST-SESSION QUESTIONNAIRE

Please answer the following questions regarding the brainstorming session you just participated in.

1. How do you feel about the process by which you generated ideas?

1 2 3 4 5 6 7

Very
Dissatisfied

Very
Satisfied

2. How do you feel about the ideas proposed?

1 2 3 4 5 6 7

Very
Dissatisfied

Very
Satisfied

3. How satisfied are you with your performance on this task?

1 2 3 4 5 6 7

Very
Dissatisfied

Very
Satisfied

APPENDIX I:

CONFIRMATION OF DEBRIEFING: IDEA GENERATION SESSION

CONFIRMATION OF DEBRIEFING

There was more to this study than you were told at the beginning. We do not tell participants the full purpose at the beginning because this might affect the way people act, and would not be an indication of everyday life.

The purpose of the study was as you were told at the beginning: to generate suggestions for the university to ease the transition to college. These suggestions will be used in the development of a university-sponsored support system to address freshmen transition issues. Of additional concern to the researchers was whether people could generate more suggestions when working alone or when working as a team and what individual difference variables affect idea generation.

PLEASE READ THE FOLLOWING AND SIGN BELOW:

I understand that the purpose of the study was to generate suggestions to be used as input in the development of a support system for freshmen experiencing transition difficulties. The researchers were also interested in whether people generate more solutions when working alone or when working with other people and what individual difference variables affect idea generation.

Most importantly, I realize that any comments/suggestions I made are completely anonymous. Also, my identity will remain strictly confidential. All data is coded and analyzed by number.

I understand that any discussion of this research with other students in my class could lead to contamination of the results of this research, and I agree to refrain from discussing this research for at least 3 months.

SIGNED _____

DATE _____

APPENDIX J:

DEAN'S THANK-YOU LETTER

October 26, 1996

TO: Members of the Class of 1999

FROM: Ellie T. Sturgis, Ph.D. *Ellie T. Sturgis*
Associate Dean. College of Arts and Sciences

RE: Freshman transitions

The freshman year at the university has a number of distinct characteristics but is generally viewed as a time of great transition. These transitions involve changing from high school to the college environment, moving from relative dependence to increased independence, leaving old friendships and forming new acquaintances, and moving from a home into an oftentimes noisy dormitory. While this phase of your life is a time of great excitement and opportunity, a number of individuals also experience considerable stress and discomfort as a result of the changes.

As you, members of the freshman class, are most currently most affected by such transitions, I request your assistance in helping me to develop a support system which will be more effective in easing this time of transition for the students at Virginia Tech. Specifically, I ask that you generate suggestions on ways in which the university could help ease the transition in two major areas of change. To accomplish this task, you will be asked to engage in two brainstorming sessions with each session addressing a different issue.

Collectively, the students, faculty, and administration of Virginia Tech can develop a support system that will aid future freshmen at Virginia Tech. I thank you for your effort and appreciate your input in helping to develop this system.

APPENDIX K:

SAMPLE IDEA GENERATION FORM FOR NOMINAL GROUP TECHNIQUE

Please generate suggestions for how Virginia Tech could help ease the transition to college in terms of social issues (not related to academic issues). Please number each suggestion.

1.

APPENDIX L:

SUMMARY TABLES AND FIGURES FOR DEPENDENT MEASURES

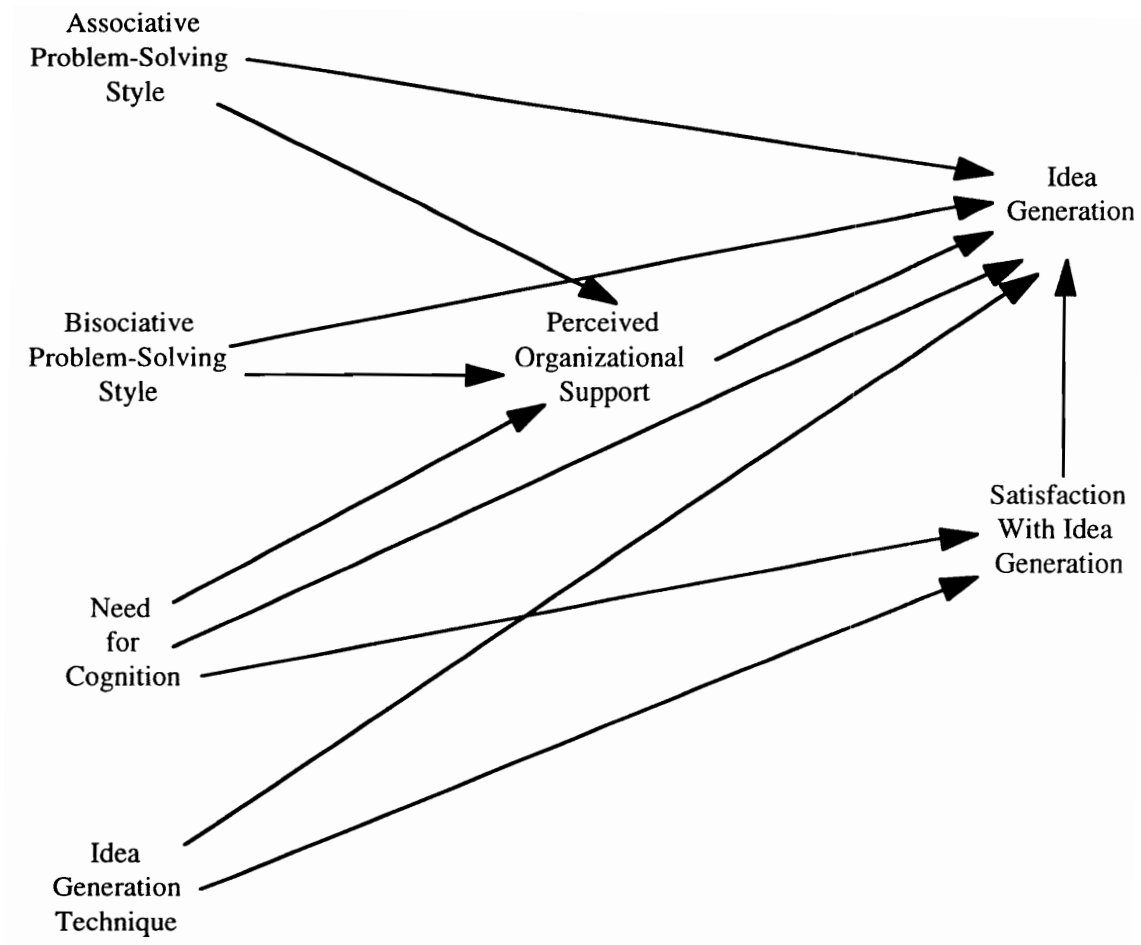


Figure L-1. Proposed model for idea generation in a team context.

Table L-2

Descriptive Statistics for Idea Generation Dimensions broken down by Idea Generation

Technique

Dimension	<u>Technique</u>		<u>F</u> ^a	<u>Effect</u> ^b <u>Size</u>
	Interactive	Nominal		
<u>Quantity</u>				
Number of Ideas				
Mean	8.00	6.94	4.54 *	.05
Standard Deviation	3.66	3.84		
<u>Quality</u>				
Feasibility of Ideas				
Mean	4.08	3.89	2.37	.03
Standard Deviation	.67	.88		
Outcome of Implementation				
Mean	3.96	3.78	2.21	.02
Standard Deviation	.66	.88		
Usability Composite				
Mean	8.04	7.67	2.35	.03
Standard Deviation	1.31	1.74		

^a represents mean-difference test between techniques ($F_{(1,89)}$ values).

^b represents partial eta-squared

* $p < .05$

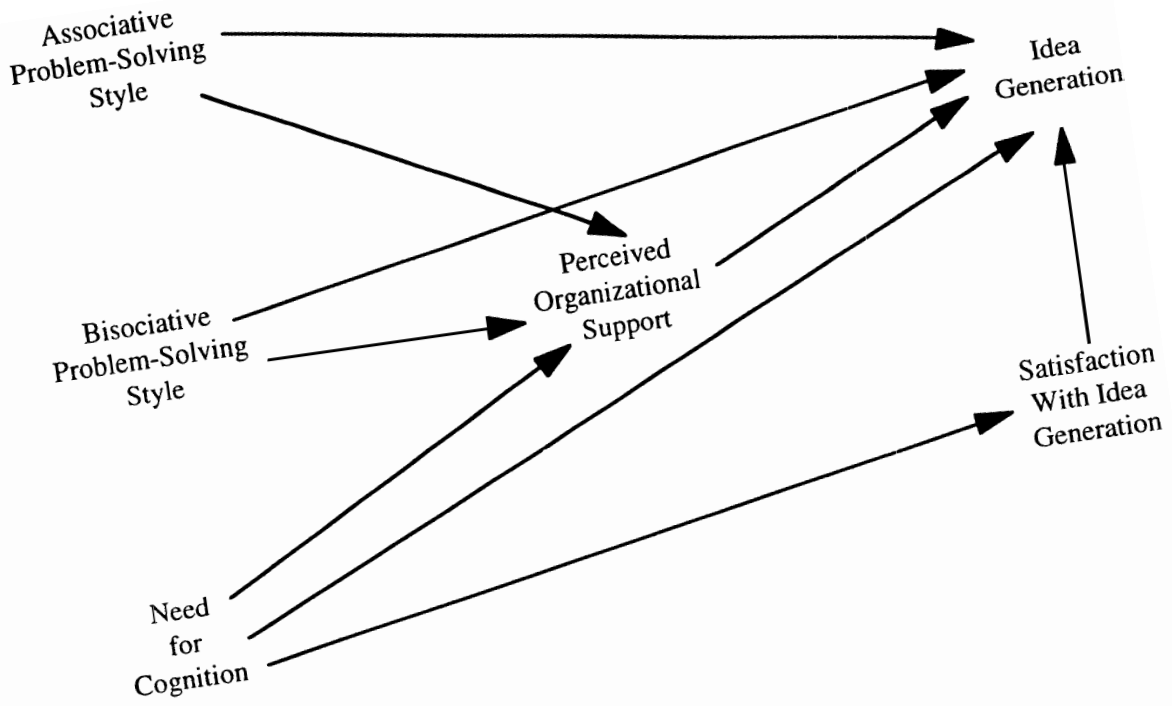


Figure L-3. Path Model.

Table L-4

Means, Standard Deviations, and Correlations Among Model Variables

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8
1. Associative Problem-Solving Style	47.01	11.50	---	.01	-.21*	.30*	.08	-.36*	.07	-.12
2. Bisociative Problem-Solving Style	41.16	8.57	---	---	.57*	-.07	.07	-.02	.05	-.08
3. Need for Cognition	110.32	17.65	---	---	---	.01	.15	.02	.07	.01
4. Perceived Organizational Support	105.70	15.06	---	---	---	---	.03	-.42*	.02	-.23*
5. Satisfaction with Idea Generation (Nominal)	20.41	3.86	---	---	---	---	---	.04	.05	.08
6. Idea Generation (Nominal)	6.94	3.84	---	---	---	---	---	---	-.12	.14
7. Satisfaction with Idea Generation (Interactive) ^a	.026	1.64	---	---	---	---	---	---	---	.10
8. Idea Generation (Interactive) ^a	.002	2.79	---	---	---	---	---	---	---	---

Note. *N* = 90.

^a These values reflect deviations from team means. These data were not used as input for path analyses, and are reported here for comparison purposes only.

* $p < .05$.

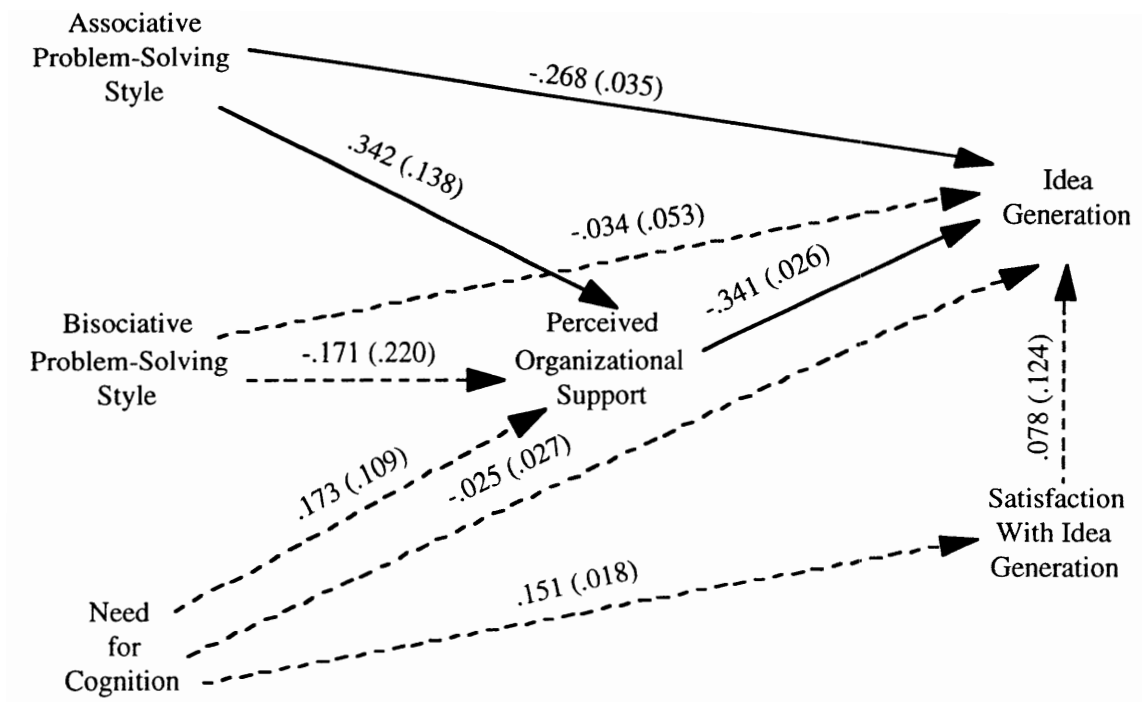


Figure L- 5. Path analysis results. Path coefficients shown are standardized betas.

Standard errors are in parentheses. Solid lines indicate significant paths ($p < .05$); dashed lines indicate non-significant paths ($p > .05$).

STEVEN C. MORGAN

PERSONAL INFORMATION

Date of Birth: April 4, 1969

Marital Status: Married

Business Address: Academic Assessment Program
Virginia Polytechnic Institute
and State University (Virginia Tech)
Blacksburg, VA 24061-0157

Business Phone: (540) 231-4581
Fax: (540) 231-4522
e-mail: morgan7@vt.edu

Home Address: 247 Fairfax Road
Blacksburg, VA 24060

Home Phone: (540) 552-7428

EDUCATION

- Ph. D. Virginia Tech, Expected May 1996
Major field of study: Industrial/Organizational Psychology
**DISSERTATION: Facilitating Idea Generation in a Team Context:
The Effects of Technique, Perceived Organizational Support,
Individual Differences, and Satisfaction with Idea Generation.**
Major advisor: Dr. Neil M. A. Hauenstein
- M. S. Virginia Tech, distinction, 1994
Major field of study: Industrial/Organizational Psychology
**THESIS: Effects of Context on the Leniency, Accuracy, and Utility of
Self-Appraisals of Performance: Social Comparison Information
and Purpose of Appraisal.**
Major advisor: Dr. Neil M. A. Hauenstein
- B. S. The University of Pittsburgh, distinction, 1992
Major field of study: Psychology
Minor fields of study: Sociology and Communications

ACADEMIC EXPERIENCE

- 1993 - 1994 *Lab Coordinator* - Department of Psychology, Virginia Tech.
Maintained two computer labs, coordinated lab scheduling, loaded
software, provided technical support as needed.

1992 - 1993 **Graduate Lab Instructor** - Department of Psychology, Virginia Tech. Developed and taught two Introductory to Psychology undergraduate labs. Designed and delivered lectures, graded exams and essays. Advised and tutored students.

APPLIED EXPERIENCE

1994 - present **Research Analyst** - Academic Assessment Office, Virginia Tech. Facilitated and analyzed focus group/ brainstorming sessions. Served as university liaison while moderating alumni focus groups throughout Virginia. Evaluated teaching/learning initiatives and other University-implemented projects using survey research techniques. Disseminated findings of research projects via campus-wide newsletter. Analyzed and presented research findings to department and university executives. Served as computer network liaison and trainer.

1995 **Intern** - Manpower Personnel & Research Division, Armstrong Laboratories, Brooks AFB, San Antonio, Texas. Conducted extensive research on team flexibility/ innovation to serve as foundation for five-year Air Force research program. Conducted site visits and interviews to formulate model of "expert" team performance. Co-authored chapter on organizational needs analysis for a training handbook.

1994 **Consultant** - The Children's Nest Daycare Center, Blacksburg, VA. Conducted job analyses and incumbent interviews. Generated comprehensive job descriptions and performed other miscellaneous human resource functions as requested.

1993 **Research Analyst** - Outcome Assessment Project, Department of Psychology, Virginia Tech. Collected, classified and analyzed data regarding career paths of Psychology graduates.

1991 - 1992 **Intern** - Office of Human Resources, University of Pittsburgh. Revised performance appraisal system. Developed selection battery for campus police officers. Designed and implemented Walk-In screening procedure. Wrote job descriptions for the university. Processed applications and conducted interviews. Represented the university at career fairs.

RELEVANT GRADUATE COURSES

Personnel
Organizational Psychology
Research Methods
Statistics for Social Science I, II

Organizational Staffing
Work and Motivation
Psychological Measurement
GTA Training Workshop

Quantitative Topics: IRT
Psychometrics
Industrial Psychology
Cognitive Psychology

Social Psychology
Multiple Regression
Job Analysis
Team Development

PROFESSIONAL AFFILIATIONS

American Psychological Association
Society for Industrial/Organizational Psychology
American Psychological Society
Southeastern Psychological Association
Academy of Management
 Managerial Consultation Division
 Organizational Development and Change Division
 Technology and Innovation Management Division

HONORS AND AWARDS

Member Psi Chi psychology honor society
Member Golden Key national honor society
Graduate Student Assembly Research Award, 1995 & 1996

PROFESSIONAL AND RESEARCH PAPERS

Morgan, S. C., Williams, J. H., & Hauenstein, N. M. A. (1996). Context and self-appraisal quality: Social comparison information and expectation of validation. Paper to be presented at the Eleventh Annual Conference of the Society for Industrial and Organizational Psychology, San Diego, CA.

Morgan, S. C. (1995). Facilitating team innovation: The effects of perceived organizational support, idea generation technique, and personality factors. In United States Research Program: 1995.

Morgan, S. C., & Hauenstein, N. M. A. (1995). Effects of context on self-appraisal quality: Comparison information and appraisal purpose. Paper presented at the Tenth Annual Conference of the Society for Industrial and Organizational Psychology, Orlando, FLA.

MANUSCRIPTS IN PRESS

Morgan, S. C. Teams and innovation: An annotated bibliography. Air Force Technical Report. Brooks AFB, TX.

Gott, S. P., & Morgan, S. C. Needs assessment. In S. Tobias & H. F. O'Neil, Jr.'s (Eds.), Handbook on training.

MANUSCRIPTS IN PREPARATION

Hauenstein, N. M. A., Donlin, J. M., Bush, J., & Morgan, S. C. Self-motives and memory for performance feedback.

COMPUTER SKILLS

Experience using SPSS/PC, SPSS-x, SAS, and JMP statistical packages. Experience using Word, Excel, Pagemaker, and Power Point in both IBM and Macintosh environments. Familiar with Windows and Macintosh systems.

REFERENCES

Available upon request.

A handwritten signature in black ink, appearing to read "N. M. A. Hauenstein", followed by a long horizontal line extending to the right.