THE BLANK PAGE EFFECT:

EFFECTS OF CONSTRAINT ON CREATIVITY

Caneel K. Joyce

Walter A. Haas School of Business
University of California, Berkeley
joyce@haas.berkeley.edu

October 2008

DRAFT: PLEASE DO NOT QUOTE, CITE OR CIRCULATE

* The current version of this paper is available for download at: http://faculty.haas.berkeley.edu/joyce/. I appreciate the helpful suggestions and insightful critiques of Barry Staw, Philip Tetlock, Cameron Anderson, Sara Beckman and seminar participants at the University of California, Berkeley Haas School of Business, Kyle Jennings and Jonathan Hey, and the many research assistants who contributed to this research. All errors are mine. I acknowledge research support from the Institute for Business and Economic Research (IBER) and the Center for Information Technology Research in the Interest of Society (CITRIS) at UC Berkeley, the California Management Review, and the Crawford Foundation.

ABSTRACT

Constraint has long been considered the enemy of creativity although it is a ubiquitous fact of social and economic life. Freedom has long been considered essential for intrinsic motivation and creativity. In seeming opposition, decision-making research reveals a "paradox of choice:" extensive choice paralyzes, hinders judgment and decreases choice likelihood. From the perspective that creativity is about making choices, this paper resolves this tension and proposes a curvilinear effect of constraint on creative performance. As predicted, a four-level experiment using a product design task showed a curvilinear effect of constraint, such that a moderate degree was optimal for creativity and originality even though constraint had a negative linear effect on intrinsic motivation. This study bridges the creativity and decision-making literatures to explain the "blank page effect" and reconciles inconsistencies between extant theory, unexplained findings and the counter-intuitive practices of creative professionals.

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> *A full understanding of any work means understanding what choices were made and from what range of possibilities they were made, the knowledge I have just suggested is relatively common among practitioners of an art. These choices are made in a complicated social context of artistic activity which constrains the range of choices and provides motives for making one or another of them.*
>
> *- Becker, 2006*

> *The initial element in solving or limiting certain issues . . . contains an enormous number of built-in decisions that limit the scope of the intellectual or visual problem at hand, thankfully preventing the paralysis that results from the overwhelming unlimited scope of decision contained in a blank page or empty space.*
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> *- Tufte, 2006*

Constraint has long been considered the enemy of creativity and the ally of effective decision-making. Historically, creativity researchers have found that too much constraint on freedom may decrease the intrinsic motivation to create (e.g., Amabile, 1983; Amabile & Gitomer, 1984). In seeming opposition to these findings, recent decision-making research has revealed a "Paradox of Choice" (Schwartz, 2004), such that too much choice can be paralyzing, and tends to undermine good judgment, intrinsic motivation (Iyengar & Lepper, 2000), and originality (Chua & Iyengar, forthcoming). If there are limitations to the benefits of freedom, then constraint may in fact be essential to creativity. This is good news given the ubiquity of constraint, especially in market-driven organizations.

This paper is about how constraint – any restriction imposed on freedom such as rules, boundaries, and scarcity – influences the creative process. Given that judgment and choice are important but often-overlooked aspects of creativity, my theory applies

findings from decision-making research to the domain of creativity. I propose a curvilinear effect of constraint, such that a moderate level of constraint is optimal. In so doing, this research bridges the creativity and decision-making literatures and resolves inconsistent findings in prior research.

This paper represents a working segment of my doctoral dissertation, focused on one of its four empirical studies. First I will provide an overview of my research question, review the literatures on creativity, choice and constraint, and develop a set of theoretical propositions. Next I will present the methods, results, and discussion of an individual-level laboratory experiment designed to test hypotheses about the effects of constraint on creativity and the moderating effect of expertise. In the dissertation the material in this paper is expanded in Chapters 1 (Introduction), 2 (Literature Review and Basic Theory), and 3 (Lab Study 1); an overview of the dissertation is found in the conclusion to this paper.

LITERATURE REVIEW AND THEORETICAL DEVELOPMENT

This section offers a conceptual analysis of the literatures on creativity, choice, and constraint, and develops a set of theoretical propositions integrating these constructs. After defining key terms, I will argue that while absolute constraint undermines creativity and intrinsic motivation, too little constraint is also counterproductive, resulting in decreased creativity and originality. While some degree of choice has repeatedly been shown to be essential to creativity, the "freedom" of the blank page can actually stifle it. I will introduce material from working professionals in a variety of creative domains which corroborates this claim. I will argue that creativity and decision-making are more

closely linked than the extant literature currently suggests, and that an integration of findings on cognitive search and problem-solving behaviors can help resolve inconsistent findings from the dominant paradigm on creativity.

Definitions

Creativity. Creativity is defined as the production of ideas, solutions, or products that are both novel and useful (Feist, 1998). Amabile points out the need for using both a theoretical and an operational definition of creativity (Amabile, 1983). For an idea to meet the theoretical definition of creative, it must be both novel (that is: new, unique, unusual, and original) and useful (that is: appropriate, adaptive, effective in solving a problem, or providing value). Novelty can be defined in either statistical (rare in the sample, unlikely to occur) or subjective terms (new to the person judging it).

For an idea to meet the operational definition of creativity, it must be judged as creative by others in the domain (Amabile, 1983; Simonton, 1999; Csiksentmihalyi, 1996). Creativity is typically measured using the Consensual Assessment Technique (*CAT,* Amabile, 1983), wherein a panel of experts in the field judges each product or idea on three basic dimensions: originality/novelty, appropriateness/usefulness, and creativity, which importantly is defined as "your own subjective definition of creativity." It has been shown that allowing judges to use their subjective definition of creativity results in highly reliable ratings. Although simpler measures exist, I prefer the externally-valid CAT over more atomistic measures such as fluency (Guilfold, 1950), which measures the sheer quantity of ideas .

Problems and Solutions. Many scholars agree that creativity can be thought of as problem solving (e.g., Osborn:1963, p1961; Treffinger, Isaksen & Dorval, 2000; Isen,

Daubman & Nowicki, 1987), and I use the language of problems and solutions throughout this paper. A *problem* is a matter or situation which needs to be resolved or overcome by identifying (through search and/or decision) or inventing (through creation) a *solution*. Just as creativity can be thought of as problem solving, so can decision-making (i.e., "I need to decide what to write about.").

In business, creative problems can involve anything from inventing a new product to meeting a certain consumer need to crafting a proposal in an integrative negotiation (e.g., Kurtzberg, 1998), to developing a new business strategy(Ford, 2008; Higgins, 1996). Even the most abstract art is solving a problem (Stokes, 1999), such as evoking an emotional reaction or communicating a political idea. I use the terms creativity and creative problem-solving interchangeably.

Constraint. Finally, constraint is defined as any restriction on freedom that limits the number of possible solutions available for solving the problem at hand, including rules, goals, limitations, norms, boundaries, and scarcity. Constraints both limit and direct the search for new ideas and solutions to problems (Stokes, 2006). Constraint is a continuous construct, with the opposite of constraint being absolute freedom of choice.

I use the term constraint slightly differently than does Amabile, and the difference is important to point out as I build heavily upon her work. Amabile and colleagues use the term *extrinsic constraints*, defined as "any social factors that control, or could be perceived as controlling, task engagement; and are extrinsic to the properties of the task itself" (Amabile & Gitomer, 1984). In their work, extrinsic constraint is usually operationalized in a way that makes social control particularly salient, such as expecting evaluation by experts (Amabile, 1979) and being allowed to make one's own choices in

task materials versus having those choices made for them - quite saliently - by others (Amabile & Gitomer, 1984), as opposed to looking at the effects of other aspects of choice on creativity, such as the number of options available (Chua & Iyengar, forthcoming) or the degree of freedom in determining which problem to solve as done in this study .

Creativity and Freedom from Constraint

Freedom from constraint has long been considered essential to creativity. This intuition is evident in our cultural archetypes of artists, on our business bestseller lists, even in the classic use of brainstorming rules (Osborn, 1963; Sutton & Hargadon, 1996). That idea that constraint on freedom squelches creativity resonates even at the sociopolitical level, where totalitarian governments are associated with stifled innovation.

The association between freedom and creativity has received empirical support as well (Amabile, 1988). At the personal level, highly creative people have been shown to be unaware of (and/or unmotivated by) social norms (Feist, 1998) and thus are not intrinsically bound by the conformity pressures felt by most. At the situational level, a variety of constraints such as the expectation of evaluation (Amabile, 1979), competition (Amabile, 1982), surveillance (Amabile, Goldfarb, & Brackfield, 1990), and contracted reward (McGraw & McCullers, 1979) have been shown to diminish the creativity of output.

The dominant explanation for these effects comes from self-determination theory (Deci & Ryan, 1980), which posits that individuals are intrinsically motivated when they perceive themselves to be acting out of free will, such as in situations providing choice and a sense of personal control. Intrinsic motivation is an essential determinant of

creativity (Amabile, 1979, 1983, 1996), and accordingly, creativity is enhanced in situations providing choice and perceived personal control (Deci, 1981; Deci & Ryan, 1985).

While the implications of this literature are profoundly important and its influence widespread, the empirical results it has generated have not always conformed to predictions. One of Amabile's earliest studies found that while participants in all conditions under the constraint of expecting evaluation were less creative than those not expecting evaluation, participants who were given specific instructions (in how to create art that would be judged as creative) displayed the opposite pattern when constrained via extrinsic evaluation (Amabile, 1979).

Indeed, a meta-analysis by Eisenberger and Cameron (1996) found that when rewards were explicitly dependent upon the fulfillment of a specific performance standard, not only was intrinsic task interest increased, but creativity was protected and in some cases even increased. Inconsistent findings (e.g., Eisenberger, Armeli, & Pretz, 1998) have prompted the qualification of the original theory by including a host of situational and individual difference moderators (e.g., Amabile, 1996; Eisenberger & Armeli, 1997). Although these critiques have been rebuffed (Cameron & Pierce, 1996; Hennessey & Amabile, 1998a), they suggest that constraints can be beneficial for creativity, yet the pattern has not been parsimoniously integrated into the existing theory.

In short, the meta-analysis by Eisenberger and Cameron (1996) suggested that the expectation of evaluation by judges had the predicted negative effects on creativity only when task instructions were not given, and the criteria with which products would be evaluated were not defined - in other words, when the task was unconstrained.

Creativity and Choices

"Creativity means creative choices of inclusion and exclusion."
— Robert McKee (1997)

The premise underlying this paper is that, like artwork (Becker, 2006), creativity is all about choices. The creative process is filled with decisions(Mumford, 1991), ranging from how to frame the problems (Hey, Joyce & Beckman, 2007), to where to search for ideas (March, 1988), to how to select ideas (Campbell, 1960; Cropley, 2006; Runco, 2003). It is likely that these choices determine in large part the degree to which novel ideas are even considered.

Creativity researchers usually focus more on idea generation ~~to~~ than the exclusion of other processes that contribute to creative end products (Dailey & Mumford, 2006). However, research has recently begun to examine subsequent stages in the creative process such as idea refinement (Lonergan, Scott, & Mumford, 2004), idea evaluation (Lonergan et al., 2004; Lubart, 1994, 2001), and idea selection (Rietzschel, Nijstad, & Stroebe, 2006).

The Paradox of Choice

Given that creativity is about choices, the decision-making literature can provide insights into the creative process and resolve findings that have so far been difficult to explain with existing theory. While Amabile's studies emphasize the importance of choice (e.g., Amabile, 1979; Amabile & Gitomer, 1984), recent work in the decision-making literature suggests another way to look at choice. Research has revealed a "Paradox of Choice" (Schwartz, 2004): too much choice can be paralyzing, undermining good judgment (Iyengar & Lepper, 2000), intrinsic motivation (Chua & Iyengar, 2006; Higgins, Trope, & Kwon, 1999; Mischel & Ebbesen, 1970; Shafir, Simonson, & Tversky,

1993), and originality (Chua & Iyengar, forthcoming). Furthermore, when given extensive choice, the likelihood of making a decision is decreased, and if a decision is made then satisfaction with ones' choice is lower than it would be if fewer options were considered or available (Iyengar & Lepper, 2000).

The same logic should apply to creative decisions. In a series of studies on creative tasks, Chua & Iyengar found that when given more choices in terms of the materials they could use to wrap a gift they exhibited more flexibility and novelty than those given less choices of materials, but experienced more stress and dissatisfaction and less intrinsic motivation. Rather than decreasing creativity as Amabile's theory would predict, having more options in terms of resources resulted in *less creative* combinations of available resources and lower use of the unusual resources that were available (Chua & Iyengar, forthcoming). Chua and Iyengar stipulate that people made the mistake of relying upon the large number of available choices to arrive at a creative solution, instead of searching for novel alternatives that are not readily available (Chua & Iyengar, forthcoming).

How Constraint Improves Creativity

Constraint can be used to counteract the negative effect of extensive choice, by both limiting and directing the creative process (Stokes, 1999). Edward Tufte, the cognitive scientist well known for his work in the presentation of visual information, talks about "the power of the initial element in solving or limiting certain issues and thus making the work manageable." He recommends selecting an initial element to populate the blank page, and then using that as a starting place:

> *"That initial element contains an enormous number of built-in decisions that limit the scope of the intellectual or visual problem at hand, thankfully preventing the*

> *paralysis that results from the overwhelming unlimited scope of decision contained in a blank page or empty space. The initial element provides a leverage point for expression. Also that starting element helps to find a problem that one can actually make progress on." (Tufte, 2006)*.

To the extent that constraints ease the elimination of choices (about where to search, what to search for, and how to evaluate and select ideas that are found), such constraint should prevent this kind of aversive reaction, or "blank page effect" in creative work.

Constraints can provide criteria for evaluating an idea's value, usefulness, and creativity (Boden, 1994; Cropley, 2006; Csiksentmihalyi, 1996; Sternberg & Lubart, 1999). Lubart argues that constraints are most important for driving the appropriateness component of creativity judgments: "without constraints, creative work would degenerate into productions that were simply novel" (Lubart, 1994). Indeed, constraint is most often associated with appropriateness or usefulness judgments.

However, I argue that constraint can also be used to drive the originality or novelty component of creativity. According to Campbell's evolutionary theory, creativity consists of two main processes: idea generation and idea selection (Campbell, 1960). Constraint can increase creativity in both.

Constraint and Original Idea Generation

One of the ways that constraint affects creativity is through idea generation. The process of looking for and generating new ideas is often referred to as "search" (e.g., March & Simon, 1958; Cyert & March, 1963; March & Olsen, 1976; March, 1981, 1988). Because time and attention are scarce resources (March & Simon, 1958), decisions about search behavior can have more influence on final outcomes than the set of ideas available in the first place (March, 1988). For instance, unless otherwise

compelled, actors tend to prefer searching for new ideas *locally,* or in conceptual spaces that are familiar and closely-related to the problem at hand, such as prior solutions (March & Simon, 1958). By definition, ideas encountered in this type of search are less original than those found in *distal* searches.

I argue that one can be compelled to search for more distal, novel ideas *if their search is constrained*. After all, necessity is the mother of invention. "Constraints force the individual to move beyond the early, mundane ideas that readily come to mind" (Lubart, 1994, p. 313). Others have suggested that establishing constraints to structure ideation can produce more innovative breakthroughs than brainstorming alone. For example, Coyne and colleagues recommend a semi-structured approach to generating ideas, wherein the range of acceptable ideas is bounded from the onset using constraints like customer user needs, strategic imperatives, and data. The ideas are continually narrowed by tailoring specific questions that enable only a few of the most fruitful ideas to be selected for building upon {Coyne, 2007, p02541}. The more constrained the search or idea generation process is, the more quickly novel ideas should emerge.

However, novelty is not everything - creativity also demands usefulness (Amabile, 1983). If search is too constrained, the search can become intractable and many of the most useful ideas may be eliminated. Furthermore, high levels of constraint are likely to have a detrimental effect on intrinsic motivation, which in turn hampers creativity (Amabile, 1983).

The combination of these two forces leads to this paper's main proposition:

> **There will be a curvilinear (inverted-U shaped) effect of constraint on creativity, such that moderate constraint results in the generation of more creative and original ideas than either high or low constraint.**

Constraint and Original Idea Selection

Constraint is also expected to affect creativity via idea selection. While idea generation has received more research attention, idea selection can have important effects on the creativity of final products (Rietzschel et al., 2006). For example, Reizschel and colleagues found that even if people are capable of generating and recognizing novel ideas, they are unlikely to select them even if asked to explicitly - a pattern referred to as the "anti-originality bias" (Rietzschel et al., 2006).

Constraint could affect idea selection in two ways. First, the evaluation and selection of ideas is costly and itself can result in too many choices (resulting again in the "paradox of choice"). If constraint produces fewer ideas, selection decisions may be more effective. "For all its supposed openness, brainstorming can end up being surprisingly narrow-minded. The first step is to consider all ideas no matter how crazy, but then you have to trim what is sure to be a substantial list of ideas to a manageable number. So what do you do? Apply quick, common-sense judgment, which usually eliminates the ideas with the greatest potential novelty (Goldenberg, Horowitz, Levav, & Mazursky, 2003). Second, constraints serve as selection criteria which can be used to ease the idea filtering process. Without some criteria, the best way to evaluate ideas is ambiguous. Just as rapidly changing environments prompt organizations to mimic those perceived to be successful (Dimaggio & Powell, 1983), ambiguous situations prompt individuals to infer appropriate courses of action from norms and the behaviors of others (Cialdini, Reno, & Kallgren, 1990; Darley & Latane, 1968; Sherif, 1936).

Similarly, accountability to constituents with unknown views leads decision-makers to decide upon the most acceptable course of action (Tetlock, 1985). This type of

ambiguity increases reliance on norms and averages (Simonson, 1989; Simonson & Nowlis, 1998), and prevents risky (Tetlock & Boetteger, 1994), extreme (Simonson, 1989; Simonson & Nowlis, 1998), and ambiguous choices (Curley, 1986). This pattern is especially strong when there is a risk of challenging the status quo (Simonson & Nowlis, 1998).

When applied to idea selection, these decision-making heuristics can result in the systematic rejection of original ideas. Relying upon norms and averages to estimate the appropriateness of behavioral options (Simonson, 1989; Simonson & Nowlis, 1998), results in mimicry, homogenization, and conformity, which by definition precludes novelty (a form of deviance). Avoiding ambiguity (Curley, 1986) and risk (Tetlock & Boetteger, 1994) precludes searching for and selecting novel ideas, because they are new by definition and their likely outcomes are unknown. Avoiding risks that challenge the status quo (Simonson & Nowlis, 1998), as creative ideas often do (Pfeffer & Sutton, 2000), is a further strike that ambiguity, or a lack of constraint, makes against creativity.

On the other hand, constraints that are too strictly defined can decrease the quality of the idea selection process. Rules can backfire when they imply a minimum acceptable standard, or discourage the use of individual judgment (Gouldner, 1950). Similarly, accountability to constituents with known views is likely to result in another low-effort tactic - conformity (Cialdini, Levy, Herman & Kozlowski, 1976; Tetlock et al., 1989) - suggesting that high constraint also discourages the selection of original (non-conformist) ideas.

The findings reviewed above suggest that moderate constraint is optimal for encouraging original idea selection, because it discourages reliance on either conformity

or on rules alone. The more risky breaking from the status quo appears to be, the more important it is to provide constraints because we are unlikely to select original ideas on our own.

Summary of Hypotheses

By viewing creativity through the lens of decision-making, it is clear that constraint can have both positive and negative effects. Therefore, I predict a curvilinear effect of constraint, such that a moderate degree is optimal for creativity (Hypothesis 1) and originality (Hypothesis 2). As predicted by extant research, I expect a linear negative effect of constraint on intrinsic motivation (Hypothesis 3).

METHODS

Overview of the Research

The goal of this study is to measure the effect of constraint on creativity. Specifically, I tested whether people solving more constrained tasks would be more or less creative than those solving less constrained tasks.

Participants were randomly assigned one of four prompts introducing a two-phase product design task. Prompts included a general topic and zero to five subtopics depending on condition as explained below. Before writing proposals, all participants did research in a controlled internet database of articles spanning these five subtopics. Participants had 40 minutes to complete both phases of this task. Judges rated proposals on the dependent variables of creativity and originality. Computerized questionnaires were completed before and after the task, making total time per experiment one hour.

Participants & Experimental Setting

Participants were 246 undergraduates at the University of California, Berkeley. Of these, seven did not write proposals and were not included in the analysis, leaving 239 total participants (38% men, 61% women). 54% received course credit and 46% were recruited from a campus-wide experimental subject pool paying $15 each. Recruiting notices called the experiment "Creative Product Design Study." The average age was 20.87 years (SD 3.25). Participants had majors spanning 62 departments, with 74 (31%) from Business, 47 (20%) from Economics and related fields, 28 (12%) from Psychology and the Social Sciences, 70 (29%) the Sciences and Engineering, 52 (22%) from the Humanities, and four (2%) undeclared. Percentages total over 100 because 38 participants had double majors and three had triple majors.

Signs hung on the doors outside and whiteboard inside the lab which read "Assessing Creativity Using a Product Design Task." The lab had 30 laptop computers separated by partitions in five rows of desks. Two pencils, a pen, blank paper labeled "Research Notes and Brainstorming," and an instruction packet were placed on each work station with the cover page that only contained a random four-digit ID number and instructions for participants not to open the packet until asked by the experimenter.

Stimuli

Selection of Topics. Before the study, the subject areas for the product design task were considered carefully. Health was chosen as the general topic for this task because it was a subject that most participants (all undergraduates) are familiar with and are somewhat interested in. The next step was to select five subtopics. Two research assistants scoured *PC Magazine's* list of the top five health websites of the year (*PC Magazine*, 2006) and identified 95 available subtopics (e.g., mammograms, managing

stress, running, gardisil, and food allergy warning labels). Next, four undergraduate research assistants flagged subtopics that were potentially upsetting, emotionally provocative, or controversial (e.g., teenage pregnancy, suicide); all flagged subtopics were eliminated. They rated the remaining subtopics on familiarity, interestingness, relevance to undergraduate students, and likelihood of resulting in a creative idea on scales of 1-5 where 5 was "high". Subtopics that averaged above a 3 on every dimension were retained. Finally, five subtopics with the most equal ratings were selected: Drug Abuse, Fitness, Nutrition, Preventing Illness and Stress.

Construction of Article Database for Research Phase. To construct the article database, I downloaded articles from two of the five websites used above - WebMD and the Mayo Clinic - because they were most comparable in length and style, and offered a broad variety of subject areas under each subtopic. 50 articles were chosen for each subtopic for a total of 250 articles. The text of each article was extracted and stripped of all images and formatting. Six hyperlinks to other articles in the database were added to the bottom of each article: two from its main topic area and one from each additional topic area. The database was made searchable using a simple keyword search engine by Google, and was accessible using a web browser. If an article's title did not clearly reflect its content, the article was given an additional title to facilitate search.

Web Browser Setup & Timer. Participants were guided through all parts of the study in a custom-built web application which enabled me to collect responses and track the time participants spent in each part of the task. All instructions, questionnaires, and both parts of the task were accessed using a standard web browser (Firefox) and a third-party "kiosk" add-on which disabled user navigation and removed toolbars, the web page

window bled to fill the whole screen.

During the product design task two elements remained on the screen. At the top of the window was a small countdown timer showing time remaining out of 40 minutes in MM:SS format; the timer was visible for both research and proposal phases. During the research phase a search bar remained at the bottom of the browser window for entering new search terms while viewing an article, as well as a button labeled "finished researching, click to write proposal." If time ran out while the participant was working on either the research or proposal writing phase, a pop-up window appeared asking them to write "time ran out" where they left off and continue on to the post-task questionnaire.

Experiment Design

The experiment used a four-level between-subjects design. To enable the detection of non-monotonic effects, constraint was manipulated a four levels: low, moderately low, moderately high, and high. Participants were randomly assigned to receive one of four task prompts which varied on constraint, or the degree to which the prompt restricted participants' freedom and choice in determining how to creatively address the issue presented. The low constraint prompt asked the participant to address any issue related to the general topic of health and the moderately-low constraint prompt asked them to solve any one of five subtopics related to health. The number of subtopics listed was reduced to three in moderately-high constraint prompt, and one in the high constraint prompt.

Procedures

Instructions. Once all participants were seated the experimenter explained that in this study they would do a product design task where they will be asked to do research

and then write a proposal for a new product that addressed a health-related issue. Participants were encouraged to be creative. Because constraints may help ensure that time and other resources are used in a more focused manner, participants were told to budget their time (40 minutes maximum) as they saw best: researching, brainstorming, and creating their final proposal from their favorite idea. (These instructions also appeared in the written task instructions both on the computer and in the prompt.)

Pre-Task Questionnaire. Next participants completed the pre-task questionnaire containing demographic questions and scales measuring control variables. Because I wanted to control for participants' level of expertise in the subject, participants were asked how much knowledge and experience they had in 20 topics relating to health, research, creativity, and product design.

Task Prompts & Manipulation of Constraint. When they finished the questionnaire, the computer program told participants to read their task prompt, which contained the same basic instructions for all conditions:

> A new product designer's job is to create new products that address specific customer issues. For example, McDonald's addressed its customers' issue of needing to eat in their fast-paced lifestyle, by introducing special packaging for meals-on-the-go. In this study, your job is also to propose a new product that addresses a specific customer issue of your choosing. Before you choose your issue and write your proposal, you will do some research using an online database. Use your paper to take detailed notes in order to substantiate your proposal later on. You will have access to these paper notes but not to the articles in the database, once you begin writing your proposal. When you are ready to finish your research and move on, click the button on the bottom of your screen. You will then be asked to indicate which issue you chose, and write a product proposal to address that issue.

To ensure that proposals would be comparable, all prompts contained the following four rules (1) Product should cost no more than $10 per unit to produce; (2)

Proposal should be creative, convincing, well-researched, and must accurately address the issue at hand; and (3) …include a mission statement, product description, and reasons why the product idea is original and useful; and (4) …include specific facts from their research to defend their idea and demonstrate that their product will be a good solution to the issue they are trying to solve. The next part of the prompt differed by condition:

1. Low Constraint. This level was told to propose a new product that addressed any health-related issue.

2. Moderate-Low Constraint. This level was told to propose a new product that addressed any one of five health-related issues. They were presented with a list of the five issues contained in the health database: drug abuse, fitness, nutrition, preventing illness, and stress.

3. Moderate-High Constraint. Similar to the Moderate-Low condition, this level was also given a choice of health-related issues, but instead of five they were asked to address any of three health-related issues. To ensure that each topic had an equal chance of being chosen across all conditions, there were ten versions of this condition's prompt, distributed equally and randomly, each with a different combination of three of the five possible issues from the database.

4. High Constraint: This level continues the same pattern of reducing the number of health-related issues available seen above, this time asking participants to address one specific health-related issue. All five possible variants of this prompt were created to ensure equal spread across the conditions, one for each topic.

Research Phase. After reading their prompts, participants clicked a button which started their 40 minute countdown timer and opened the article database for them to begin research. They could search for articles using keywords, or click on links found at the end of articles. Participants were given paper and pencils and took notes on their research. When they were ready to continue on to the proposal-writing stage, participants clicked a button at the bottom of the screen and the article database closed.

Proposal Writing Phase. The web-based survey provided a proposal template which was designed to elicit clear, detailed, and thoughtful product idea descriptions from all participants, thereby minimizing time and effort confounds and increasing the reliability of judge ratings. The template contained five questions:

> *1. Problem:* Refer to your paper instructions, and type the exact problem you are trying to solve.
>
> *2. Mission:* You will describe your product in more detail later, but for now, imagine that you need to sell your product idea to an executive in 30 seconds or less. In one or two sentences, what is the vision or "mission" for the new product you are proposing? What does it aim to do or achieve? Be compelling.
>
> *3. Description:* In 2-3 paragraphs, please describe your product, including its functions, features, benefits, and appearance. Be concrete and detailed, so that your reader can visualize the product you propose creating. What does it do? How does it work? How is it used? What does it look like? Use references to your research notes to substantiate your and defend proposal as a good solution to the prompt you were given.
>
> *4. How is this idea original?* In 1-2 paragraphs, make a persuasive argument about how your product idea would be novel and unique in terms of addressing the issue you set out to address in this task. Remember, use references to your research notes to substantiate your claims.
>
> *5. How is this idea useful?* In 1-2 paragraphs, make a persuasive argument about how your product idea would be effective and valuable in terms of addressing the issue you set out to address in this task. Again, please use references to your research notes to substantiate your claims.

If the forty-minute time limit ran out while a participant was still working on either the research or proposal writing phase, a pop-up window appeared asking them to write "time ran out" where they left off and continue on to the post-task questionnaire.

Post-Task Questionnaire. At the conclusion of the experiment, all participants responded to a manipulation check ("While doing this project I had a lot of freedom in deciding exactly what problem I was going to solve"); several scales which inquired about their intrinsic motivation after the task, satisfaction with their own performance, emotions, and other subjective reactions to the task; and gathered demographic information. Participants were excused at the end of the hour.

Measures

Expertise. Expertise was calculated as the average of twenty items (*Chronbach's alpha* = 0.88) from the pre-task questionnaire which asked about participants' pre-existing knowledge and experience with various subjects and hobbies relevant to the task. Items were diverse, relating to health (e.g., "physical fitness"), doing research (e.g., "web surfing"), creativity (e.g., "creative problem solving"), and business / product innovation (e.g., "the newest products and gadgets"). The survey introduced the scale as "a list of possible interests that you might spend your time thinking and learning about or doing." Participants rated each item in terms of how interested they were in each on 5-point Likert scales, ranging from 1 (*very slightly or not at all*) to 5 (*extremely*).

Time Allocation. Based on tracking data collected by the web-based experimental program, three variables reflect participants' allocation of time during the two phases of the product design task: *time spent on research, time spent on proposal,* and a proportional measure, *time spent on research / total time.* Measures reflect the

number of minutes spent in that phase.

Intrinsic Motivation. Intrinsic motivation was calculated as the average of seven items (Chronbach's alpha = 0.89) from the post-task questionnaire, all rated on five-point scales. The following adjectives were rated in terms of how accurately they described the task from 1 (*not at all accurate*) to 5 (*very accurate*): *interesting*, *boring* (reverse-coded), *fun*, *motivating*, and *important*. For the question, *How much did you enjoy this task?,* 1 meant *not at all* and 5 meant *very much*; and for the question *If you were to participate in another experiment, would you be interested in participating in a similar task in the future?*, 1 meant *not at all* and 5 meant *certainly.*

Creativity & Originality. The main dependent variables were measured using a method based on Amabile's Consensual Assessment Technique (*CAT*, 1983). Five trained judges, blind to condition and hypotheses, independently rated each proposal on *creativity* (using your own subjective definition), *originality*, *appropriateness*, and *effectiveness*. (This study tests predictions only about originality and creativity; appropriateness and effectiveness were included to encourage ratings high in internal and discriminant validity.)

Inter-rater reliability was estimated with a two-way mixed model intra-class correlation (ICC) appropriate for when judge effects are fixed. Initial reliabilities for the five judges were lower than desirable for both originality (ICC = 0.73) and creativity (ICC = 0.70). This was likely the large number of ideas rated by each judge (n = 274) and the length of the proposals (roughly 2 pages each), which can produce inconsistent interpretations across judges and make achieving reliable ratings more difficult.

Discrepancies in judge ratings are often resolved through discussion, a method

used in creativity research and Assessment Center contexts (Thornton, Thornton & Rupp, 2006). Face-to-face discussion is the most common method, but it has been criticized because of the propensity for social pressure to result in judges changing their ratings to achieve consensus even if the revised rating does not reflect their personal view, thus limiting the validity of the multi-judge system.

A more unbiased approach is to apply a mathematical adjustment to ratings to improve their consistency while maintaining their independence. For each proposal, the rating with the highest absolute difference from the mean of all five ratings was removed. In cases where there was a tie in absolute differences, one of the tied ratings was randomly selected for removal, alternating between positive and negative differences where ties differed in sign. This process eliminated outliers to increase reliability without substantially changing mean values, resulting in four ratings per proposal. Creativity and originality achieved good inter-rater reliability estimates (ICC = 0.85 and 0.87, respectively) as calculated with the one-way random model appropriate when judge effects are random.

RESULTS

The primary goal of this study was to establish whether or not the degree to which a product design task was constrained had an effect on the creativity and originality of the final product. I wanted to test for both linear and curvilinear effects, so there were four conditions, ranging from low to high constraint.

The main finding was that, as predicted, constraint had a curvilinear effect on creativity and originality, meaning that moderate levels of constraint were associated with higher ratings on these variables than either low or high levels of constraint. Participants

given low-constraint ("address any health-releated issue") and high-constraint (e.g., "address the health-related issue of stress") prompts wrote proposals rated as more creative and more original than did participants in the two moderate conditions (those who picked either one of five, or one of three health-related issues). All statistical tests are two-tailed.

Product Proposals

The main data used to test the hypotheses were the product proposals participants wrote, as rated by four independent judges. Examples of products included vitamin-enhanced flour, drug awareness slogans on coffee cups, stress reduction programs on mp3 players, and airborne pollutant detectors in cars.

Descriptive Statistics and Correlations

Table 1 shows means, standard deviations, and correlations among the key variables. Scale reliabilities and intra-class correlations are given on the diagonal. As can be seen, judges' ratings of proposals' creativity and originality had good reliabilities (ICC=0.81 and 0.85, respectively). The intrinsic motivation (alpha=0.89) and expertise (alpha=.088) were also reliable, with good internal consistency.

Most correlations were low and nonsignificant, with some exceptions. Creativity and originality were significantly correlated ($r=0.84$, $p<.01$). Expertise was correlated with creativity ($r=0.15$, $p<.05$) and post-task intrinsic motivation ($r=0.26$, $p<.01$). There was a marginally significant negative correlation between intrinsic motivation and constraint ($r=-0.11$, $p<.10$).

How much time participants spent in the research and proposal-writing stages of the task was related to many variables. Time spent on reserach was negatively related to

creativity (r=-0.20, p<.01), originality (r=-0.16, p<.05), and marginally to post-task intrinsic motivation (r=-0.12, p<.10). When time was analyzed as a proportional measure (time spent on research / total time), the pattern is the same (r=-0.16, p<.05; r=-0.12, p<.10; and r=-0.16, p<.05, respectively). Time spent on proposal-writing displayed an inverse pattern of relationships to these variables, correlating positively with creativity (r=0.16, p<.05), originality (r=0.21, p<.01) and post-task intrinsic motivation (r=0.19, p<.01).

Across all conditions, creativity scores averaged 3.59 (SD = 1.08) and originality averaged 3.35 (SD = 1.20) on a scale of 1 to 7 where 7= "very" creative / original. Intrinsic motivation averaged 1.90 (SD = 0.86) on a five point scale.

Table 2 presents the means and standard deviations of each variable for all four experimental conditions. The data were analyzed using one-way ANOVAs with polynomial constrasts to test for both linear and quadratic effects.

Manipulation Check

The item "I felt free regarding the problem I was trying to solve" was used as a manipulation check, and confirmed that the manipulation of constraint was effective; the results were negative and linear ($F(1, 236) = 3.41$, $p<.05$).

Creativity

Hypothesis 1 predicted a curvilinear effect of constraint on creativity. A one-way ANOVA revealed an overall effect of constraint on creativity, $F(3,234) = 3.67$, $p < .05$. In a polynomial contrast, only the quadratic term was significant, $F(1,234) = 10.04$, $p < .01$, indicating a curvilinear (inverted-U shaped) effect of constraint on creativity, as predicted. Figure 1 illustrates this effect.

To further investigate the nature of the observed curvilinear effect, planned contrasts were conducted. First I compared the two moderate constraint groups combined to the two extreme groups (high and low constraint) combined. As predicted, the mid-low (M = 3.73, SD = 1.16) and mid-high (M = 3.92, SD = 1.06) constraint groups wrote proposals rated as significantly more creative than did the low (M = 3.39, SD = 0.96) and high (M = 3.39, SD = 1.03) constraint groups, $F(1, 237) = 10.681$, $p = .001$. There were no significant differences between the two moderate constraint groups and the two extreme groups, supporting the hypothesis that constraint would have a curvilinear effect on creativity.

Originality

Hypothesis 2 predicted a curvilinear effect of constraint on originality. As predicted, there was an overall effect of constraint on originality, although the effect was only marginally significant $F(3,234) = 2.26$, $p < .10$. Again, the quadratic term was significant, $F(1,234) = 6.69$, $p < .05$, while the linear term was not, $F = 0.078$, $p = 0.708$), again suggesting a curvilinear relationship between constraint and originality. Figure 2 illustrates this effect.

Again planned contrasts supported the hypothesized curvilinear effect of constraint, this time on originality. The mid-low (M = 3.55, SD = 1.24) and mid-high (M = 3.54, SD = 1.06) constraint groups combined wrote proposals rated as significantly more original than the low (M = 3.18, SD = 1.14) and high (M = 3.13, SD = 1.27) constraint groups combined, $F(1, 237) = 7.13$, $p < .01$. As with creativity, there were no differences between the two constraint groups in the middle nor the two constraint groups at the extremes.

Intrinsic Motivation

Hypothesis 3 predicted a negative linear effect of constraint on intrinsic motivation after the task was complete. A one-way ANOVA showed that the overall effect of constraint on post-task intrinsic motivation was not significant $F(3,234) = 2.09$, $p = .10$. Figure 3 illustrates a generally negative trend, with a sharp decline between the mid-low and mid-high constraint groups. The low ($M = 2.03$, $SD = 0.85$) and mid-low ($M = 2.04$, $SD = 0.81$) constraint groups appear almost equally high on intrinsic motivation, while the ($M = 1.74$, $SD = 0.93$) and high ($M = 1.77$, $SD = 0.90$) constraint groups appear almost equally low. An independent samples t-test supports this account, $t(236) = -2.51$, $p < .05$.

DISCUSSION

Creativity is largely about making decisions, but without any constraints to limit one's choices, could freedom actually be stifling? The results support the hypothesis that constraint has a curvilinear effect on creativity and originality, such that a moderate degree of constraint is optimal when creativity is desired. Like other decisions, creative problem-solving may be subject to a "blank page effect" similar to the "paradox of choice." The findings suggest that there are limits to the benefits of freedom and choice, which challenges an assumption underlying psychological theories of creativity - that freedom is the ideal for creativity and intrinsic motivation. Although participants who created under very unconstrained conditions enjoyed high levels of intrinsic motivation, their performance was just as poor as those who created under the most constrained conditions. The largest drop in intrinsic motivation happened between the two moderate conditions, implying that while some degree of choice was essential, three choices were

dramatically better than five. As designers, artists, and other creators have long espoused, constraint is not deleterious to creativity; rather, it is essential.

Limitations & Future Research

There are however several limitations to this study that must be addressed in future research. Although effort was made to use a creativity task similar to one found in the real-world, the laboratory is never a replacement for the field. Field research on the long-term effects of early constraints on later creativity is currently underway (Study 4). Also, constraints are seldom experienced in as "neutral" a manner as they were here—they usually result from a person or process that gives the restriction additional meaning that could alter the effect of the constraint, a notion supported by cognitive evaluation theory (Deci, 1975; Deci & Ryan, 1980; Ryan, 1982) on the differential effects of informational versus controlling rewards on intrinsic motivation. Future research will examine how power differences moderate the effects of constraint on creative performance (Studies 2 and 3).

Finally, it is possible that judges ratings captured more than just creativity. I attempted to prevent this through the design. First, I wanted to be sure that proposals generated under more constrained conditions were not rated more highly simply because they were more specific. Requiring all participants to back up their proposal with research that they conducted before writing it helped ensure a minimum level of specificity, regardless of condition. Second, it ensured that all participants had access relevant information on the topic. Another reason the task involved research in this controlled database was to minimize the potential creativity benefits of knowledge activation (Rietzschel, 2007) which could result from addressing a specific constrained

topic. Because prior exposure to subcategories of brainstorming topics is thought to increase creativity and originality within that subcategory by making related knowledge more accessible (Rietzschel, 2007), I wanted to expose all participants to specific knowledge from each possible, regardless of condition. The novel experimental paradigm developed for this study overcame this challenge, manipulating constraint without confounding it with knowledge activation or informational value.

Contribution

This study makes a theoretical contribution by bridging the decision-making and creativity literatures to reconcile the inconsistent findings on cognitive and motivational responses to a wide range of constraints. By showing that the cognitive judgments used in the creative process are influenced by the same contextual constraints as other types of decisions, it helps to unite the creativity and decision-making literatures, both of which gain from such an integration. The findings shed light on the adaptive nature of creativity in everyday life.

This research also contributes important empirical detail to the literature on creativity by attending to non-monotonic effects of constraint on creativity. Functional form was not taken for granted; the research design went beyond the choice/no-choice dichotemous variables of previous research and enabled the detection of both linear and curvilinear effects. As such, this paper does not compete with research done by Amabile and colleagues on intrinsic motivation, but rather extends it to resolve a paradox observed in the real world which was not previously explained by academic theory or popular notions about the benefits of freedom.

These findings provide encouragement to organizations that are institutionally

embedded, resource-scarce, or otherwise restricted. From a managerial perspective, these findings suggest that while some amount of choice is important for encouraging creativity, it is important for creators to have some boundaries to structure problems and limit the endless options available to them. Paradoxically, by making boundaries and limits explicit, managers can enable their employees to fully exploit a search space, exploring it in more original and creative ways. Necessity, it would seem, is truly the mother of invention.

By focusing on the decision-making aspects of creativity and search, the frustration and overwhelm so often experienced when approaching a blank page is made comprehensible, and thus, solvable. Creativity is resilient, and in fact performs best when given some challenge to overcome. As author Bob Garfield put it, "The lack of boundaries does not liberate, it enslaves."

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TABLES & FIGURES

Table 1

Means, Standard Deviations, and Correlations Among Variables

	Mean	SD	1	2	3	4	5	6	7
1 Constraint (condition)									
2 Creativity	3.59	1.08	0.02	(0.81)					
3 Originality	3.35	1.20	-0.01	.84**	(0.85)				
4 Intrinsic Motivation	1.90	0.86	-0.11°	0.07	0.00	(0.89)			
5 Expertise	3.17	0.63	0.01	.15*	0.10	.26**	(0.88)		
6 Time spent on research	23.41	7.05	0.04	-.20**	-.16*	-0.12°	0.00	-	
7 Time spent on proposal	24.93	8.46	0.00	.16*	.21**	.19**	-0.07	-.62**	-
8 Time spent on research / total time	0.49	0.13	0.06	-.16*	-0.12°	-.16*	0.02	.93**	-.85**

Note. N ranges from 223 to 274 due to missing data. Values in parentheses along the diagonal are reliability estimates (ICC for Creativity and Originality ratings, Chronbach's alpha for other scales).

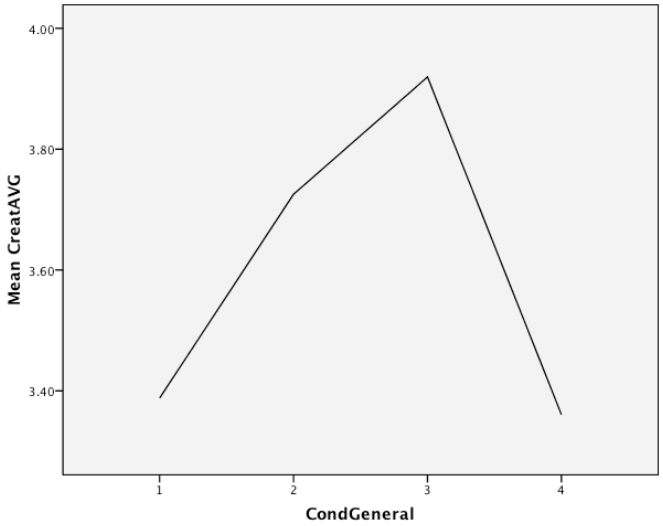
** p < .01, * p < .05, ° p < .10 (two-tailed).

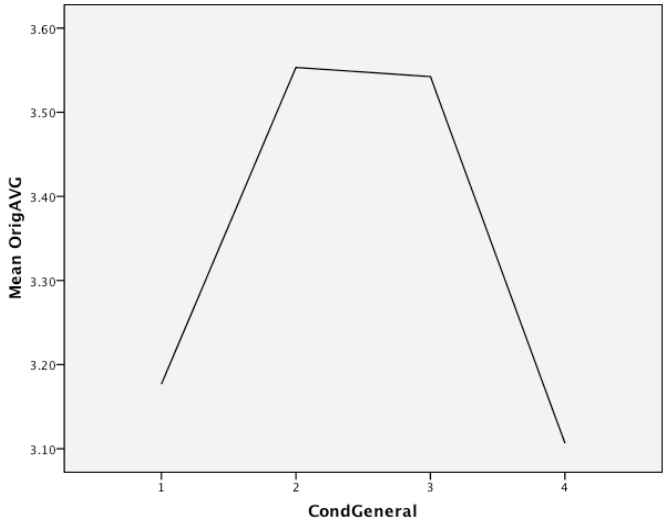
Table 2

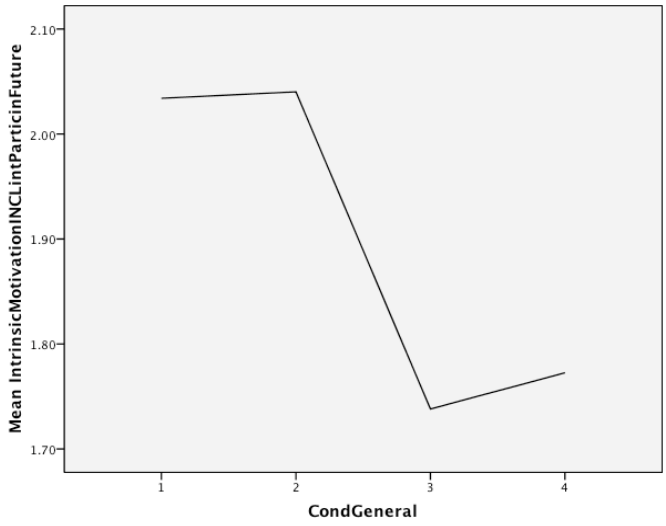
Means and Standard Deviations of Dependent Variables by Condition

	Creativity		Originality		Intrinsic Motivation	
Constraint	*M*	*SD*	*M*	*SD*	*M*	*SD*
Low	3.39	0.96	3.18	1.14	2.03	0.85
Mid-Low	3.73	1.16	3.55	1.24	2.04	0.81
Mid-High	3.92	1.06	3.54	1.06	1.74	0.93
High	3.39	1.05	3.13	1.27	1.77	0.90

FIGURES


Mean CreatAVG
4.00
3.80
3.60
3.40
1
2
3
4
CondGeneral


Mean OrigAVG
3.60
3.50
3.40
3.30
3.20
3.10
1
2
3
4
CondGeneral


Mean IntrinsicMotivationINCLintParticinFuture
2.10
2.00
1.90
1.80
1.70
1
2
3
4
CondGeneral

APPENDIX: Overview of the Dissertation

The preceeding represent Chapters 1-3 of my doctoral dissertation (introduction, literature review and theory, and Study 1). While Study 1 established main effects, Studies 2 and 3 will identify boundary conditions to these effects. Specifically, these two experiements examine the role of power as a moderator of the effect constraint on creativity. Those in positions of high power have been shown to be more optimistic with regard to risk-taking, and as such they engage in more risky behaviors than those in low power positions (Anderson & Galinsky, 2006). Because creativity and novelty are strongly associated with risk (Dewett, 2006; Glover & Sautter, 1977), power should also increase one's tolerance for novel ideas and thus increase creativity. Power activates the behavioral approach system (BAS) (Keltner, Gruenfeld, & Anderson, 2003). The BAS is associated with increased associative thought and attentional flexibility (Friedman & Forster et al., 2000, 2001, 2005) both of which are associated with creativity, and increased perception of rewards in the environment (Keltner et al., 2003), which could increase ones' ability to recognize useful solutions in search and contribute to creativity. Thus, power is expected to have a positive main effect on creativity, such that those in higher power positions should be more creative than those in lower powered positions.

There are also reasons to believe that power and constraint would have an interactive effect on creativity. Like accountability to unknown audiences (Curley, 1986; Simonson, 1989; Simonson & Nowlis, 2000; Taylor, 1995; Tetlock & Boetteger, 1994) unconstrained tasks are characterized by ambiguity, which can result in conservatism, conformity, and compromise, thus decreasing decision-makers likelihood of generating or sharing novel ideas that may challenge the status quo. However, because power makes people less likely to perceive risk (Anderson & Galinsky, 2006), we'd expect high-powered people to experience this effect to a much smaller

degree. In this way, power serves to protect those who have it when they are in ambiguously defined situations such as unconstrained creative search. High powered people are therefore expected to benefit less from constraints than low powered people, for whom constraints have a protective effect against conservatism. Power should moderate the effect of constraint on creativity, such that those in higher power positions should be more creative in unconstrained creative tasks than those in lower powered positions.

Thus, Chapter 4 presents an analysis of the literature on power and risk-taking, and describes the methods used in Study 2; This study builds upon this basic experimental paradigm used in the first study and introduces power as a moderator by assigning participants a role as either a Vice President or an Assistant. Chapter 5 describes the design of a laboratory study (Study 3) that tests the same hypotheses as Study 2 but using a more "pure" manipulation of power - a word search prime. While Study 2 is strong in terms of face validity and external validity, Study 3 emphasizes internal validity.

While the first few chapters emphasize the role of constraint in the creative process of individuals, there are reasons to believe that constraint may serve a similar function for groups and teams, which face many challenges to getting on the same page. Given the importance of problem definition and cooperation in creative teams, constraints can play a critical role in establishing shared frames of the problem a team is attempting to solve, and in guiding the team towards the invention of an effective solution. Chapter 6 extends the individual-level theory that was proposed and tested in Chapters 2-5 to the team level of analysis. First it reviews the theory and research on creativity and innovation in teams from the organizational behavior and psychology literatures, asking the question "How do creative teams establish a shared understanding of the problem they are trying to solve?" The analysis focuses on issues of group

diversity, intra-group conflict and negotiation, and team problem framing. Then it draws from a multi-discliplinary body of work on framing processes in design and new product development teams. Finally introduces a team-level theory of constraints and creativity.

Ch. 7 empirically tests this theory in a longitudinal multi-method study of 62 New Product Development (NPD) teams as they went through the NPD process, from problem identification to prototype (Study 4). It begins by explaining the empirical setting and the NPD process as it was conducted by the teams included in this study. The teams were from five semesters of new product development courses at U.C. Berkeley's Haas School of Business and MIT's Sloan School of Management. All classes were were composed of a multi-disciplinary mix of MBAs, graduate students from Engineering and the School of Information, and industrial design students from two of the most prestigiuos design schools in the country, the California College of the Arts (CCA) and the Rhode Island School of Design (RISD).

Chapter 7 examines how constraints that were self-imposed by teams in the form of a mission statement effected both team processes (using survey data) and the creativity of the final outcome (in the form of the final product proposal and prototype).

The dataset used in Chapter 7 is uniquely valuable. First, it is rare to be able to compare so many teams (n=62) with such in-depth data. Especially when subjected to multi-level regression analysis, the dataset offers generous statistical power. Second, in many ways it emulates teams functioning in organizations - teams are functionally diverse, work together intensely on a project for an extended time (15 weeks), and their product proposals and final prototypes are evaluated by industry professionals just as NPD teams are judged by their peers and superiors in the real world. Third, there is a unique amount of homogeneity across teams with respect to resource constraints, time limitations, and group composition; all teams are

required to hit milestones in accordance with the class's syllabus at roughly the same time each time in the semester the course is taught. Finally, a wealth of rich data were collected using a variety of methods - interviews and observation, multiple surveys, archival document analysis, online team collaboration, and video. By combining qualitative, quantitative, and content-analytic methods the propositions can be subjected to a variety of operationalizations.

Chapter 8 offers a general discussion and offers a multi-level integration of the constraints and creativity model based on the findings from the four studies included in this dissertation. It discusses the implications of this work and its contribution to both theory and practice, acknowledges its limitations, and discusses future studies for this research program. Chapter 9 is the conclusion.