# EXPLORING THE ROLE OF EXTERNAL REWARDS IN CREATIVE COGNITION

by

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# Abstract

Existing research examining the effects of external rewards on creativity lacks a clear consensus on the issue. While some research suggests that monetary (versus social) rewards are detrimental to creativity, other research has found that monetary rewards can enhance creative performance. These disparate findings seem to stem from extant literature's lack of focus on cognitive processes through which external rewards affect creativity. In this dissertation I model the location and movement of ideas in an individual's mental space and demonstrate that social rewards prompt a broader idea exploration leading to higher creativity. However, if a specific goal to be creative is made salient, focused idea exploration as induced by monetary rewards leads to even higher creativity.

# Preface

This research was conducted in accordance with the suggested ethics guidelines of the University of British Columbia, Vancouver, BC. Behavioural Research Ethics Board, University of British Columbia approved subject research via certificate number H09-00141 dated February 1, 2009.

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I am indebted to my parents and in me it is part of them that functions. I dedicate my dissertation to them.

To my parents

# 1. Introduction

Creativity is fundamental to innovation and invention, and thus is of vital importance across both basic and applied scientific disciplines (e.g., physics, architecture, engineering, health care). As such, a significant amount of research and resources have been dedicated to understanding how to foster creativity both in individual and in group environments. One factor that has received extensive attention concerns the use of external rewards in motivating an individual's creativity. However, nearly three decades of research has failed to reach a consensus regarding the effects of various kinds of external rewards (e.g., monetary versus social rewards such as recognition or feedback) on creative performance (Eisenberger and Shanock 2003). While some research suggests that monetary rewards are detrimental to creativity as compared to social rewards (Amabile 1982a), other research has found that monetary rewards can enhance creative performance, especially when the rewards are contingent on the creativity of the outcome (Eisenberger and Cameron 1996; Eisenberger and Selbst 1994).

I propose that these disparate findings may stem from a limited understanding of the cognitive processes through which rewards affect creativity. Despite the fact that creativity is seen as a product of both motivational and cognitive processes (Runco and Chand 1995; Ward, Smith, and Finke 1999) the extant research on external rewards and creativity has examined only the motivational implications of external rewards.

The current dissertation work intends to addresses this gap in the literature by examining the underlying cognitive mechanism through which external rewards affect the idea generation process in a creative task. Consistent with the extant research, I focus on two types of external rewards, namely monetary and social-recognition rewards, and examine their impact on creativity when the contingency of the reward to the creative outcome is varied. Using the Galileo System methodology, I model generation, location and movement of ideas in an individual's mental space under different reward and contingency conditions. Findings from this research demonstrate that monetary and social-recognition rewards prompt different mental strategies for idea search and consequently affect creativity depending on the reward's contingency.

Specifically I find that irrespective of reward contingency, a social recognition reward leads to a broader search for ideas while a monetary reward induces a more focused search for ideas. Hence, when reward contingency is absent, social recognition leads to a higher level of creativity as compared to when either a monetary or no reward is offered. However, when reward is contingent on creativity, the focused search for ideas as induced by a monetary reward occurs in an area farther away from the domain of conventional ideas. Hence, in this condition, the monetary reward leads to higher creativity than when either a social recognition or no reward is offered.

The rest of the dissertation is organized as follows. First, I review the extant literature on external rewards and creativity, and highlight the research gap in the literature. Next, I develop my theorizing and propose specific hypotheses with respect to the effects of external rewards on creativity. Then, I report an experiment and analyses conducted to test the proposed hypotheses. Finally, I conclude the dissertation with a general discussion of theoretical and managerial implications.

## 2. The Effects of External Rewards on Creativity

Understanding the effects of external rewards on creativity has been one of the challenges facing researchers over the past forty years. Although an extensive amount of research has been conducted to examine the role of external rewards in creative performance, there is still an ongoing debate on whether external rewards enhance or reduce creativity. I begin by offering a brief overview of this literature.

## 2.1 The detrimental effect of external rewards on creativity

Early research studying the effect of external rewards on creativity suggested a detrimental effect of the rewards on creativity. For example, Glucksberg (1962), using Duncker's (1945) candle problem, demonstrated that monetary rewards as compared to no rewards undermine individuals' creative performance. In Duncker's problem, individuals are presented with several objects on a table: a candle, a pack of matches, and a box of tacks, all of which are next to a cardboard wall. The task is to figure out, using only the objects on the table, how to attach the candle to the wall so that the candle burns properly and does not drip wax on the table or the floor. The correct solution involves using the box of tacks as a candleholder. That is, one should empty the box of tacks and then tack it to the wall placing the candle inside. The solution is considered as a measure of creativity because it involves an ability to see an object as performing a different function from its typical use (i.e., the box is not just a repository for tacks but can also be used as a stand) (Maddux and Galinsky 2009). Glucksberg (1962) presented the candle problem to his participants. In addition, for half of his participants, they were told that they could win \$5 if their solution time was in the top 25% and \$20 if it was the fastest solution time (monetary reward condition). The other half of the participants did not receive such

information (no reward condition). The results showed that participants in the no-reward condition solved the problem significantly faster than those in the monetary reward condition. Similar results have also been observed by other researchers. For example, in a study conducted by Kruglanski, Friedman, and Zeevi (1971), participants, who had applied to psychology department for admission, were either given an extrinsic incentive (i.e., reward condition) or no extrinsic incentive (i.e., no reward condition). Specifically, participants in the reward condition were offered a "guided tour of the Department of Psychology", while those in the no-reward condition were offered nothing for their participation in the study. All participants were then given two creativity tasks. The first one involved suggesting as many titles as possible for a given literary paragraph, while the second one involved a composition of a story, using as many words as possible from a given list of fifty words. The results revealed that respondents in the no-reward condition.

Interestingly, researchers have also demonstrated the detrimental effects of external rewards on creativity among non-human subjects. Harlow, Harlow, and Mayer (1950), for example, reported that monkeys engaged in the assembling mechanical puzzles showed a general deterioration of interest in the task as well as of the quality of solutions when extrinsic reward (food) was introduced, as compared to when no reward was offered. In sum, the earlier studies in this domain have found that external rewards impair creativity.

#### 2.2 External rewards, motivation, and creativity

Social psychologists propose that external rewards reduce intrinsic motivation and therefore impair creativity (Barron and Harrington 1981; Nicholls 1972; Woodman, Sawyer, and Griffin 1993). Intrinsic motivation has been defined as the motivation to engage in an activity

primarily for its own sake, while extrinsic motivation is the motivation to engage in an activity primarily to meet some goal external to the work itself, such as external rewards or meeting some other requirement (Collins and Amabile 1999). Amabile (1983a, 1983b) proposed the Intrinsic Motivation Hypothesis of Creativity, which posits that while intrinsic motivation is conducive, extrinsic motivation is detrimental to creativity. A number of experimental studies support this view and reveal that creativity is reduced with inducement of extrinsic motivation through external rewards (e.g. money), constraints (e.g. expected evaluation; Amabile 1979), surveillance (Amabile, Goldfarb, and Brackfield 1990), competition (Amabile 1982b), and restriction of choice (Amabile and Gitomer 1984).

The predominant view is that extrinsic rewards undermine intrinsic motivation and therefore hurt creativity (Amabile 1983a, 1983b; Kruglanski et al. 1971). Further, this reduction of intrinsic motivation happens because provision of external rewards, which may be seen as a requirement to alter one's behavior, diminishes self-determination (Eisenberger and Cameroon 1996). Deci (1971) was the first to suggest that external rewards may decrease intrinsic motivation. Building on his work, Deci and Ryan (1985) posit that motivation is innately promoted by perceptions of self-determination and competence. External constraints on behavior, including rewards, innately reduce intrinsic motivation by lessening the perception of personal freedom. Individuals may view the external reward for an enjoyable task as an attempt to control their behavior. This aversive reduction in perceived autonomy may reduce intrinsic motivation, which can consequently hurt creativity (Amabile 1983a, 1983b). Thus, external rewards that are perceived as controlling (e.g. money), may decrease intrinsic motivation and subsequently hurt creativity.

However, at the same time, results from some other studies suggest that external rewards

may not always hurt creativity. Although under many circumstances extrinsic rewards may be perceived as externally controlling and thus decrease intrinsic motivation and subsequently hurt creativity, there are situations when external rewards may be perceived as supportive of one's self-determination or freedom. In such latter cases, these external awards might actually enhance rather than reduce intrinsic motivation and subsequently enhance creativity. Controlling rewards include money (Deci 1971, 1972), tokens (Glover and Gary 1976), toys (Amabile 1982a), and food (Ross 1975), whereas supporting rewards include verbal reinforcement (Amabile 1982a), social recognition and symbolic rewards e.g., good player award (Anderson, Manoogian, and Reznick 1976).

#### 2.3 The role of reward contingency

The research reviewed so far aligns with the argument that extrinsic controlling rewards (e.g. monetary rewards) harm creativity. Interestingly, another body of research investigating the effects of external rewards on creativity challenges the above findings by suggesting that under certain conditions, external rewards can boost creative performance (Eisenberger and Selbst 1994; Eisenberger and Cameron 1996). Eisenberger and Armeli (1997) argue that the conventional view of external rewards reducing creativity conflicts with the long standing behavioral argument that divergent thinking should be enhanced by systematic reward (Pryor, Haag, and O'Reilly 1969; Skinner 1953; Torrance 1970; Winston and Baker 1985). In fact, some empirical evidence supports this view. For example Glover and Gary (1976) report that when given an external reward participants generate more creative uses for common items. Also, Winston and Baker (1985), after reviewing twenty studies, conclude that there is compelling

evidence to support the view that rewarded creativity training effectively enhances divergent thought which can lead to higher creativity.

In an effort to reconcile the above discussed mixed findings, Eisenberger and Armeli (1997) propose that the detrimental effects of rewards on creativity reported in earlier behavioral studies may be a function of the ambiguous contingency of the reward, rather than being the function of the reward itself (e.g. Amabile 1983a, p. 127). Specifically, they point out that in the earlier studies where external rewards were found to hurt creativity, participants were generally not informed explicitly that the reward was contingent upon *creative* performance. Eisenberger, Haskins, and Gambleton (1999) propose that an external reward can either increase or decrease creativity depending on the individual's discrimination of the kind of performance required to obtain the reward. They argue that reward dependent on simple or repetitive performance would discourage spontaneity of performance and reduce creativity. Because people are rewarded more often for conventional than creative performance in everyday life, they may perceive that reward depends on conventional, socially well-accepted performance when the instructions do not specify any reward contingency (Eisenberger, Rhoades, and Cameron 1999). However, if the task instructions make it clear that external rewards (e.g., money) are based on *creative* performance then we should observe positive effect of rewards on creativity.

This proposition has received support from a number of recent studies which demonstrate that when individuals are told explicitly that rewards are contingent on novel performances, external rewards (e.g. monetary rewards) or constraints (e.g. evaluation) can boost creativity. For example, when asked to generate solutions to human resource management problems, Shalley (1995) found that the highest creativity occurred when participants had a creativity goal and worked alone under evaluation expectations. More recently, Eisenberger and colleagues report

results from multiple studies (e.g., Eisenberger, Armeli, and Pretz 1998; Eisenberger and Rhoades 2001; Eisenberger and Shanock 2003), showing that individuals who expect creativitycontingent monetary rewards generate more novel, creative outputs than individuals who do not expect any rewards. For example, Eisenberger and Rhoades (2001, Study 3) asked their students in an introductory psychology class to generate creative titles for a short story. Students were either promised a monetary reward for high creativity ("If your titles are judged to be among the top half of the students in this class in terms of creativity, you will receive a financial reward next week for you to keep."), or given no such promise. The titles produced were rated for creativity by independent coders. Results revealed that students who were promised a financial reward for creativity generated more creative titles than those in the no-reward condition. More interestingly, to provide process explanation for the results, these scholars posit that external rewards, when contingent on creativity, enhance perceived self-determination (i.e., the underlying construct of intrinsic motivation) and hence increase creativity (Eisenberger et al. 1999).

# 3. Research Gap

The above review of the literature suggests that when reward contingency is absent, supporting rewards (e.g. social recognition) will lead to higher creativity as compared to both controlling rewards (e.g. monetary rewards) and no rewards. That is so because supporting rewards will enhance intrinsic motivation and hence lead to higher creativity. Controlling rewards on the other hand will lead to reduced intrinsic motivation thereby decreasing creative performance.

The extant literature further suggests that when reward contingency is salient, external rewards will enhance intrinsic motivation and will lead to higher creativity as compared to when no rewards are offered. These findings imply that both social recognition and monetary rewards, when contingent on creativity, should enhance intrinsic motivation and hence lead to higher creativity. In other words, when reward contingency is salient, there may not be any difference between social and monetary rewards in terms of their effects on creativity.

Thus, reviewing the existing research reveals the following gaps. First, although findings from Eisenberger and his colleagues' research (Eisenberger and Cameron 1996; Eisenberger and Armeli 1997; Eisenberger and Rhoades 2001) imply that social and monetary rewards would affect creativity similarly when reward contingency is salient, no empirical research has actually examined this question. Further, there is a lack of understanding of how these two types of rewards can affect cognition, and creativity cognition in particular. I argue that this lack of understanding stems from extant literature's unilateral focus on the motivational approach to study creativity.

Theorists claim that creativity is jointly determined by motivation, cognition, and knowledge. Runco and Chand (1995) proposed a two-tier model of creative thinking, suggesting

that cognition is the primary component of the creative processes, while knowledge and motivation form the second tier and influence these processes (see figure 1). Thus, although motivation is an important component of creative processes, it along with knowledge is a contributing rather than a controlling factor and hence has been considered secondary to cognitive processes (Collins and Amabile 1999). Creativity as such is seen as a by-product of cognitive processes (Ward et al. 1999).

Although cognition is deemed to play a crucial role in creative performance, this variable has received meagre attention while studying the effects of rewards on creativity. This is partly because this line of research has largely been carried out by social psychologists who have focused on the motivational impact of rewards on creativity. However, given that the ability to generate novel thoughts is one of the most salient aspects of the human mind (Ward 2001), and cognition constitutes the fundamental aspect of creativity, I believe it is crucial to examine the cognitive mechanisms through which external rewards affect creativity. In fact, researchers in recent years do acknowledge this gap in the literature (e.g., Shalley and Perry-Smith 2001), and call for more research in this area (e.g., Yuan and Zhou 2008). Thus, in this dissertation, I investigate the cognitive processes through which external rewards, in particular monetary and social recognition rewards, affect creativity.

# 4. Theoretical Development

#### 4.1 Broad versus narrow mental exploration

Creativity has invariably been regarded as a search process. For example, searching for novel ways to carry out a task (Eisenberger and Shancock 2003), information search to bring long-term creative projects to fruition (Collins and Amabile 1999), or searching for possible solutions in a novel and an appropriate way (Moreau and Dahl 2005). Perkins (1997) puts forth this search process as the one through the "possibility space" of solutions, while acknowledging that different mental typographies can make solutions (or their relevant inputs) either very accessible or extremely hard to find. Hence, creative performance can be viewed as a result of the search process in an individual's perceptual space.

Traditionally, it has been believed that a diverse or dispersed search (i.e. divergent thinking) is imperative to higher creativity (Eisenberger and Selbst 1994; Guilford 1968; Runco 1991). That is because divergent thinking helps individuals identify interesting problems and creative ways to implement solutions (Basadur 1994). On the flip side, an effective creative problem solving requires generation of varied and diverging potential solutions (Ford 1996). In fact, Woodman et al. (1993) note that divergent thinking is a cognitive key to creativity. Thus, this line of research suggests that creative outcomes are more likely to occur when individuals engage in broad exploration within their mental space (Stokes 2001; Burroughs, Moreau, and Mick 2008; Moreau and Dahl 2005).

Interestingly, a separate line of research suggests that a more focused or structured search process can also enhance creativity. Although broad and random exploration may be of value, a more structured process may also hold the key to higher creativity. Some scholars argue that an open-ended random exploration for ideas in mental space is an inefficient process (Boden 1991;

Goldenberg, Mazursky, and Solomon 1999). In contrast, a structured search process (e.g., through the use of templates; Goldenberg et al. 1999) that involves focused exploration of ideas that are farther away from common ideas can cut inefficiencies linked with random exploration and therefore lead to heightened creativity (Perkins 1981).

#### 4.2 Rewards and mental exploration

Following the above discussion, I propose that a monetary versus a social-recognition reward may induce alternative search strategies in an individual's mental space. Specifically, I suggest that a monetary reward will encourage a more focused search of ideas. Money has been shown to induce a focused mindset and make people driven to accomplish a given specific goal by focusing narrowly on the given task (Eisenberger and Aselage 2009; Eysenck and Eysenck 1982). For example, Eysenck and Eysenck (1982) tested their participants on a cued recall test under conditions of high versus low monetary rewards and found that individuals in the high monetary condition focused only on the attributes that were specifically relevant to the subsequent recall test as compared to the participants in the low monetary condition who processed the attribute information more broadly. Money has also been shown to induce risk taking tendencies (Coles, Daniel, and Naveen 2006; Rajgopal and Shevlin 2002). When individuals have an opportunity to receive money, they take riskier decisions to make it happen. For example, Coles et al. (2006) analyzed real life industry data and demonstrated that when CEOs of the companies have stock options as part of their compensation (i.e. there is an opportunity for them to earn extra money), they take riskier policy decisions such as investing more in R&D than plant and machinery. Very interestingly, these executives also focus on fewer

lines of business; that is, they take a more focused approach to business. Thus, building on prior literature, I propose that monetary rewards will induce a more focused search of ideas.

In contrast, a social-recognition reward should encourage a broad and comprehensive search for ideas. Prior research suggests that rewards that have a social component (e.g., recognition) prompt individuals to explore broadly while solving a problem (Johnson 1976). This is so because social rewards make individuals realize that their performances will be subject to social scrutiny, and this expectation of social scrutiny has been shown to make individuals engage in a more vigilant and comprehensive information search so as to cover their bases (Kruglanski and Freund 1983; Tetlock 1983; Tetlock and Boettger 1989). For example, Tetlock and Boettger (1989) tested their participants when expectation of social scrutiny was either present or absent. Participants were given either diagnostic information alone or diagnostic information plus additional non-diagnostic information and were asked to make some predictions using that information. They found that participants who had expectation of social scrutiny used a broader set of information (i.e. used both the diagnostic and the non-diagnostic information) to make their predictions as compared to those who did not have any expectations of social scrutiny. Thus, I propose that because a social recognition reward can induce expectation of social scrutiny, it would induce a broader search for ideas.

#### 4.3 Reward contingency, mental exploration and creativity

Next, I propose that these alternative search strategies prompted by different kinds of rewards will interact with reward contingency to jointly determine creative performance. When rewards are not explicitly stated to be contingent on creativity, a social-recognition reward should lead to greater creativity compared to a monetary or no reward. Indeed, the broader

search inspired by a social-recognition reward enables the individual to explore more options and better identify creative solutions. However, a different pattern of results is expected when rewards are contingent on creative performance. By definition, creativity contingency presents a clear goal to be achieved. Thus, while a monetary reward is likely to induce a narrower and focused exploration, in this instance the creativity contingency motivates the focused exploration to occur in a domain distant from the mundane. This happens because a monetary incentive, besides prompting a focused mindset, also induces greater risk seeking tendencies (Eisenberger and Aselage 2009; Kachelmeier and Shehata 1992). Thus, when a monetary reward is contingent on creative performance (i.e., when a specific creative goal is salient), I anticipate an increase in risk taking will prompt individuals to take chances on outlier ideas in an effort to secure the reward. This should induce a focused exploration of truly creative, transcendental ideas away from the domain of conventional ideas. Therefore, I expect that when creativity reward contingency is made salient, a monetary reward will lead to greater creativity than a socialrecognition or no reward. In this instance, a social-recognition reward should still lead to greater creativity than when no rewards are offered, due to its broader exploration.

In summary, although both monetary and social-recognition rewards can enhance creativity compared to no reward, I theorize that they operate via different mechanisms: while a social recognition reward encourage broader exploration, a monetary reward leads people to explore a small, yet distant (from mundane ideas) solution space when reward-creativity contingency is salient.

# 5. Hypotheses

Based on the above theorizing, I formally propose the following hypotheses:

#### 5.1 Creative performance

- H1A: In the absence of reward contingency, people will exhibit greater creativity when they are promised a social recognition reward than when they are promised a monetary reward or are not promised any reward.
- H1B: When reward is contingent on creativity, people will exhibit highest creativity when they are promised a monetary reward, followed by when they are promised a recognition reward, and then when they are not promised any reward.

## **5.2 Exploration for ideas**

H2: A social recognition reward will lead to a broader exploration of ideas as compared to a monetary and no reward, regardless of whether the creativity contingent reward instructions are present or not.

#### **5.3** Location of exploration

H3: A monetary reward will lead to a more focused search away from mundane ideas when reward is contingent on creativity.

To test the above hypotheses, I conducted an experimental study as detailed in the next section.

# 6. Experiment

## 6.1 Stimuli

The experiment employed an idea generation task as the focal stimuli. The task involved generating ideas to tackle a socially relevant problem, for which all participants were expected to have some prior knowledge or experience. Specifically, all participants were asked to generate as many ideas as possible to help reduce teenage smoking for a Non-Government Organization (NGO). Participants were first presented with the following information (see appendix A for the complete survey):

"The NGO operates in North America and works primarily in the domain of teenage health promotion. Recent research conducted by this NGO on teenage smoking behavior revealed that one in four teenagers in North America smokes. This research further found that nearly all first-time use of tobacco occurs before high school graduation. If adolescents don't start smoking by the age of 18 the odds are that they never will. However, for those who experiment with cigarettes, this research shows that teens can get hooked on nicotine much more quickly than adults by extremely low levels of tobacco."

Next, participants were told that this NGO had approached our school and was seeking ideas on how to fight teenage smoking. Hence, the participants' task was to brainstorm and come up with as many ideas as possible to reduce teenage smoking.

#### 6.2 Design

A 3(Reward Type: Monetary vs. Social-recognition vs. No-reward) x 2(Reward Contingency: Creative-outcome vs. Control) between-subjects design was employed for the experiment. Both reward contingency and reward type were manipulated through task instructions. The reward contingency instructions focused on whether or not participants would be evaluated on the creativity of their generated ideas. The reward type manipulation focused on whether a monetary, a social-recognition, or no reward would be offered.

Specific manipulations were as follows: Participants in the 'monetary reward – creative outcome' condition read, "As a way to say thank you, the NGO will provide monetary rewards for the contribution made by the top three students who generate the most creative ideas by offering them \$150, \$100 and \$50 respectively", whereas those in the 'monetary reward control condition' read, "As a way to say thank you, the NGO will provide monetary rewards for the contribution made by the top three students by offering them \$150, \$100 and \$50 respectively." Similarly, participants in the 'social-recognition reward – creative outcome' condition read, "As a way to say thank you, the NGO will provide recognition rewards for the contribution made by the top three students who generate the most creative ideas by posting their names and pictures, along with their ideas, on its website. These students will also be featured on school (name of the school was provided here) media (name of the school magazine was provided here) and website", whereas those in the 'social-recognition reward - control condition' read, "As a way to say thank you, the NGO will provide recognition rewards for the contribution made by the top three students by posting their names and pictures, along with their ideas, on its website. These students will also be featured on school (name of the school was provided here) media (name of the school magazine was provided here) and website".

Participants in the 'no reward – creative outcome' condition were told to generate creative ideas, whereas those in the 'no-reward – control' condition were simply told to generate ideas to fight teenage smoking. In both of these conditions, no reward information was identified (see appendix A for the complete survey).

#### 6.3 Pre-test

A pre-test was conducted to examine whether the two types of rewards were equally acceptable and appealing to the respondent population. Thirty-eight undergraduate students (24 women) from the same population as those in the main study participated in the pre-test in small groups of no more than five participants per session. They were randomly assigned to either the monetary or the social-recognition reward condition. All participants were given the following information:

"A Non-Government Organization (NGO) operating in North America has approached our school and wants to seek student ideas on a particular social issue. This NGO is planning to give out some kind of reward to students for their participation but is unsure of what to offer. Below, you will be presented with one reward idea. We are interested in knowing what you think about this reward".

Then depending on the condition, participants were either provided details of the monetary reward or the social recognition reward (utilized in the main study), and were asked to indicate their opinions on 1(not at all) – 7(very much) scales for two items: "How accepting would you be of the above mentioned reward?" and "How appealing do you think the reward is to you?"

Responses to these two items were highly correlated (r = .56, p < .001) and were thus averaged to create a single index. One-way ANOVA indicated no significant difference between the acceptability of the monetary (M = 4.64) and the social recognition (M = 4.53) rewards (F <1). Thus, the pre-test confirmed that the two types of rewards employed in the experiment were equally acceptable to the respondent population.

#### **6.4 Procedure**

A total of one hundred forty six undergraduate students (79 women) from the University of British Columbia participated in the experiment in exchange for a partial course credit. All participants were run individually and were randomly assigned to one of the six treatment conditions. Participants were first presented with a paper based survey packet. The introduction page stated that the current study was being run in partnership with an NGO that was seeking student ideas on a social issue. The next few pages contained instructions related to the manipulations as detailed previously. The focal task involved generating ideas to fight teenage smoking. Specifically, participants were told to brainstorm and generate as many ideas as possible. Further, they were asked to write down and number the ideas sequentially in the order they thought of them. Specific instructions presented to the participants were:

"In this part of the task please brainstorm and generate as many ideas as possible. Just keep writing down the ideas as they come to you. DO NOT worry about elaborating on your ideas, we just want you to generate as many ideas as possible and write them down as they come to your mind. You are free to write down your ideas in whatever way you prefer (e.g. in order, or scattered all over the page). However please number the ideas

sequentially in the order you thought of them. You may use as many or as few of these sheets as you like to record your ideas".

Each participant was provided with five blank white sheets of paper to record their ideas. None of the participants used all five sheets.

Once the participants finished recording all the generated ideas, they indicated their current feelings on a 1 (not at all) to 7 (very much) scale for ten mood items, namely, happy, cheerful, excited, depressed, sad, upset, relaxed, calm, stressed and tense.

The next set of questions tested participants' level of involvement during the experiment. Each participant answered five involvement questions. The items, measured on a 7-point scale from 1 = "not at all" to 7 = "very much" were: 1) How much did you enjoy this study, 2) Doing this task was fun, 3) How much effort did you spend in completing this study, 4) How important would you say this task was for you, and 5) How relevant would you say this task was for you?

Next, participants answered a specific question with respect to the strategy they had adopted while generating the ideas. On a scale of 1 to 7 they were asked to indicate what was the closest to the strategy the had followed while generating the ideas. 1 was anchored at strategy A (I wanted to stick to traditional ideas that would serve the NGO's purpose) while 7 was anchored at strategy B (I was ok to take risks and suggest some very out of the box ideas).

The experiment concluded with some demographic (e.g. age, gender) and suspicion probe questions.

# 7. Analysis and Results

In this section I report five sets of analyses from this study. First, I report results with respect to mood and involvement measures (analyses 1a and 1b) in order to rule out potential alternative explanations. Second, I examine the number of ideas generated by each participant to assess the differences in the amount of effort employed by respondents under different treatment conditions (analysis 2). The next set of analysis (analysis 3) tests hypotheses 1a and 1b by assessing the creativity level of the ideas generated. Analysis 4 tests hypothesis 2 by examining the search processes induced by alternative types of external rewards. Analysis 5 tests hypothesis 3 and sheds light on the location of search area vis-à-vis the domain of conventional ideas. Last two sets of analysis are conducted to further understand the process through which different rewards affect creative ideation process. Analysis 6 assesses the sequential position of the most creative idea that is generated while analysis 7 assesses the risk strategy adopted by individuals under different treatment conditions while generating the ideas.

## 7.1 Analysis 1: Mood and involvement

#### 7.1.1 Analysis 1a: Mood

The participants' responses to the ten mood items loaded on three different factors. Thus, three different mood indices were created: a positive mood index (happy, cheerful and excited;  $\alpha = .79$ ), a negative mood index (depressed, sad and upset;  $\alpha = .84$ ) and an arousal index (relaxed (R), calm (R), stressed and tense;  $\alpha = .79$ ). A 3(Reward Type) x 2(Reward Contingency) between-subjects ANOVA revealed no significant interaction or main effects for any of the three indices (*F*'s < 1), suggesting that there were no mood differences among the treatment conditions (see table 1 for the means).

#### 7.1.2 Analysis 1b: Involvement

All participants' responses to five involvement related questions were averaged to create an involvement index (enjoy, fun, effort, important and relevant;  $\alpha = .85$ ). A 3(Reward Type) x 2(Reward Contingency) between-subjects ANOVA revealed no significant interaction, main effects or contrasts for the involvement index (*F*'s < 1), suggesting that there was no difference in the level of involvement among the treatment conditions (see table 1 for the means).

#### 7.2 Analysis 2: Number of ideas generated

A total of 1,277 ideas were generated by all 146 participants, with the mean being 8.75 ideas per respondent and a standard deviation of 3.65. A 3(Reward Type: Monetary vs. Social-recognition vs. No-reward) x 2(Reward Contingency: Creative-outcome vs. Control) between-subjects ANOVA for the number of ideas generated revealed no significant effect of the treatments (F's < 1). Thus, participants across treatment conditions generated comparable numbers of ideas (see table 2).

#### 7.2.1 Discussion

The fact that participants produced comparable number of ideas under different reward conditions suggests that there is probably no difference in the amount of effort put in by the respondents. This result is then at odds with the prior research findings. Previous research finds that different types of rewards can induce different levels of motivations (Amabile 1982a), which implies that the number of ideas generated in this study should have varied depending on the conditions. I posit that the non-effect observed in the study might be due to a ceiling effect. The topic employed in this experiment might have been of high relevance to the undergraduate participant population and thus induced high motivation among the participants. For example, participants were informed of the gravity of the teenage smoking problem and the threat it poses to an adolescent's life. This high level of intrinsic motivation among the participants might explain why we did not observe any difference among the different reward conditions in the number of ideas generated or involvement as observed in previous analysis. If the focal task was relatively lower in relevance to the participants, I would expect to see a difference in the effort under different reward conditions. I discuss this further in the general discussion section.

#### 7.3 Analysis 3a: Creativity of ideas generated

To assess the creativity level of the ideas generated, all 1,277 ideas were first screened for unique ideas. Two expert judges, both marketing graduate students, one working in the area of social marketing (specifically focused on fostering anti-smoking behaviors) and the other working in the area of consumer behavior, independently completed the screening task. There was a 97% agreement between the coders and all the differences were resolved through consultation with the author. This process identified 337 unique ideas from the original idea set.

Next, twelve judges were hired from the same population as the study participants to rate each of the 337 unique ideas (Dahl, Chattopadhyay, and Gorn 1999; Goldenberg et al. 1999). All judges were presented with only the unique ideas in order to control for frequency effects (i.e., more frequently presented ideas might be judged as more or less original) and were asked to rate each of the unique idea on how creative, original, novel and innovative they thought it was on a 7-point scale (1: not at all; 7: very much). These ratings from 12 judges were then averaged to create mean creativity, originality, novelty, and innovativeness scores for each of the unique idea (alphas for the four scores across 12 judges ranged from .84 to .87). These four mean scores for each unique idea were then used to calculate the mean creativity, originality, novelty and innovativeness scores for each participant (i.e., the mean judges' scores for all the ideas generated by each respondent were summed and then divided by the total number of ideas generated by that respondent for each of the four items). Mean scores on these four items for all the participants loaded on the same factor and were averaged to create an overall creativity index ( $\alpha = .98$ ) for each participant.

Mathematically,

 $x_{nsii}$  = Creativity score for a participant

where,

*p* is participant number,  $p = 1, 2, \dots, P$ 

*s* is number of items is creativity measure, s = 1,2,3,4

*i* is number of ideas generated by participant *p*,  $i = 1, 2, \dots, I$ 

*j* is number of judges  $j = 1, 2, \dots, 12$ 

#### Hence,

Average of 12 judges' ratings for each of the unique idea on each of the four creativity items

$$x_{psi.} = \frac{\sum_{j=1}^{J} x_{psij}}{J}$$

Mean score on each of the four creativity items for each participant

$$x_{ps..} = \frac{\sum_{i=1}^{I_p} x_{psi.}}{I_p}$$

Creativity index score for each participant

$$x_{p\dots} = \frac{\sum_{s=1}^{S} x_{ps\dots}}{S}$$

See appendix B for the examples of ideas that were rated as highly creative and the ones that were rated as more conventional (i.e., lower on creativity).

A 3(Reward Type) x 2(Reward Contingency) between-subjects ANOVA revealed a significant 2-way interaction for the overall creativity measure (F (2, 140) = 6.98, p < .01; see figure 2). Further analysis indicated that in the control condition (i.e. when no reward condition were rated as more creative (M = 2.62) than those generated in either the monetary reward (M = 2.37; t (140) = -2.55, p < .05) or the no reward conditions (M = 2.41; t (140) = 2.25, p < .05). No statistical difference was observed (t < 1) between the latter two conditions. However, a different pattern of results emerged for the creative-outcome reward contingency condition. Specifically, the ideas generated in either the social recognition specifically, the ideas generated in either the social recognition reward (M = 2.95) or the no reward condition were rated as more creative (M = 2.95) than those generated in either the social recognition means (M = 2.73; t (140) = 2.03, p < .05) or the no reward condition were rated as more creative (M = 2.95) than those generated in either the social recognition reward (M = 2.73; t (140) = 2.03, p < .05) or the no reward conditions (M = 2.52; t (140) = 4.23, p < .001). Also, the ideas generated in the social recognition reward condition were judged as more creative than those generated in the no reward condition were judged as more creative than those generated in the no reward condition t (140) = 2.09, p < .05).

Examining the data from a different perspective, I conducted comparisons between the two reward contingency conditions for each type of reward. A significant contrast only emerged in the monetary reward condition, such that the generated ideas were judged to be more creative when the creativity reward contingency was present (M = 2.95) versus absent (M = 2.37; t (140) = 5.68, p < .001). Contrasts were not significant for either the social recognition (t (140) = 1.14, ns) or no reward (t (140) = 1.19, ns) conditions (see table 3 for the means).

Traditionally, creativity has been assessed via two dimensions, originality (which is reflected in the above analysis) and appropriateness (Moreau and Dahl 2005; Burroughs et al. 2008). To be creative an idea must be different from what is already known, thus reflecting the originality dimension. Yet at the same time, a creative idea must also be appropriate in solving the problem at hand. In other words, an original, but bizarre idea is not a creative idea (Lubart 1994). Thus, in addition to assessing the originality of the generated ideas as above, I also examined the appropriateness of the ideas generated across all conditions.

#### 7.3.1 Appropriateness of the ideas generated

In order to assess the appropriateness of the generated ideas, twelve judges, different from those who assessed the creativity/originality of the ideas, were hired from the respondent population to rate each of the unique idea on three appropriateness related variables (Dahl et al. 1999; Goldenberg et al. 1999). These judges rated how appropriate, useful and practical they thought each of the idea was on a 7-point scale. The ratings were then averaged to create mean appropriateness, usefulness, and practicality scores for each of the unique idea (alphas for the four scores across 12 judges ranged from .77 to .85). These three mean scores for each of the unique idea were then used to calculate the mean appropriateness, usefulness, and practicality
scores for each participant, in the same manner as described previously. Mean scores on these three items for all the participants loaded on the same factor and were therefore averaged to create an overall appropriateness index ( $\alpha = .76$ ) (see appendix B for the examples of ideas that were rated as highly appropriate and the ones that were rated as inappropriate i.e. low on appropriateness).

Two-way 3(Reward Type) x 2(Reward Contingency) ANOVA revealed no significant treatment effects (Fs < 1) for the appropriateness index (see table 2 for the means). Hence, the ideas generated across all treatment conditions were equally appropriate.

#### 7.3.2 Discussion

The results from the above analyses replicate findings from the previous literature. In line with the work of Amabile and colleagues (Amabile 1983a, 1983b; Collins and Amabile 1999), I found that when reward contingency instructions are absent, a social recognition reward leads to more creative ideas than either monetary reward or no reward. However, no difference is observed in the creativity of the ideas under monetary and no reward conditions. Note that this latter finding presents an inconsistency with results observed in the past, where monetary rewards (versus no reward) have been shown to undermine creativity (Glucksberg 1962). It is possible that the nature of the focal task might be driving this non-effect. Specifically, because all participants were expected to have some prior knowledge about the teenage smoking issue, even those in the monetary control condition can come up with some creative ideas, thus reducing the potential difference between the monetary versus no reward conditions. In other words, the absence of a significant difference between the creativity of ideas generated under

monetary and no-reward conditions may have been driven by a floor effect due to the nature of the task.

On the other hand, when the rewards were contingent on creativity, I replicated the findings observed by Eisenberger and colleagues (Eisenberger and Armeli 1997), such that the promise of rewards leads to more creative ideas as compared to when no rewards are offered. In addition, results from this analysis advance our current understanding by demonstrating that the type of reward matters. Although both monetary and social recognition rewards lead to higher creativity as compared to no reward when the creativity-reward contingency is present, monetary reward induces even higher creativity than the social recognition reward. These results thus demonstrate that although social rewards usually lead to higher creativity compared to no reward scan result in even higher creativity than social rewards.

The above analysis utilized the average creativity of all the ideas generated by each participant as the focal dependent variable. Although this measure (i.e., average creativity score) has been widely used in the creativity literature, some recent research suggests that the focus should instead be on the most creative idea. In particular, scholars have argued that the success of idea generation in innovation usually depends on the quality of the best opportunity identified (Girotra, Terwiesch, and Ulrich 2010). In the world of innovation, the extremes, and not the average or the norm, are of importance (Terwiesch and Ulrich 2009). Hence, in the next set of analysis I analyzed the creativity of the most creative idea generated by each participant.

#### 7.4 Analysis 3b: Creativity of the most creative ideas

Using the twelve judges' creativity ratings as obtained previously, I first identified the most creative idea generated by each participant (i.e., the idea with the highest creativity score). Then I ran a 3(Reward Type) x 2(Reward Contingency) between-subjects ANOVA for this highest creativity score for each participant.

Results from this analysis fully replicated those observed for the average creativity score in the previous analysis (analysis 3). Specifically, a significant 2-way interaction emerged (F (2, 140) = 7.29, p < .01; see figure 3), such that in the control condition (i.e. when no reward contingency was mentioned), the most creative ideas generated in the social recognition reward condition were rated as more creative (M = 3.74) than those generated in either the monetary reward (M = 3.36; t (140) = -2.40, p < .05) or the no reward conditions (M = 3.37; t (140) = 2.46, p < .05). No statistical difference was observed (t < 1) between the latter two conditions.

However, a different pattern of results emerged when the creative-outcome reward contingency was present. In particular, the most creative ideas generated in the monetary reward condition were rated as more creative (M = 4.24) than those generated in either the social recognition reward (M = 3.89; t (140) = 2.15, p < .05) or the no reward conditions (M = 3.51; t (140) = 4.60, p < .001). Also, the most creative ideas generated in the social recognition reward condition were judged as more creative than those generated in the no reward condition (t (140) = 2.32, p < .05).

Also, the comparisons between the two reward contingency conditions for each type of reward replicated the results as observed for previous analysis. A significant contrast only emerged when monetary reward was offered, such that the most creative ideas were rated to be more creative when the creativity reward contingency was present (M = 4.24) versus absent (M =

3.36; t (140) = 5.57, p < .001). Contrasts were not significant for either the social recognition or no reward conditions (t's < 1).

#### 7.4.1 Discussion

In this section, I found the same pattern of results for the most creative ideas as that observed for the average creativity score in the previous analysis. These results suggest that the interactive effect of reward type and creativity reward contingency impact the average creativity score and the most creative idea score in a similar fashion.

Until now, I have used subjective measures to assess the creativity level of the generated ideas. Specifically, all the analyses so far are based on the subjective ratings given to each idea by the twelve different judges. This method, known as consensual assessment technique (Amabile 1982b), is widely used and is well accepted in literature. However, to further bolster the support to my theory, in the next section, I use an objective measure (i.e., uniqueness of the ideas generated) as a proxy for creativity to analyze the effects of different reward conditions on the quality of the ideas generated.

#### 7.5 Analysis 3c: Uniqueness of the ideas generated

As discussed earlier, the creativity of an idea can be judged through its originality and novelty. Also, the constructs of originality and novelty are highly and positively correlated with uniqueness of the ideas. Hence, the uniqueness of an idea could be used as another measure of creativity. In the context of the current experiment, the idea that is generated with the lowest frequency may be considered as the most unique idea. Based on this premise, I first calculated a uniqueness score for each participant. Each idea was given a uniqueness score based on the number of times it was generated in the pool of all 1,277 ideas generated by 146 participants. For example, "increase cigarette prices" was generated 60 times and hence was given a score of 60, while "increase fines for underage smoking" was generated only 11 times and was therefore given a score of 11. These uniqueness scores for all the ideas generated by each participant were averaged to produce a uniqueness score for each participant. Lower scores indicate higher uniqueness of the ideas produced by a participant.

As anticipated, the uniqueness score and the average creativity score revealed a significant and negative correlation (r = -.56, p < .001). This suggests that as creativity increased, the uniqueness score decreased (i.e., more unique ideas were produced).

Next, a 3(Reward Type) x 2(Reward Contingency) between-subjects ANOVA was conducted with the uniqueness score as the dependent variable. A significant 2-way interaction emerged on this measure (F(2, 140) = 4.24, p < .05; see figure 4). Specifically, in the control condition (i.e., when no reward contingency was mentioned), social recognition reward produced more unique ideas (M = 16.88) than when no reward was offered (M = 20.40; t(140) = -2.16, p <.05). Although the uniqueness of ideas under the social recognition reward was higher than what was observed under the monetary reward condition (M = 19.25) it did not reach a level of significance (t(140) = 1.44, p = .15). No statistical difference was observed (t < 1) between the monetary and no reward conditions.

However, when the rewards were contingent on creative outcome, the uniqueness score was significantly higher in the monetary reward condition (M = 12.24) as compared to both the social recognition (M = 16.04; t (140) = -2.10, p < .05) and no reward (M = 19.51; t (140) = -4.19, p < .001) conditions. Also, the social recognition reward lead to higher uniqueness of ideas as compared to no reward (t (140) = -1.97, p = .05).

In addition, the comparisons between the two reward contingency conditions for each type of reward replicated the results those observed in previous analyses. A significant contrast emerged only in the monetary reward condition, such that a higher uniqueness was observed when the creativity reward contingency was present (M = 12.24) versus absent (M = 19.25; t (140) = -4.04, p < .001). Contrasts were not significant for either the social recognition or no reward conditions (t's < 1)

#### 7.5.1 Discussion

The results from this set of analysis utilizing uniqueness of ideas as an objective measure of creativity replicated the results obtained in previous sets of analyses. The analyses and findings so far have focused on the level of creativity of ideas generated. What remains unclear is how these ideas are generated, or more specifically how individuals search for ideas in their mental space under different reward conditions.

Thus, the next sets of analyses aim to uncover the underlying cognitive processes (i.e., individuals' search patterns in their mental space) through which reward type and reward contingency jointly affect creativity. Specifically I hypothesize that a social recognition reward as compared to no reward will lead to higher creativity irrespective of its contingency because a social recognition reward should prompt a diverse and broad exploration. On the other hand, a monetary reward will induce a more focused and narrower exploration, leading to lower creativity when individuals are not specifically instructed to be creative.

#### 7.6 Analysis 4a: Exploration of ideas in perceptual space

This set of analysis was conducted to examine the idea exploration strategies employed by respondents under different reward treatment conditions. To study the exploration patterns, I first ascertained the average position of each idea number (i.e. first idea, second idea, third idea and so on) in a multidimensional perceptual space. To this end, the Galileo system of multidimensional scaling was utilized to systematically map the individual positions and the associations between each of the idea numbers as generated in the mental space by participants across each of the six treatment conditions. The Galileo System is a theoretical and methodological model that views human cognition as an associational process in which concepts or ideas exist as cognitive units in mental space. The proximity between these units or ideas indicates the psychological relationships between the concepts (Vishwanath and Chen 2008; Woelfel and Fink 1980). See appendix C for detailed overview of the Galileo System.

To begin with, the Galileo methodology requires an estimate of the distances among all possible pairs of the concepts or ideas of interest. This distance between each pair of idea represents the dissimilarity between the two ideas. The ideas that are perceived more dissimilar would have higher distance between them than ideas that are perceived to be more similar. Given N concepts or ideas, the distance has to be estimated among N(N - 1)/2 pairs of ideas. These distance estimates are submitted to the Galileo System algorithm to obtain a set of Cartesian coordinates which indicate the position of each idea in a multidimensional conceptual space. Using these coordinates, a map can be drawn to represent the location of each idea in the mental space. Thus, if ideas generated in one condition are diversely spread with greater distances among them, it would indicate a broader search, whereas the reverse would indicate a more focused search.

In addition, under the Galileo methodology, a criterion pair has to be selected and designated an arbitrary distance such that this distance serves as a referent against which judges could provide distance estimates for other pairs of ideas. Two expert judges who had prior experience working with teenage students and in anti-smoking campaigns were employed to obtain the distance estimates. Two ideas were arbitrarily chosen from the pool of 1,277 ideas and were allocated a distance of 100 units between them. Both judges were asked to consider this distance of 100 units as the reference point, and provide their estimates for each pair of ideas generated by each respondent.

Next, the pair-wise distance estimates generated by the two judges were averaged (r = .59, p < .001) and entered into the Galileo algorithm. The Galileo software then calculated the mean distance between each pair of ideas that were generated under each of the six treatment conditions and converted these mean distances into Cartesian coordinates. To examine the positions of these ideas in a perceptual space in different treatment conditions, the coordinates from the six datasets were subsequently converted to a common origin and rotated to a least-squares fit that produced the most congruent space (Woelfel, Holmes, and Kincaid 1988). Figure 5 demonstrates the Galileo maps displaying the positions of ideas in mental space, generated in each of the six treatment conditions. Note that co-ordinates generated by the Galileo algorithm indicated existence of a 15-dimensional conceptual space (i.e. 15 dimensions explained 100% of variance in the data). However, given reproductional constraints, only 2-dimensional Galileo maps are presented here. These two dimensions explain 34–40% of variance in data for different conditions. However, absolute distance data (i.e., one explaining 100% of the variance) was utilized for statistical analyses. Also, the Galileo system does not specify a set of statistics for

analysis. Researchers using the system often employ ANOVAs with follow-up t tests (Lee and Barnett 1997) for this purpose.

Thus, to statistically compare and contrast the positioning of different ideas under various treatment conditions, a two-way ANOVA was conducted on the mean distances between each pair of the ideas generated by respondents across six treatment conditions. Note that, as discussed earlier, higher average distance between the generated ideas indicates broader exploration. An overall, non-significant two-way interaction emerged (F < 1). However, a significant main effect of reward type (F(2, 140) = 7.03, p < .01; see figure 6) was present. Hence, to further understand the idea generation process, the data were collapsed for the two contingency conditions and a one-way ANOVA was conducted for mean distance between the ideas under the three reward type conditions (F(2, 143) = 7.13, p < .01). The average distance between the ideas generated was significantly higher for the social-recognition reward condition (M = 93.11) than for either the monetary reward (M = 85.59; t(143) = -3.52, p < .01) or the no reward (M = 86.94; t(143) = 2.95, p < .01) condition; the contrast between the latter two conditions was not significant (t < 1).

#### 7.6.1 Discussion

An examination of the Galileo maps obtained from this set of analysis shows that the two social-recognition reward conditions produced ideas that were more spread out in comparison to monetary or no reward conditions, suggesting that the social-recognition reward induced broader exploration. This observation was further supported by statistical analysis. The ideas generated under social recognition reward condition had higher average distance among them. That is, they were more diversely dispersed in the perceptual space, as compared to the ideas that were generated under the monetary reward or no reward condition, regardless of whether the instruction specified reward contingency or not.

Results from this set of analysis provides support for the proposition that the social recognition reward indeed leads to a broader exploration as compared to both monetary and no rewards irrespective of reward contingency. Both the monetary and no reward conditions induce a narrower search of ideas. As no reward condition can be considered as a control or default condition with no external treatment (i.e., reward is being offered), it appears that a monetary reward may not have any effect on the exploration strategy.

Hence, I conducted the next set of analyses to further understand the differences in exploration processes between monetary and no reward conditions. Specifically, I test the proposition that monetary rewards induce not only a narrow, but also a systematic exploration of ideas, whereas social recognition rewards and no reward induce a rather random exploration of ideas.

#### 7.7 Analysis 4b: Systematic versus random exploration

The concept of systematic versus random idea generation was tested through a measure of 'Idea Buildup' (Girotra et al. 2010), which measures the extent to which subsequent ideas build upon preceding ones. A higher degree of progressive build-up of ideas indicates a more systematic approach to idea generation. To study the progressive build-up of ideas, I further analyzed the Galileo maps as obtained under each of the six treatment conditions and studied the path of ideas in the sequence they were generated (see figure 7). A closer look at these paths indicates that the idea generation process is more systematic and focused under monetary reward conditions while it appears to be more random under social recognition and no reward conditions.

Statistical analysis was then conducted to validate this observation. The sequential distance between the ideas was utilized as a measure of progressive build-up (Girotra et al. 2010), such that a smaller sequential distance between the ideas will indicate a higher degree of progressive build-up. To illustrate, a smaller distance between idea 1 and idea 2 indicates that these two ideas are very similar, suggesting that idea 2 was built on idea 1. Using the distance estimates provided by the expert judges (as used in previous analysis), an average sequential distance was calculated for each participant. First, only the distance estimates between the sequential ideas (e.g. idea 1 & idea 2, idea 2 & idea 3 and so on) as provided by the two judges were averaged for each participant. Then, an average sequential distance score was calculated for each participant. Then, an average sequential pair of ideas for that particular participant.

A two-way ANOVA for the mean sequential distance revealed a non-significant interaction (F < 1). However, a significant main effect of reward type (F(2, 140) = 6.64, p < .01, see figure 8) was present. Thus, to further understand this main effect, the data were collapsed for the two contingency conditions and a one-way ANOVA (Reward type) was conducted for the mean sequential distance score (F(2, 143) = 6.91, p < .01). Simple contrasts revealed that the average mean sequential distance was significantly lower for the monetary reward condition (M= 79.04), indicating a higher degree of progressive build-up, than for the social-recognition reward condition (M = 88.89; t(143) = -3.72, p < .001) and marginally lower as compared to the no reward condition (M = 83.99; t(143) = -1.90, p = .06). The contrast between the latter two conditions was also marginally significant (t(143) = 1.89, p = .06).

#### 7.7.1 Discussion

The forgoing analysis further clarifies the mechanism through which monetary versus social recognition rewards affect creativity. It is observed that a monetary reward induces a narrower, yet more systematic idea exploration strategy, whereas a social recognition reward induces a broader and a highly random exploration strategy. When no reward is offered, I found that individuals use a rather narrow and random exploration strategy.

Reviewing the results obtained so far indicate an interesting pattern. A closer look at the results obtained for exploration pattern in conjunction with the ones obtained for creativity of the ideas indicate that broader exploration of ideas under social recognition reward condition does correspond to higher creativity of the generated ideas, while narrower exploration under no-reward corresponds to lower creativity of the ideas. This observation is consistent with previous literature which suggests that diverse exploration corresponds to higher creativity (Eisenberger and Selbst 1994; Guilford 1968). Although this relationship has been proposed numerous times, to my knowledge the current research is the first to empirically demonstrate the subject effect.

An intriguing pattern of results however emerged for the creativity contingent monetary reward condition. Although a narrower search of ideas is observed in this condition, participants generate highly creative ideas. As proposed earlier, I reason that although a monetary reward induces a rather narrow exploration, creativity contingency prompts individuals to engage in this narrow search at a distant area away from conventional ideas, thus leading to greater creativity. If this proposition is true, we should observe the narrow exploration at a farther distance from the conventional ideas only when the monetary reward is contingent to creative performance. The next set of analysis is conducted to test this proposition.

#### 7.8 Analysis 5a: Location of exploration in perceptual space

This set of analysis aims to illustrate the relative location of exploration under different treatment conditions, with respect to the location of the most conventional idea. To achieve this, the most conventional idea was first identified from the 1,277 generated ideas. Two criteria were used to identify this idea. One, the target idea had to be generated the highest number of times, and two, it had to be rated the lowest on creativity by the judges. As a result, 'Increase cigarette prices' was selected as the most conventional idea. Next, the same two expert judges used in the previous set of analyses estimated the distance between the most conventional idea and each of the other generated ideas for each respondent. The same methodology as described in the previous section was adopted for this distance estimation task.

These distance estimates were then averaged for the two judges (r = .72, p < .001) and were entered into the Galileo algorithm. The output from this algorithm provided Cartesian coordinates for each of the ideas, suggesting location of each idea with respect to each of the other ideas and the most conventional idea in the perceptual space for all six treatment conditions (see figure 9).

Further, to statistically assess the location of exploration, I constructed a variable that measured the mean distance of the exploration area from the most conventional idea for each respondent. First, for each of the two judges, I averaged their distance estimates for each participant (between the most conventional idea and each of the ideas generated by this particular participant). This resulted in two average distance measures, one from each judge, between the most conventional idea and all the ideas created by each respondent. Then, these two values were averaged to obtain a mean distance estimate between the most conventional idea and all the other

ideas generated by each respondent. This mean distance was used as the measure of distance between the area of exploration and the most conventional idea.

A two-way ANOVA conducted for this mean distance value revealed a significant twoway interaction between the reward type and reward contingency (F(2, 140) = 4.43, p < .05; see figure 10). Specifically, in the control condition (i.e. when no reward contingency was mentioned), the average distance of the generated ideas from the most conventional idea was significantly higher in the social recognition reward condition (M = 106.06) than either the monetary reward (M = 99.00; t(140) = -2.13, p < .05) or the no reward condition (M = 99.57; t(140) = 1.98, p < .05). No statistical difference was observed between the latter two conditions (t < 1). In the creative outcome contingent condition, however, the average distance of the generated ideas from the most conventional idea was significantly higher in the monetary reward condition (M = 111.61) than in the social-recognition reward (M = 104.37; t (140) = 1.99, p < .05) or the no reward condition (M = 102.27; t (140) = 2.68, p < .01). No statistical difference was observed between the latter two conditions (t < 1). Examining the data from a different perspective, I conducted comparisons between the two reward contingency conditions for each type of reward. Results indicated a significant difference only in the monetary reward condition, such that the exploration area was significantly farther away from the conventional idea when the monetary reward was contingent on the creative outcome (M = 111.61) as compared to when such contingency instructions were absent (M = 99.00; t(140) = 3.61, p < .001). The same contrast was not significant for the other two reward conditions (t < 1).

#### 7.8.1 Discussion

The results from this set of analysis confirm the proposition that although monetary reward leads to a more focused search, the creativity contingency moves this area of exploration to a domain farther away from conventional ideas, thereby resulting in higher creativity. In sum, while social recognition reward may lead to broader exploration of ideas, the monetary reward induces a narrower search. However, creativity contingency transforms the conceptual space where this narrower search happens, by taking it farther away from the domain of conventional ideas hence leading to highest level of creativity.

An integration of the results obtained so far indicates a comprehensive story of how different types of rewards may affect creativity. Social recognition reward induces a broader exploration of ideas irrespective of whether the rewards are contingent on creativity or not. This broader exploration of ideas leads to higher creativity as compared when no reward is offered. Also, the exploration under social recognition reward condition is highly random. Hence, it appears that when a social recognition reward is offered, individuals randomly search for ideas in a broad perceptual space and at some point hit the most creative idea. In contrast, monetary reward induces a narrower, yet more systematic exploration. When a specific goal to be creative is salient, this narrow, systematic exploration happens at a farther distance from the conventional ideas and hence leads to the highest level of creativity.

It seems plausible that when a creativity contingent monetary reward is offered, it may prompt individuals to move to a distant area from conventional ideas right away and then explore other ideas in a more systematic fashion in a small area. In other words, it is possible that individuals in this condition would hit upon the most creative idea at the very beginning of their

exploration process and continue to search around that point in a narrow area. I test this hypothesis in the final set of analysis.

#### 7.9 Analysis 6: Sequential position of the most creative idea

This analysis aims to analyze the sequential position of the most creative idea among all ideas generated by a participant. I hypothesized that under creativity contingent monetary reward condition, individuals will generate the most creative idea earlier in their exploration process those in all other treatment conditions. To control for the total number of ideas generated by each participant, the sequential position of the most creative idea was assessed in terms of its percentile rank.

A percentile is the value of a variable below which a certain percent of observations fall. For example, the 20th percentile is the value below which 20 percent of the observations may be found. In this research context, if the most creative idea is in the 20<sup>th</sup> percentile rank, it means that 20 percent of all the ideas were generated before this particular idea was generated.

The most creative idea for each respondent was the one that had highest creativity rating as calculated in analysis 3. The percentile rank (i.e. percentile sequential position for the most creative idea) was then calculated using the following formula:

$$p_n = \frac{100}{N} \left( n - \frac{1}{2} \right)$$

Where,

N = total number of ideas generated by a participant ranked according to sequential position n = is the sequential position of the most creative idea For example, if a respondent generated eight ideas and the most creative idea was the second idea generated, the percentile sequential position of the most creative idea for this respondent will be 18.75.

Next, a two-way ANOVA was conducted for the percentile information of the most creative idea to assess the sequential position at which it was created. Note that, a lower versus a higher percentile sequential position indicates that the idea was generated earlier in the sequence of the ideas. An overall significant two-way interaction emerged (F(2, 140) = 4.74, p < .05). Specifically, there was no difference in when the most creative idea was generated among all reward types when the creativity contingency was absent (i.e., monetary reward (M = 55.58), social recognition reward (M = 49.21) and no reward (M = 53.54; for all contrasts: F's < 1). However, when the rewards were contingent on creativity, monetary reward lead to significantly lower percentile position of the most creative idea (M = 31.67) as compared to both social recognition (M = 58.44; t(140) = -3.27, p < .01) and no reward (M = 53.00; t(140) = -2.72, p < .01). There was no significant difference between the latter two conditions (t < 1).

The evaluation of other sets of contrasts indicated that monetary reward when contingent on creativity lead to significantly lower sequential position of the most creative idea (M = 31.67) than under control condition i.e. when reward was not contingent on creativity (M = 55.58; t(140) = -3.05, p < .01). No difference was observed between the creativity contingency and control conditions for either social recognition or no reward conditions (all t's < 1; see figure 11).

#### 7.9.1 Discussion

The results from this set of analysis further strengthen my proposition and demonstrate that a monetary reward when contingent on creativity indeed makes individuals to shift their focus immediately to a search space farther away from the conventional ideas, and keeps them focused in that narrower area while searching for new ideas. Social recognition reward, on the other hand, induces a random search in a broad area, and this approach takes individuals to reach their most creative idea at some later point in time.

As proposed earlier I argue that monetary rewards induce exploration at a location farther away form conventional ideas when a specific goal to be creative is present because monetary rewards induce willingness to take risk. While social recognition rewards on the other hand induce risk aversiveness and hence lead to boarder exploration for ideas. I test this proposition in the next set of analysis.

#### 7.10 Analysis 7: Adopted strategy during generation of ideas

This analysis aims to assess the degree of risk seeking participants engaged in while generating ideas under different treatment conditions. As detailed previously I hypothesized that a monetary reward when contingent on creativity should induce a higher propensity to take risks, while the social recognition reward should reduce the tendency to take risks.

Participants' responses to the risk strategy question were analyzed using a two-way ANOVA. An overall significant two-way interaction emerged (F(2, 140) = 3.39, p < .05; see figure 12). Further analysis indicated that as hypothesized individuals under social recognition reward condition were more risk averse as compared to those in the monetary and no reward condition regardless of the reward contingency manipulation (i.e. when no reward contingency

was mentioned:  $M_{\text{Social Recognition}} = 3.85$ ,  $M_{\text{No Reward}} = 5.04$ ,  $M_{\text{Monetary Reward}} = 4.56$ ; simple contrast between social and no reward: t(140) = -3.03, p < .01; contrast between social and monetary reward ; t(140) = 1.79, p = .07; when creativity reward contingency was mentioned explicitly:  $M_{\text{Social Recognition}} = 3.76$ ,  $M_{\text{No Reward}} = 4.84$ ,  $M_{\text{Monetary Reward}} = 5.73$ ; contrast between social and no reward: t(140) = -2.56, p < .05; contrast between social and monetary reward: (t(140) = 4.52, p < .001)). There was no difference in the risk seeking strategy between the monetary (M = 4.56) and no reward (M = 5.04) conditions when no reward contingency was mentioned (t(140) = -1.20, ns). However, when the rewards were contingent on creativity, monetary reward (M = 5.73) led to greater risk seeking than the no reward condition (M = 4.84 (t(140) = 2.13, p < .05). Also monetary reward under creativity contingency condition led to higher risk seeking (M = 5.73) as compared to under control condition (M = 4.56 (t(140) = 2.80, p < .01). There was no difference between the two reward contingency conditions when no rewards were offered (t < 1).

#### 7.10.1 Discussion

The results from this set of analysis shed further light on why monetary and social recognition rewards may lead to narrow versus broad search for ideas. Although previous research has indicated that money induces risk seeking tendencies, we find that this occurs only when people in the monetary condition were provided with a clear goal. On the other hand, we observe that social recognition reward leads to risk aversiveness and makes people search more broadly so as to cover their bases.

## 8. Conclusion and General Discussion

#### 8.1 Summary of results

In this dissertation, I theorize and demonstrate the differential effects of monetary and social recognition rewards on creativity under alternative reward contingency conditions. Specifically, when the reward contingency is absent (i.e., when individuals are not explicitly told that the reward is contingent on creativity), a social recognition reward results in higher average creativity than both monetary and no rewards. In contrast, when rewards are contingent on creative outcomes, a monetary reward leads to higher average creativity as compared to both social recognition and no rewards. The social recognition reward in this condition still results in higher creativity than when no reward is offered. The above effects hold true not only for the average creativity of all the ideas generated by a participant, but also for the most creative idea, as well as for the degree of uniqueness of the ideas generated by a participant.

More importantly, findings from this research also shed light on the cognitive process that underlies the above observed effects. Using the Galileo System methodology, I demonstrate that different external rewards lead to alternative exploration strategies in mental space, which drives the observed effects. Specifically, a social recognition reward prompts a broader and rather random exploration for ideas, whereas a monetary reward induces a narrower, yet more systematic explanation. When no reward is offered, we observe a rather narrow and random exploration of ideas. Thus, when the creativity reward contingency is absent, the broader exploration prompted by the social recognition reward leads individuals to produce more creative ideas. However, when rewards are contingent on creativity, the rather narrow and focused exploration induced by the monetary reward occurs in a domain farther away from conventional ideas, thus leading to higher creativity compared to the other two conditions. It is also

demonstrated that social recognition reward induces a tendency to avoid risk while a monetary reward when coupled with a specific goal to be creative encourages people to take more risk.

In sum, findings from this research demonstrate that monetary versus social recognition rewards induce alternative exploration strategies in a person's mental space, which subsequently affect creative performance depending on the reward contingency. Additional measures in the study show that the observed effects are not driven by mood, involvement, or processing effort.

#### 8.2 Contributions

This dissertation research makes both theoretical and methodological contributions. In terms of theoretical contributions, first of all, the current research advances our understanding of the effects of external rewards on creativity. While the extant research in this domain has predominantly focused on the motivational aspects of external rewards and their effects on creativity, in this dissertation, I approach this question from a cognitive perspective. By doing so, this research offers insights to the underlying cognitive processes through which different kinds of external rewards influence creativity. Specifically, this work demonstrates that different kinds of rewards (i.e., a monetary versus a social recognition reward) can lead to alternative types of cognitive processes (i.e., exploration strategies in mental space), which further affect creativity differently.

Second, this research identifies an important moderator to the effects of rewards on creativity, namely the creativity-reward contingency. While the extant research either suggests that social recognition rewards are superior to monetary rewards in terms of encouraging creativity (Amabile 1982a), or implies that these two types of rewards are comparable in terms of affecting creativity (Eisenberger and Cameron 1996), I propose and demonstrate that both of

these two types of external rewards can enhance creativity, but depending on the creativityreward contingency. Specifically, when the creativity-reward contingency is absent, the broader exploration prompted by a social recognition reward leads to higher creativity compared to that observed under a monetary reward. However, if individuals are explicitly told that the rewards are contingent on creative performance (i.e., the creativity-reward contingency is present), the narrower, yet focused exploration prompted by a monetary reward will happen in an area that is farther away from the conventional ideas, thus leading to greater creativity compared to a social recognition reward.

Finally, this dissertation sheds light on the debate in the extant literature with regards to whether broad or focused exploration leads to higher creativity. While some research suggests that a broad exploration for ideas is imperative to high creativity (Stokes 2001), others suggest just the opposite; that is, a broad exploration is fraught with inefficiencies and a focused search for ideas is a better approach to creativity (Boden 1991; Goldenberg et al. 1999). The current research offers reconciliation to this debate by suggesting that both of these two types of exploration strategies can enhance creativity, but under different conditions. When individuals are not explicitly told to be creative, a broad versus focused exploration as induced by a social recognition reward is likely to encompass more creative ideas. However, when explicitly told that the rewards are contingent on creative performance, individuals in the monetary reward condition will explore a narrow, yet distant area away from the conventional ideas, thus resulting in higher creativity compared to those in the social recognition reward condition.

This research also makes an important methodological contribution. Using the Galileo System methodology, this research employs a new way of analyzing the generation and exploration of ideas in an individual's mental space. Although the Galileo algorithms have

previously been used in assessing brand and product perceptions (Dinauer and Fink 2005; Vishwanath and Chen 2008), this research is the first to extend its use to the investigation of creative production. Although generating creative outputs is largely a mental exploration process, the extant literature has been extremely limited in its ability to directly measure or assess mental exploration. Thus, the methodology employed in this dissertation advances our ability to directly measure the idea generation process under different contexts. Going forward, researchers can use the Galileo algorithms to examine not only the static locations of ideas but also their movements in a perceptual space under different conditions.

#### 8.3 Limitations and future research

This research is also limited in several dimensions, thus offering opportunities for future research. Broadly speaking, there are three main limitations in this research, namely the reward manipulation, the focal task, and the role of prior knowledge. I will discuss each in detail below.

Considering the reward manipulation used in the current study, there are four potential issues that are worth discussing. The first one concerns the types of rewards included in the study. I limited the investigation to the independent effects of two types of external rewards, namely monetary versus social recognition rewards. I chose these two types of rewards because they have been widely studied in the extant literature. However, a combination of a monetary and a social recognition reward can often be observed in real life. For example, a monetary reward may be publicly awarded. Thus, it raises an interesting question – how would a combination of a monetary and a social recognition reward affect creativity? This question certainly deserves future investigation.

The second issue that relates to the reward manipulation pertains to the magnitude of rewards employed in the study. In the empirical study, I used a small amount of monetary reward and an equally acceptable social recognition reward, both of which were regarded as valuable by study participants. However, the current research is silent on whether increasing or decreasing the magnitude of these rewards may affect creativity differently. Would increasing the magnitude of monetary or social recognition rewards produce similar or different patterns of effects? Would they affect the exploration strategies differently? It would be worthwhile for future studies to examine the relationship between the magnitude of rewards and output creativity.

The third issue that relates to the reward manipulation is that all the rewards were framed as gains in the current research. However, rewards could also be framed as losses under certain conditions. For example, instead of promising a reward based on performance, participants could be given a reward to start with and asked to return all or part of it if the performance did not meet the pre-set criteria. According to Prospect Theory (Tversky and Kahneman 1981), individuals are more motivated by potential losses than gains. Thus, it would be interesting to explore how rewards framed in the loss versus gain domain may affect creative cognition differently.

The last issue that relates to the reward manipulation concerns the fact that participants in the current experiment were promised to receive real monetary rewards. Recent research studying the effects of money on human behaviour indicates that just priming money can change behaviour (Vohs, Mead, and Goode 2006). For example, money primes have been shown to make people self-sufficient or less of a social being. This line of research raises the question of whether priming people with money can also lead to the same kind of effect on creativity as observed in the current study's actual monetary reward condition. Also, what about other types of non-monetary rewards, such as tokens and loyalty program points? Would they have similar effects on creative cognition?

The second area of limitation in this dissertation concerns the focal task employed in the study. Specifically, I employed a task (i.e., how to prevent teenage smoking) that was of high relevance to my participants, thus causing people to have relatively high motivation. Although this characteristic of the task served the current research purposes well, future research needs to examine whether the results observed in this work can be replicated in situations where individuals' processing motivation is low to moderate, and external rewards would therefore influence people's interest or motivation level. Along similar lines, I observed no difference in terms of the appropriateness of the ideas generated by participants in various treatment conditions. One could argue that this result was found because the focal task was of high relevance to the target participants, and people hence generated comparable and reasonably appropriate ideas. Thus, future research that employs tasks that vary in participants' level of motivation and relevance might test the generalizability of the findings from this work.

The third area of limitation in this research is that it does not explicitly consider the role of prior knowledge in the reward-creativity relationship. I chose this particular task (i.e., how to prevent teenage smoking) because undergraduate students (my participants) tend to have some knowledge about this area. However, individuals differ in their expertise or prior knowledge in various creative tasks they engage in; therefore, it seems that prior knowledge might interact with reward to jointly affect creativity. Echoing this intuition, Runco and Chand (1995), in their two-tier model of creativity, propose knowledge as the third pillar of creativity along with cognition and motivation. However, the effects of prior knowledge on creativity remains unclear and scholars have revealed mixed results. While some scholars argue that greater prior

knowledge benefits creativity (Weisberg 1999), others suggest just the opposite and advocate that knowledge plays a much more limited role and can even be detrimental to creativity (Frensch and Sternberg 1989). These varied perspectives are reflected in the foundational view and the tension views of creativity, respectively (Burroughs et al. 2008). The tension view holds that because creativity must fundamentally represent an outcome that goes beyond the existing knowledge, a tension exists between what is known and what we can discover. On the one hand, creativity may involve breaking free of past ways of thinking and viewing the world. From this perspective, existing knowledge represents an impediment to creativity (Burroughs et al. 2008). On the other hand, the foundational view disagrees with this proposition and argues that creative contributions build upon prior creative work, and individuals need time to develop a foundation in an area before such contributions can be made, thus prior knowledge can facilitate creativity (Weisberg 1999). Although prior knowledge was not manipulated in this study, I believe future research that examines the interactive effect of prior knowledge and reward on creativity can be fruitful.

As with most of the behavioral studies, the current work was done in a laboratory setting with undergraduate students as participants. Given the substantive implications of this work, it will be desirable to test and replicate the observed results in more real life situations. Also this raises the question about the generalizability of currents results across cultures. Current study was conducted in a North American University where we observe predominantly the independent culture. Future research may be conducted in interdependent cultures where social recognition may weigh more than monetary benefits. Finally, current work did not take into account individual differences in chronic creative abilities. While it is possible that rewards may lose the effect on people who are highly creative, it can also be argued that rewards may enhance

creative output for these people. Thus, it is worth investigating how individuals' chronic creative ability might moderate the effects of rewards on creativity in future research.

#### 8.4 Implications and conclusion

In addition to theoretical and methodological contributions, findings from this dissertation also offer important practical implications. For example, the consumer market is rapidly shifting away from simply maintaining long-term consumer relationships to creating consumer interactions. Marketers are trying to involve consumers in their innovation processes through various avenues, such as crowd sourcing or community-based design (e.g., 99designs.com), product customization (e.g., Nike ID), and knowledge co-creation (e.g., iPod Lounge, Wikipedia). A key question marketers may ask is what rewards they can use to effectively encourage participation from creative and highly original consumers. The current work offers insights to this question. For example, if a company is collecting preliminary ideas from consumers, a social recognition reward may be helpful as it will lead to a broader set of solutions which the company can take in house and develop further (e.g., new product ideas). However, if a company is looking for a more focused set of ideas (e.g., logo design) it would be better to offer a creativity contingent monetary reward.

Findings from this research also have implications for other marketing disciplines. For example, the advertising industry is always looking for creative, appropriate, and impactful content. While a monetary reward may motivate individuals to generate extremely creative ideas or content, a social recognition reward may produce more moderate and appropriate content. In addition, results from this research also offer insights in terms of designing rewards for employees within an organization. For example, in a sales function, monetary rewards may be

more effective when specific parameters to earn those rewards are clearly defined (e.g., well defined sales quotas). In contrast, social recognition rewards might be more effective when achievement parameters are more abstract and cannot be defined concretely (e.g., maintaining good relations with a client).

In summary, creativity permeates many aspects of social life in today's world. How to enhance creativity has become a long term pursuit for many organizations, businesses, and individuals. I am hopeful that this work will not only advance our current knowledge, but will also inspire more research in this fascinating domain.

# 9. Tables and Figures

# 9.1 Tables

### Table 1: Treatment means for mood and involvement indices

Index		Reward Type		
	Contingency	Monetary	Social Recognition	None
Positive Mood Index	Creative- Outcome	4.45 (1.16)	4.24 (1.24)	4.40 (1.05)
	Control	4.13 (1.01)	4.05 (1.00)	4.00 (.88)
Negative Mood Index	Creative- Outcome	2.03 (1.26)	2.08 (1.21)	2.29 (1.21)
	Control	2.44 (1.09)	2.26 (1.19)	2.35 (1.08)
Arousal Index	Creative- Outcome	3.17 (1.09)	3.51 (1.11)	3.89 (1.18)
	Control	3.61 (1.18)	3.67 (1.10)	3.68 (1.14)
Involvement Index	Creative- Outcome	4.63 (1.43)	4.09 (1.37)	4.46 (1.07)
	Control	4.50 (1.18)	4.48 (1.19)	4.46 (1.07)

# Table 2: The number of ideas generated

	Reward Type				
Contingency		Social			
	Monetary	Recognition	None		
Creative-	8 82	7.86	0 32		
Outcome	0.02	7.80	9.52		
Control	9.00	8.44	8.92		

	Reward Contingency	Reward Type		
		Monetary	Social Recognition	None
Creativity of Ideas	Creative- Outcome	2.95 (.40)	2.73 (.43)	2.52 (.38)
	Control	2.37 (.23)	2.62 (.30)	2.41 (.31)
Appropriateness of Ideas	Creative- Outcome	4.58 (.23)	4.59 (.33)	4.68 (.21)
	Control	4.62 (.25)	4.61 (.18)	4.63 (.25)

Table 3: Treatment means for creativity and appropriateness of the generated ideas

Figure 1: Runco and Chand's (1995) two-tier model of creativity thinking















# Figure 5: Galileo maps depicting exploration of ideas in mental space

Figure 5a: Monetary Reward – Creativity Contingent



Figure 5b: Monetary Reward – Control






Figure 5d: Social Recognition Reward – Control



Figure 5e: No Reward – Creativity Contingent







Figure 6: The average distance among all pairs of the generated ideas



#### Figure 7: Galileo maps depicting buildup of the ideas

Figure 7a: Monetary Reward – Creativity Contingent











Figure 8: The average distance between the sequential ideas



# Figure 9: Galileo maps depicting the location of ideas generated with respect to the most conventional idea

(■ Represents the most conventional idea)

Figure 9a: Monetary Reward – Creativity Contingent



Figure 9b: Monetary Reward – Control



Figure 9c: Social Recognition Reward – Creativity Contingent



Figure 9d: Social Recognition Reward – Control





Figure 9e: No Reward – Creativity Contingent



Figure 10: Average distance of the generated ideas from the most conventional idea











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## Appendices

### **Appendix A: Experimental survey**

Note: This appendix contains the survey used in the experiment. The treatment manipulations were induced through instructions on pages 4 and 5 of the survey. Hence, this appendix contains six page 4s and 5s, one for each treatment condition. Page numbers on top right indicate the page numbers as in the original survey.

Page 1

## **Marketing Study**

In this study, you will be asked to complete a number of unrelated tasks. Please read and follow the instructions carefully for each task. Should you have any questions, please raise your hand and the study administrator will help you.

Also, note that once you have flipped to the next page of the survey please do not go back to any of the previous pages.

Thank you!

#### Introduction

A Non-Government Organization (NGO) operating in North America has approached our school to seek student ideas on a particular social issue. Thus, this task is aimed to collect such student ideas and forward it to the NGO.

On the next few pages we will give you details of this task. In addition, the study administrator will explain the process to you. It is important that you follow all the instructions very carefully. Also note that all the responses will remain anonymous and no personal information will be identified.

Due to administrative policies we are not be able to divulge the name of the NGO for which we are running today's study. However, this NGO operates in North America and works primarily in the domain of teenage health promotion. Recent research conducted by this NGO on teenage smoking behavior revealed that one in four teenagers in North America smokes. Nearly all first-time use of tobacco occurs before high school graduation. If adolescents don't start smoking by the age of 18 the odds are that they never will. However, for those who experiment with cigarettes, this research shows that teens can get hooked on nicotine much more quickly than adults by extremely low levels of tobacco.

This NGO is now approaching Universities/Colleges in North America to seek student ideas on how to fight teenage smoking.

Your task is to brainstorm and come up with ways to reduce teenage smoking.

As a way to say thank-you, the NGO will provide **monetary rewards** for the contribution made by the top three students who generate the most **creative ideas** by offering them **\$150, \$100** and **\$50** respectively.

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This NGO is now approaching Universities/Colleges in North America to seek student ideas on how to fight teenage smoking.

Your task is to brainstorm and come up with creative ideas to reduce teenage smoking.

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This NGO is now approaching Universities/Colleges in North America to seek student ideas on how to fight teenage smoking.

Your task is to brainstorm and come up with ideas to reduce teenage smoking.

#### **Brainstorming Ideas**

Your task in this study is to suggest creative ideas to reduce teenage smoking.

- 1. In this part of the task, please brainstorm ideas and generate as many creative ideas as possible. Just keep writing down the ideas as they come to you. DO NOT worry about elaborating on your ideas, we just want you to generate as many ideas as possible and write them down as they come to your mind.
- 2. You are free to write down your ideas in whatever way you prefer on the provided 'Brainstorming' sheets (e.g. in order, or scattered all over the page). However please number the ideas sequentially in the order you thought of them. You may use as many or as few of these sheets as you like to record your ideas. There will be no time limit to brainstorm your ideas. However, we have observed that students usually spend 10-20 minutes for this part of the task.

If you have read and understood the instructions above, please ask the study administrator for the brainstorming sheets and begin this part of the study. Please keep in mind that the NGO will provide **monetary rewards** for the contribution made by the top three students who generate the most **creative** ideas by offering them **\$150**, **\$100** and **\$50** respectively.

Use the sheets labeled 'Brainstorming Sheet' to record all your ideas.

Please let the study administrator know when you think you have listed all your ideas.

#### DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO
Your task in this study is to suggest ideas to reduce teenage smoking.

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Use the sheets labeled 'Brainstorming Sheet' to record all your ideas.

Please let the study administrator know when you think you have listed all your ideas.

Your task in this study is to suggest ideas to reduce teenage smoking.

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Use the sheets labeled 'Brainstorming Sheet' to record all your ideas.

Please let the study administrator know when you think you have listed all your ideas.

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Use the sheets labeled 'Brainstorming Sheet' to record all your ideas.

Please let the study administrator know when you think you have listed all your ideas.

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Use the sheets labeled 'Brainstorming Sheet' to record all your ideas.

Please let the study administrator know when you think you have listed all your ideas.

Page 6

Please turn to next page only if you have already recorded your ideas.

# How Are You Feeling Right Now

Now, we would like to assess how you are feeling right now. On each of the following scales please circle the extent to which the indicated feeling reflects **the way you feel at this moment**.

	Not at a	V	Very much					
Нарру	1	2	3	4	5	6	7	
Stressed	1	2	3	4	5	6	7	
Tense	1	2	3	4	5	6	7	
Relaxed	1	2	3	4	5	6	7	
Depressed	1	2	3	4	5	6	7	
Cheerful	1	2	3	4	5	6	7	
Sad	1	2	3	4	5	6	7	
Excited	1	2	3	4	5	6	7	
Upset	1	2	3	4	5	6	7	
Calm	1	2	3	4	5	6	7	

## Please turn over the page

## **Follow-up Questions**

In this section, you will be asked several questions to help us understand how you reached the final solution. There are no right or wrong answers to these questions we are only interested in your honest opinion.

#### A. Your thoughts

First, we'd like to understand what went through your mind as you were completing this task. For example, how you went about completing this task, any strategies you used to generate the new ideas and then coming up with final solution. You may also write down any specific thoughts or feelings you had when performing the task. Please be as detailed as possible in recording your thoughts. There are no right or wrong answers. We are simply interested in understanding what was going through your mind at the time.

## Please turn over the page

## B. Please answer the following questions with respect to the task you have just completed

1.	How satisfied were you with your performance on this task?									
	1	2	3	4	5	6	7			
	Not at all						Very much			
2.	How appealing do you think are the ideas you generated?									
	1	2	3	4	5	6	7			
	Not at all						Very much			
3.	Did you enjoy	doing th	is task?							
	1	2	3	4	5	6	7			
	Not at all						Very much			
4.	How effective	do you t	hink are	e the ide	as you	genei	rated?			
	1	2	3	4	5	6	7			
	Not at all						Very much			
5.	How relevant	would yo	ou say tl	nis task	was for	vou	2			
	1 2	3	4	5	6	7				
	Not at all						Very much			
6.	How importan	t would	you say	this tas	k was f	or yo	u?			
	1	2	3	4	5	6	7			
	Not at all					V	ery much			
7.	How much eff	ort did y	ou spen	d in cor	npleting	g this	study?			
	1	2	3	4	5	6	7			
	Not at all						Very much			
8.	Doing this task	x was fui	1.							
	1	2	3	4	5	6	7			
	Not at all						Very much			

# Please turn over the page

C. Below, you are presented with a set of strategies. We would like you to indicate quickly the extent to which a strategy you think is closest to what your working strategy was while generating the ideas. Please note that we *do not* want you to analyze or think deeply at this moment about which strategy you'd prefer or why. Instead, we ask that you report what comes to mind immediately. Please circle the number that best describes your choice.

Strategy A: I wanted to stick to traditional ideas that would serve the NGO's purpose.

Strategy B: I was ok to take risks and suggest some very out of the box ideas.

1 2 3 4 5 6 7 Strategy A Strategy B

#### **D.** About You

- 1. Your gender: \_\_\_\_\_ male \_\_\_\_\_ female
- 2. Your age: \_\_\_\_\_
- 3. Is English your first language or mother tongue? \_\_\_\_\_ no \_\_\_\_\_ yes
- 4. How fluently do you speak the English language?
- \_\_\_\_\_poorly \_\_\_\_\_somewhat well \_\_\_\_\_proficiently \_\_\_\_\_very fluently
- 5. How many years have you lived in an English-speaking country? \_\_\_\_\_\_years
- 6. Your main affiliation is with what faculty (e.g. Commerce, Engineering, Fine Arts etc.):

# **Appendix B: Examples of the generated ideas**

#### Examples of ideas that were rated as highly creative

- "Take kids to a "mock hospital" for a week to live in the shoes of a cancer victim"
- "Experiment, put animal (mouse or rabbit) in the hallway and let them smell the smoke every day and display the photo's and changes"

#### Examples of ideas that were rated as more conventional i.e. lower on creativity

- "Increase price of cigarette"
- "More pamphlets about not smoking in local clinics"

#### Examples of ideas that were rated as highly appropriate

- "Have a doctor/nurse come into the school and talk about lung cancer, etc. (and show pictures)"
- "Talk about the money-saving aspect of not smoking > Eg: if you smoke for \_ years you threw away enough money that could have been used to (buy a car, go on a trip, etc)"

#### Examples of ideas that were rated as inappropriate i.e. low on appropriateness

- "Make something else that teenagers can get addicted to (opium not too popular at the moment, may be marijuana)"
- "Make cigs free, then it wont be cool to smoke anymore"

### Appendix C: The Galileo System methodology

Human cognition has been viewed as an associational process, in which concepts exist as cognitive units or nodes in mental space. The proximity between the units in the mental space indicates the psychological relationships and associations between the concepts (Vishwanath and Chen 2008). The Galileo system is a theoretical and methodological model that takes this associational point of view (Barnett 1988; Woelfel and Fink 1980). The Galileo procedure begins with the selection of concepts or cognitive units. The ideas generated by each subject can be considered as these cognitive units in the context of the current research paradigm. The space for the concepts is defined by the psychological distance between every possible pair of concepts, and assessed through paired-comparison magnitude-scale judgments (Dinauer and Fink 2005). The distance estimates are averaged and submitted to a multidimensional scaling algorithm from which a set of coordinate axes is produced. From these coordinates, a map is drawn that represents the conceptual associations between the concepts i.e. the generated ideas. The distance between each concept or the idea in this case reflects the relationships between them: ideas that are more similar are closer than those that are more dissimilar and farther apart (Vishwanath and Chen 2008). Thus, the greater distance between the ideas will indicate higher, broader exploration, while shorter distance will suggest narrower or more focused exploration.

The measurement of psychological distances in the Galileo system is closely analogous to the measurement of physical distance (Woelfel and Saltiel 1988). Because distances are scored at the ratio level, the data can be subjected to standard statistical operations such as ANOVA, cluster analysis and multivariate regressions. This allows for a sophisticated examination and interpretation of the associations between concepts across different treatment conditions. In addition, Galileo measurement is very reliable and superior to other hierarchical models of attitude and cognition (Dinauer and Fink 2005; Vishwanath and Chen 2008).

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