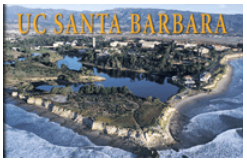

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Individual Creativity, Ex-ante Goals and Financial Incentives

February 24, 2013

Gary Charness* and Daniela Grieco†

Abstract

Creativity is a complex and multi-dimensional phenomenon that has hardly been considered by economists, despite a great deal of economic importance. This paper presents a series of experiments where subjects face creativity tasks where, in one case, ex-ante goals and constraints are imposed on their answers, and in the other case no restrictions apply. The effects of financial incentives in stimulating creativity in both types of tasks is then tested, together with the impact of personal features like risk and ambiguity aversion. Our findings show that, in general, financial incentives affect "in-box" (constrained) creativity, but do not facilitate "blue sky" (unconstrained) creativity. However, in the latter case incentives do play a role for ambiguity-averse agents, who tend to be significantly less creative and seem to need extrinsic motivation to exert effort in a task whose odds of success they don't know. We do find that measures of creative style, sensation-seeking preferences, and past involvement in artistic endeavors are related to our creativity score, but do not find any difference across gender for either form of creativity.

Keywords: creativity; incentives; ambiguity; ex-ante goals; constraints.

JEL Classifications: A13, B49, C91

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1. Introduction

Creativity is a vital input into the well-being and success of a society, contributing in economic, social, and aesthetic dimensions. According to Henry Poincaré, creativity represents the "ability to unite pre-existing elements in new combinations that are useful". It seems that creativity implies (a) a *combination* of existing things that should be (b) *recognized in its utility by peers*. A culture without creativity becomes stagnant. Thus, it seems quite valuable to consider how to stimulate creativity to the extent possible. While the fields of cognitive and social psychology (and others) have long considered aspects of creativity, there has been little or nothing on this topic in the economic literature.

Is the creative act the result of simply a "taste" for creativity? Or can creativity be fostered by effort or investment? If so, what factors are more likely to nurture it? Economists are typically concerned with incentives, which are usually (but not always) financial in nature. On the one hand, historical achievements such as the Manhattan Project suggest that providing incentives can deeply facilitate creative solutions. In the same vein, the patent system was developed with the aim of providing a strong incentive to produce novel ideas and products without the gains from doing so being appropriated by other entities. However, on the other hand, artists and perhaps even academic researchers do not appear to need financial incentives to produce creative art or research, respectively: ideas seem to arrive at their own rate, independently of direct incentives but possibly affected by interaction with others.

Thus, it is far from obvious what the effects might be regarding financial incentives and creativity. In this paper, we posit two types of creativity. With "in box" creativity, there is a specific and delineated goal. Examples could be finding a way to decrease the size of a computer, developing a new drug for a specific purpose, or even a large endeavor such as the

Manhattan Project. In this case, we suspected that financial incentives could be very useful. On the other hand, "blue sky" creativity could be considered to represent pure and unfettered thinking outside the box, so that here is no obvious underlying *ex-ante* goal or direction. Our measure of this form of creativity seems to overlap with previous definitions of "conceptual" creativity. We suspected that directly incentivizing blue-sky creativity would be ineffective or possibly even counter-productive.

The experiment consisted of two tasks aiming at measuring these forms of creativity. Participants were randomly assigned to one of two conditions: they could receive a flat payment ("no incentives") for completing the task, or be remunerated according to their performance, i.e. on the basis of their position in a ranking within a group of peers. In addition, people completed a questionnaire that summarized their demographic characteristics, their involvement in creative activities like music, performing arts, craft (Hocevar, 1980), their creative style according to previous classifications (Simonton, 2000), their level of sensation-seeking (Zuckerman et al. 1964). We also included two incentivized questions designed to capture risk and ambiguity attitudes.

Our results confirm our main hypothesis. We find that monetary incentives are effective in stimulating creativity when ex-ante goals are specifically defined and the nature of the task is fairly well defined. So when society has a clear objective in view, it does appear useful to have policies that involve rewarding creativity with respect to achieving this objective. However, incentives for performance with respect to pure "blue sky" creativity provide no benefit; an exception applies to ambiguity-averse people, who would tend to otherwise avoid amorphous activity. Of course, this does not mean that society should not facilitate such

creativity by providing some form of financial security for creative individuals such as researchers or artists.

2. Related literature

2.1. Definitions and dimensions of creativity

Until the middle of the 20th century, creativity was studied as a minor topic within a number of various disciplines such as psychology, sociology, and cognitive science. The turning point for the emergence of creativity as a separate sphere of study can be traced back to the seminal works of Guilford (1950) and Torrance (1962, 1974, 1989), who attempted to measure creativity from a psychometric perspective. The Torrance test of creative thinking compares "convergent" to "divergent" thinking and is still a reference tool for measuring creativity. At the same time, personality tests were developed with the aim of identifying potentially-relevant traits as characteristics of creative people, such as independence of judgment, self-confidence, openness to experience, balanced personalities, attraction to complexity, aesthetic orientation, and risk taking (see, among the others, Sternberg, 1985). While certain aspects of creativity studies are still being debated, significant advancements have been made (Simonton, 2000). The challenge of investigating the issue of creative potential using conceptual and experimental approaches towards problem-solving processes is more recent and was initiated in Nielsen et al. (2008)'s research.

For our purpose, creativity can be defined as "the production of novel and useful ideas in any domain" (e.g. Stein, 1974; Woodman et al., 1993). In contrast, innovation represents the successful implementation of creative ideas within an organization: creativity by individuals and teams is therefore the starting point for innovation. Creativity has usually been related to the

development of ideas that are appropriate to a definite situation (e.g., Amabile, 1983; Mumford and Gustafson, 1988): due to its context-specificity, it seems to imply a singular entity. Nonetheless, scholars agree upon the fact that creativity is not a unitary construct and that the choice of tasks and measures of creativity depends on the research objectives.

Sternberg (1999) outlines a typology of creativity based upon the outcome of the creative process and contrasts forward incrementation to conceptual replication. Although this categorization is useful, it focuses upon the end product, leading to two problems. First, only ideas that reach the end of the process are studied, so that the sample is biased toward more successful ideas. Second, the categorization encourages retrospective analysis of the process, which may lead to bias in recollection.

Galenson (2004)'s research on creativity identified two creative methods or styles: “conceptual” and “experimental”. The former corresponds to the generation of a new idea (a kind of “deductive” process), the latter is a new combination of existing items (an “inductive” process that relies on experience). The former corresponds to “divergent thinking”, the latter is a form of “convergent thinking”. Although creativity tasks are usually categorized as either convergent or divergent, most creative problems contain elements of both (Nielsen et al. 2008). Convergent tasks require a single correct response, whereas divergent tasks require producing many different correct answers (Hudson, 1966; Runco, 2006 and 2007).

Fiore and Schooler (2001) borrow the concept of “problem space” from information processing theory and use it to emphasize the need of distinguishing between ill- and well-structured problems. Besides the dimension of convergent versus divergent, problems might differ because they are delimited by clear versus ambiguous constraints: participants can be

required to consider only the given set of variables, or to also account for all the possibilities that might help in completing the task.

2.2. Tasks for measuring creativity

The specific task one chooses to measure creativity is of course an essential issue (see Sternberg, 1988): due to the multi-dimensional nature of creativity, it is very difficult to find a task that measures it univocally. Therefore, the task must be tailored to the research question, with an effort made to establish a dialogue between the research question and the task. Individual creativity is traditionally measured by tests in the psychological domain like Guilford's individual's performance on intelligence tests (1950; 1962), Torrance creativity test (1974), or the more recent Mayer et al. (2003)'s insight test.

Divergent tasks consist of multiple-use tasks (like "List as many uses for a paperclip/rubber band as you can think of") and attribute tasks (like "List as many things that are blue/have wheels as you can think of"). Convergent tasks use remote associates and verbal insight problems (like "What word are all three of these words - cream, skate, water - related to?"). Studies like Bowden and Jung-Beeman (2003) and Dow and Mayer (2004) use remote associations and verbal-insight problems (like "Marsha and Marjorie were born on the same day of the same month of the same year to the same mother and the same father, yet they are not twins. How is that possible?").

In problem-finding research, scholars examine the degree to which the problem has been formulated before the creator begins the process. In general, researchers propose a continuum ranging from closed to open problems: a true closed problem is one that is presented to the participant, when the method for solving the problem is known ("convergent" in Torrance's terminology); open problems occur when the participant is required to find, invent, or discover

the problems ("divergent"). Dillon (1982) argues that most artistic endeavors generally represent open problems; responses to a suggestion scheme illustrate outcomes of organizational open problems. Psychologists rely also on some "disposal measures" that are based on self-reported descriptions of subject's own personality: Gough (1979)'s Creative Personality Scale, Hocevar (1980)'s Creative Behaviour Inventory, and Kirton (1976)'s Creative Cognitive Style (see a recent paper by Gino and Ariely, 2011).

2.3. Motivation and incentives to creativity

Both intrinsic and extrinsic motivations appear to play roles as determinants of creative behavior. Concerning the former, intrinsic motivation might consist of the "joy" of being creative. Amabile (1989)'s studies with children show that crowding out emerges in the presence of monetary incentives, as is typical in the literature on intrinsic motivation. Despite the conventional wisdom in economics, financial incentives are not always effective and may even be counterproductive. Deci and Ryan (1985) discuss an experiment in which children's intrinsic motivation to engage in an activity is undermined by financial rewards. Similarly, Gneezy and Rustichini (2000) show that paying only a small wage for charitable work can lead to lower productivity than relying completely on intrinsic motivation and paying nothing. Paying an excessive amount can also lead to poor outcomes due to a sense of pressure, as suggested by the results in Ariely et al. (2009). On the other hand, Charness and Gneezy (2009) find that it may be possible to "crowd-in" intrinsic motivation by paying students to go to the gym and exercise; students who had not been previously regular gym attendees continued to go to the gym after the payment period had ended.

At the individual level, both cognitive (knowledge, cognitive skills, and cognitive styles preferences) and non-cognitive (e.g., personality) aspects appear to be related to creative

behavior. More specifically, individual creativity is documented to be a function of antecedent conditions (e.g., past reinforcement history, biographical variables), cognitive style and ability (e.g., divergent thinking, ideational fluency), personality factors (e.g., self-esteem, locus of control), relevant knowledge, motivation, social influences (e.g., social facilitation, social rewards), and contextual influences (e.g., physical environment, task and time constraints). Furthermore, since the seminal work by Amabile et al. (1996), and adding to the traditional psychological approach to individual creativity (Barron, 1955; MacKinnon, 1965), scholars in management science have assumed that the social environment can influence both the level and the frequency of creative behavior. Organizational creativity is a function of the creative outputs of its component groups and contextual influences (organizational culture, reward systems, resource constraints, the larger environment outside the system, and so on) and represents a complex individual-situation interaction (Woodman and Schoenfeldt, 1989).

Two questions underlie engagement in the creative process. First, *why* do people engage in creative activity? Motivations might depend on internal sources, such as self-determined behavior, joy or desire to be creative. Alternatively, creative behavior might be a response to an external demand perhaps reflecting a job description, an experimental requirement, or environmental needs. Second, *what* is the initial state of the trigger, i.e. the degree of problem-finding (i.e. the ability to recognize that there is a problem and define it). The first question involves the drivers for idea generation, whereas the second takes into account the degree of problem-finding needed at the starting point of the creative process. The strong historical focus on creativity testing (see Amabile, 1996, or Albert and Runco, 1999) has meant that, in many studies, participants are presented with a problem (the creativity test) and have external demands placed on them to engage in creativity. Responsive creativity can also be

found in many studies of occupational creativity. Historically, in the literature on occupational creativity, researchers have been concerned primarily with "professional creatives" - for example, architects, engineers, and R&D scientists. Each of these occupations presents the incumbent with a demand for creativity. Of course, the degree to which the tasks are open or closed may depend upon the individual organization and/or the particular role or individual. For many of them, however, autonomy in choosing tasks may be limited.

3. Experimental design

The first set of our experiments on individual creativity involves asking individuals to perform a task in a creative manner. The experiment has a 2x2 design, consisting of two real-effort tasks ("in box" vs. "blue sky") and two treatments (incentives vs. flat payments). Each participant was assigned to only one of the four treatments. The relative creativity of each participant is evaluated by peers and by externals judges (blind to treatments and conditions), in line with Poincare's definition emphasizing that the "new combination" should be recognized in its utility by peers and with Amabile's notion of "social consensus".

3.1. Tasks

We capture experimental creativity by using "combination" tasks, and conceptual creativity by asking for the development of a totally new product or vision.

"In box" task

In the in-box condition, people are asked to choose from the following questions:

1. "Choose a combination of words to create an interesting story." The words supplied are: house, zero, forgive, curve, relevance, cow, tree, planet, ring, send.

2. "Starting from the number 27, obtain the number 6 by using at least two different numerical operations." Possible answers include: (27:3) – 3 = 6, or [(27 + 3): 2 – 12]! = 6.

"Blue sky" task

In the blue-sky condition, people are asked to choose from the following questions:

1."If you had the talent to invent things just by thinking of them, what would you create?"

2."Imagine and describe a town, city, or society in the future."

Participants were told that the creativity of their output would be ranked in relation to that of the other four people in the group. People in another mutually-anonymous 5-person group (in order to avoid strategic effects on the evaluations) performed this ranking.

We consider our treatments to be something of a minimal intervention, in the sense that the tasks, while different in some dimensions, are not dissimilar in others.

3.2. Treatments

Incentives treatment

In the incentive treatment, we paid people on the basis of the assessments made. In each group, the person with the highest ranking received an additional $15, the person with the second-best ranking received an additional $12, the person with the third-best rating received an additional $9, the person with the fourth-best ranking received an additional $6, and the person with the lowest ranking received an additional $3; these payments were made in addition to the standard $5 payment for showing up on time to the experiment).

No-incentives treatment

In the no-incentive treatment, we paid people a flat amount of $9 (plus the $5 show-up fee) for completing the response. The tasks were identical to those in the incentives treatment.

In both cases, people were told the five individuals in another group would rank the creativity of the exercise.

A major advantage of having evaluations by peers dealing with the same task is that they are most likely to be attuned to what is perceived to be creative in the relevant reference group (recall that "creativity should be recognized in its utility by peers"). However, after the experimental sessions, we also had the responses evaluated by two external judges, blind to treatments and conditions.

3.3. Risk and ambiguity attitude

After completing the task, we asked subjects to answer two incentivized questions on risk and ambiguity attitude (Gneezy and Potters, 1997; Charness and Gneezy, 2010): each individual is endowed with 100 units and can invest any portion of this amount in a risky asset that had a 50% chance of success and paid 2.5 times the amount invested if successful; the individual retains the units not invested. Participants were told that two of the participants (one for the risk-aversion question and one for the ambiguity-aversion question) would be chosen at random in each session for actual payoff implementation of these choices, and a coin would be flipped after the session to determine success or failure for these investors. This procedure provides a measure of risk aversion for each individual: the higher the investment the less risk averse the

individual is. The question on ambiguity attitude is identical, except that we did not tell people the probability that the investment would be successful.

3.4. Questionnaire

The questionnaire is composed of:

- 10 couple of questions on creative and cognitive style and sensation-seeking attitude, based on Nielsen at al. 2008)'s questions on creative style and on Zuckerman et al. (1964)'s questions on sensation-seeking attitude. Zuckerman et al. (1964)'s sensation-seeking scale was originally comprised of 34 items written on a forced-choice form. We consider only a selection of the items pertaining to preferences for the new and unfamiliar as opposed to the familiar, preferences for irregularity as opposed to regularity and routine, social values based on the stimulation value of other persons as opposed to their reliability and predictability, preferences for security as opposed to adventure, and need for general excitement.

- Seven questions on demographic features: gender, age, major, number of siblings, birth-order, right or left-handed, married/divorced/unmarried parents plus other six questions on past involvement in creative activities, as in Hocevar (1980). This inventory originally included a list of 77 activities and accomplishments that are commonly considered to be creative (e.g., painted an original picture, wrote an original computer program, excluding school or university work); for each item, participants indicated the frequency of the behavior in their adolescent and adult life. The scoring rule was to sum up each participant's ratings for the activities included in the inventory. In our questionnaire, the inventory is scored for creativity in six areas: art, crafts, performing arts, math-science, literature, and music.

4. Procedures

The experiments were conducted at the University of California, Santa Barbara. There were 14 pen-and-paper sessions between May 2012 and September 2012, with a total of 236 participants. There were 97 people in the "in box" task, with 53 in the no-incentives condition and 44 in the incentives condition; there were 139 people in the "blue sky" task; with 70 in the no-incentives condition and 69 in the incentives condition[1]. The subjects were undergraduate students (42% from Social Sciences, 40% from Hard Sciences and 18% from Humanities), with 57.2% females. We employed a between-subjects design: no individual participated in more than one session. In each session, the participants were paid a $5 show-up fee, plus their earnings from the experiment. At the beginning of each session, participants were welcomed and, once all of them were seated, the instructions were handed to them in written form before being read aloud by the experimenter. All subjects completed a final questionnaire containing demographic information, personality details and two incentivized questions measuring risk and ambiguity aversion. The sessions took approximately one hour, with average earnings of $15.

5. Experimental results and discussion

5.1. Creativity evaluation

As mentioned above, people in one group evaluated and ranked the individual responses from people in another group. To make comparisons across treatments, we had two external judges - blind to treatments - evaluate all of the answers on a 1-10 scale: the two judges'

[1] These numbers are not evenly divisible by 5 because: (a) one subject's answer in Session 3 was unreadable; (b) one subject in Session 6 did not give us back the sheet containing his answer; (c) two subjects in Session 14 did not show up.

evaluations exhibited a good degree of consistency (Cronbach's alpha = .6). Our "creativity score" is the average of the two independent evaluations.

5.2. Role of financial incentives

The introduction of financial incentives has a positive effect on the level of creativity when the task is characterized by the presence of *ex-ante* goals and constraints. In the "in box" condition, participants who received a payment dependent upon their ranking (incentives treatment) are more creative than subjects who receive a flat payment (no-Incentives treatment): the average level of creativity score increases with incentives from 5.075 to 5.909 and this difference is significant (Wilcoxon rank-sum test on individual averages, with $Z = -2.673$ and $p = 0.007$, two-tailed test).

However, in the "blue sky" condition, the average creativity score with incentives is not significantly different from that in the no-Incentives treatment: the average level of creativity score is 5.079 and 5.150, respectively, and there is no significant difference (Wilcoxon rank-sum test on individual averages, with $Z = 0.532$ and $p = 0.594$, two-tailed test).

Figure 1 summarizes previous results.

[FIGURE 1]

Table 1 reports summary statistics on the creativity score according to the task and the treatment.

[TABLE 1]

5.3. Incentives and risk/ambiguity aversion

This section provides a deeper analysis of the role of monetary incentives and individual attitude towards risk and ambiguity.

We characterize investment choices in the ambiguous lottery in terms of "risk aversion" and "ambiguity aversion". Furthermore, we consider the interaction between the presence of monetary incentives and risk/ambiguity aversion. Finally, we introduce the "ambiguity-risk gap", which represents the difference between the amount a subject decided to invest in the ambiguity lottery and the amount she decided to invest in the risky lottery. One hundred and thirteen people showed no ambiguity-risk gap; of the rest, 99 people invested more with risk than with ambiguity, while 24 people invested less with risk than with ambiguity. This is significantly different from random behavior (Z = 6.763, p = 0.000, two-tailed binomial test). Overall, the average investment with risk was 63.34 and the average investment with ambiguity was 51.04, quite a sizable difference. We find the familiar pattern that men invest more than women under risk (71.41 versus 57.26, Z = 3.930, p = 0.000, to-tailed ranksum test); however, the difference is diminished into statistical insignificance under ambiguity (53.43 versus 49.23, Z = 0.897, p = 0.370). So our evidence suggests that men are more sensitive to ambiguity than women; to the best of our knowledge there is no previous evidence on this issue.

When considering "In box" creativity, the only engine for creativity is incentives. Table 2 shows that financial incentives *per se* matter (coeff = 1.558, p = 0.051, two-tailed test), as neither risk- or ambiguity-aversion or the gap between ambiguity and risk, or any interaction between risk, ambiguity and incentives is significant.

[TABLE 2]

At first blush, incentives appear to be ineffective in shaping "blue sky" creativity. However, a deeper analysis indicates that the relationship between creativity and incentives is mediated by ambiguity attitude. The regression in Table 3 examines the role of risk and ambiguity aversion, as well as interactions between these attitudes and financial incentives.

[TABLE 3]

Interestingly, ambiguity (but not risk) plays a twofold role: the more a subjects prefers ambiguity to risk, given the degree of risk-aversion, the higher her creativity score in "blue sky" tasks (coeff = 0.015, p = 0.025, two-tailed test). Furthermore, subjects who showed a non-negative ambiguity risk gap reach a significantly higher creativity score than subjective with a negative ambiguity risk gap: the average score is 5.30 versus 4.82, and this difference is significant (Wilcoxon rank-sum test on individual averages, with Z = -1.98 and p = 0.047, two-tailed test).

Additionally, ambiguity interacts with financial incentives: although in general financial incentives do not succeed in stimulating "Blue sky" creativity, we find that ambiguity-averse people are more sensitive to financial incentives (coeff = 0.016, p = 0.062): since "blue sky" creativity has no definite goals in terms of outcome, subjects do not face clearly their probability of success. Uncertainty about probability is a definition of ambiguity (Ellsberg, 1961): ambiguity-averse subjects might be more disturbed by this type of creative task, but incentives might be used to stimulate creativity and compensate this effect.

5.4. Personality features and previous measures of creativity

We now focus on the role of demographic features and personal attitudes like creative/ cognitive style and sensation-seeking mind-set.

Focusing on "in box" creativity, we observe that neither creative style nor preferences for sensation-seeking nor involvement in artistic tasks plays a role. Among demographic variables, we find only that the number of siblings seems to affect creativity negatively and significantly (coeff = -.36, p = 0.014). Nevertheless, all in all, in-box creativity appears to respond to financial incentives, but little else.

[TABLE 4]

Turning to "Blue sky" creativity, two significant effects do emerge (see Table 5). First, the more a subject's creative style can be described as "conceptual" rather than "experimental", the highest the creativity score in "blue sky" tasks. This classification is based on work by Nielsen et al. (2008), which introduces operational definitions of Galenson (2004)'s creative methods: conceptual creative people have definite goals and methods, whereas experimentally creative people do not have clearly established methods, use trial and error, and do not have specific goals. Consistently with these definitions, our data show that "blue sky" creativity seems to be a form of "experimental" creativity: the more the subject exhibits a creative style that can be described as "conceptual", the lower the score in "blue sky" creativity (coeff = -.016, p = 0.083). Second, students majoring in the hard sciences appear to be weakly more creative (coeff = .686, p = 0.052).

[TABLE 5]

Summing up, we considered the fit of our measures of creativity with previous measures of creative style and personality, finding that "blue sky" creativity overlaps somewhat with Galenson (2004)'s definition of "experimental" creativity. Furthermore, students with a major in the hard sciences show higher scores.

6. Conclusion

Creativity is a main driver of the world's economy. Without creativity in areas such as science, technology, and the arts, our lives would be considerably poorer economically and aesthetically. From an economist's standpoint, one critical question is whether it is possible to incentivize creativity. We investigate whether incentives for performance can lead to higher levels of creativity. To the best of our knowledge, we are the first to do so. We consider two forms of creativity in a laboratory environment. When a task is delineated with specific *ex-ante* goals, we find evidence that in fact it is possible to successfully induce a higher degree of creativity with financial incentives. This result is applicable to a wide range of economic environments, particularly when a clear need has been identified. However, we find no evidence that paying for performance induces creativity that is relatively unconstrained and non-goal-oriented, except when an individual is averse to ambiguity. In this case, it doesn't pay to provide performance incentives. Perhaps the best that can be done to achieve creativity in these realms is to create a research environment where funds are available as needed for talented researchers. This seems preferable to having competitions for research grants, as this latter approach seems much more conducive to incremental advances.

We have just begun to scratch the surface in the area of creativity and incentives. There is undoubtedly a vast landscape of issues worth investigating in this area. For example, what forms of incentives are best? How well do incentives work in an environment involving group brainstorming or group decision-making? We plan on investigating these and other research questions and invite others into this embryonic area.

References

Albert, R.S. and Runco, M.A. (1999). The history of creativity research. In R.S. Sternberg (Ed.). *Handbook of Human Creativity*, pp. 16–31. New York: Cambridge University Press

Amabile, T. M. (1983). *The Social Psychology of Creativity*. New York: Springer-Verlag.

Amabile, T.M. (1989). *Growing Up Creative: Nurturing a Lifetime of Creativity*. Norwalk, CT, US: Crown House Publishing Limited.

Amabile, T.M. (1996). *Creativity In Context: Update To The Social Psychology Of Creativity*. Boulder: Westview Press.

Ariely, D., Gneezy, U., Loewenstein G. and Mazar, N. (2009). Large stakes and big mistakes. *The Review of Economic Studies*, 76, 451-469.

Barron, F. (1955). The disposition towards originality. *Journal of Abnormal Psychology*, 51, 478-485.

Bowden, E. M. and Jung-Beeman, M. J. (2003). Aha! Insight experience correlates with solution activation in the right hemisphere. *Psychonomic Bulletin & Review*, 10, 730-737.

Charness, G. and Genicot, G. (2004). An experimental test of risk-sharing arrangements. Working Papers gueconwpa~04-04-02, Georgetown University, Department of Economics.

Charness, G. and Gneezy, U. (2009). Incentives to exercise. *Econometrica*, 77, 909-931.

Deci, E. and Ryan, R. (1985). *Intrinsic Motivation and Self-determination in Human Behavior*. New York: Plenum.

Dillon, J.T. (1982). Problem finding and solving. *Journal of Creative Behavior*, 16, 97-111.

Dow, G. T. and Mayer, R.E. (2004). Teaching students to solve insight problems: Evidence for domain specificity in creativity training. *Creativity Research Journal*, 16, 389- 402.

Ellsberg, D. (1961). Risk, ambiguity, and the Savage axioms. *Quarterly Journal of Economics*, 75(4), 643-669.

Fiore, S.M. and Schooler, J.V. (2001). Convergent or divergent problem space search. The effect of problem structure on group versus individual problem solving. *Proceedings of the Human Factor Ergonomic Society 45th ANNUAL MEETING*, 483-487.

Galenson, D.W. (2004). A portrait of the artist as a very young or very old innovator: Creativity at the extremes of the life cycle. *NBER*, Working Paper No. 10213.

Gino, F. and Ariely, D. (2012). The dark side of creativity: Original thinkers can be more dishonest. *Journal of Personality and Social Psychology*, 102(3), 445-459.

Gneezy, U. and Potters, J. (1997). An experiment on risk taking and evaluation periods. *Quarterly Journal of Economics*, 112, 631-645.

Gneezy, U. and Rustichini, A. (2000). Pay enough or don't pay at all. *Quarterly Journal of Economics*, 115(3), 791-810.

Gough, H. G. (1979). A creative personality scale for the Adjective Check List. *Journal of Personality and Social Psychology*, 37, 1398-1405.

Guilford, J.P. (1950). Creativity. *American Psychologist*, 5, 444–454.

Guilford, J.P. (1962). *A Source Book for Creative Thinking*. New York: Charles Scribner's Sons.

Hocevar, D. (1980). Intelligence, divergent thinking, and creativity. *Intelligence*, 4, 25-40.

Hudson L. (1966). *Contrary Imaginations: A Psychological Study of the English Schoolboy*. London: Methuen.

Kirton, M. (1976). Adaptors and innovators: A description and measure. *Journal of Applied Psychology*, 61(5), 622-629.

Mayer, R., Dow, G. and Mayer, S. (2003). Multimedia learning in interactive self-explaining environment: What works in the design of agent-based microworlds? *Journal of Educational Psychology*, 95(4), 806-813.

MacKinnon, D.W (1965). Personality and the realization of creative potential. *American Psychologist*, 20, p. 273-281.

Mumford, M. and Gustafson, S. (1988). Creativity syndrome: integration, application, and innovation. *Psychological Bulletin*, 103, 27-43.

Nielsen, B.D., Pickett, C.L. and Simonton, D.K. (2008). Conceptual versus experimental creativity: Which works best on convergent and divergent thinking tasks? *Psychology of Aesthetics, Creativity, and the Arts,* 2(3), 131-138.

Runco, M. A. (2006). *Creativity: Theories and Themes: Research, Development, and Practice*. San Diego: Academic Press.

Runco, M. A. (2007). Correcting the research on creativity. *Creativity Research Journal*, 17, 321-327.

Simonton, D.K. (2000). Creativity: Cognitive, personal, developmental, and social aspects. *American Psychologist*, 55, 151-158.

Stein, M. (1974). *Stimulating Creativity*. New York: Academic Press.

Sternberg, R. J. (1985). *Beyond IQ: A Triarchic Theory of Intelligence*. Cambridge: Cambridge University Press.

Sternberg, R. J. (1988). Mental self-government: A theory of intellectual styles and their development. *Human Development*, 31,197–224.

Sternberg, R. J. (Ed.) (1999). *Handbook of Creativity*. New York: Cambridge University Press.

Torrance, E. P. (1962). Guiding Creative Talent. Englewood Cliffs, NJ: Prentice Hall.

Torrance, E. P. (1974). *The Torrance Tests of Creative Thinking. Norms-Technical Manual Research Edition. Verbal Tests, Forms A and B- Figural Tests, Forms A and B*. Princeton, NJ: Personnel Press.

Torrance, E.P (1989). The nature of creativity as manifest in its testing. In R.J. Sternberg (Ed.), *The Nature of Creativity: Contemporary Perspectives*. New York: Cambridge University Press.

Woodman, R.W., Sawyer, J.E. and Griffin, R.W. (1993). Toward a theory of organizational creativity. *The Academy of Management Review*, 18(2), 293-321.

Woodman. R. W. and Schoenfeldt, L. F. (1989). Individual differences in creativity: An interactionist perspective. In J. A. Glover. R. R. Ronning. and C. R. Reynolds (Eds.), *Handbook of Creativity*: 77-92. New York: Plenum Press.

Zuckerman, M., Kolin, E. A., Price, L. and Zoob, I. (1964). Development of a sensation-seeking scale. *Journal of Consulting Psychology*, 28(6), 477-482.

Figures and tables

Figure 1. Effects of financial incentives

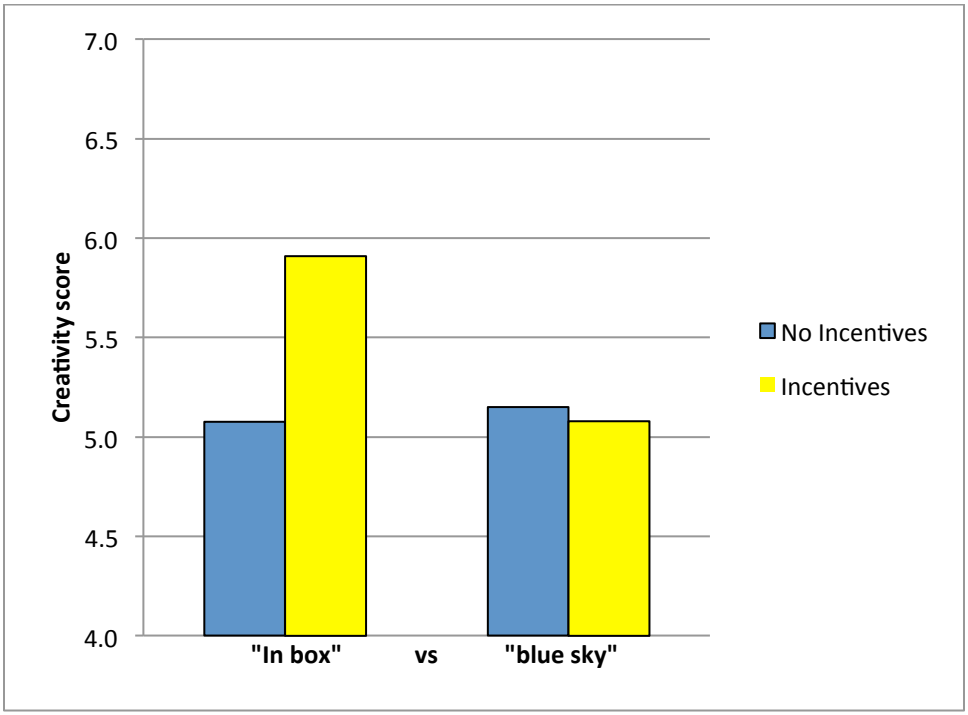

Table 1. Creativity score: summary statistics

Treatments	"In box" with no incentives	"In box" with incentives	"Blue sky" with no incentives	"Blue sky" with incentives
Average	5.075	5.909	5.150	5.079
Standard error	.193	.240	.165	.152
Min	1.5	1.5	2	2.5
Max	7.5	8.5	7.5	8.0
Obs.	53	44	70	69

Table 2. "In box" creativity: Determinants of creativity score

Creativity Score	**Tobit regression**
Incentives	1.558**
	(.786)
Risk-aversion	-.007
	(.417)
Ambiguity-risk gap	-.001
	(.863)
Incentives*Risk-aversion	.008
	(.508)
Incentives*Ambiguity-aversion	.004
	(.754)
Constant	5.125***
	(.836)
Log-likelihood	-170.22
Chi(2)	10.17
N. of obs.	95
Controls: gender, age, major, creative style, sensation-seeking attitude, past involvement in artistic tasks	
**** significant at 1%; ** significant at 5%; * significant at 10%.*	

Table 3. "Blue sky" creativity: Determinants of creativity score

Creativity Score	**Tobit regression**
Incentives	.459 (.508)
Risk-aversion	-.008 (.005)
Ambiguity-risk gap	.015** (.006)
Incentives*Risk-aversion	.006 (.009)
Incentives*Ambiguity-aversion	.016* (.008)
Constant	4.86 (.503)
Log-likelihood	-222.13
Chi(2)	11.19
N. of obs.	134
Controls: gender, age, creative style, sensation-seeking attitude	
**** significant at 1%; ** significant at 5%; * significant at 10%.*	

Table 4. "In box" creativity: Demographic features and personal attitudes

Creativity Score	**Tobit**
Creative style	-.15 (.11)
Sensation seeking	.04 (.21)
Past involvement in artistic tasks	-.06 (.13)
Major: hard sciences vs. social/humanities	.22 (.46)
Gender	-.28 (.33)
Right-handed	.07 (.52)
Siblings	**-.336** (.14)
Birth-order	.02 (.18)
Constant	4.48** (1.61)
Log-likelihood	-159.61
Chi(2)	20.99
N. of obs.	92
Regressors include incentives, risk-aversion, ambiguity-aversion, ambiguity-risk gap, and the interacting variables between incentives and risk/ambiguity-aversion. The creative style is a dummy variable that is 1 in case of "conceptual" creativity, and 0 in case of "experimental" creativity.	
**** significant at 1%; ** significant at 5%; * significant at 10%.*	

Table 5. "Blue sky" creativity: Demographic features and personal attitudes

Creativity Score	**Tobit regression**
Creative style	**-.16****
	(.08)
Sensation seeking	.16
	(.17)
Past involvement in artistic tasks	.11
	(.09)
Major: sciences vs. social/humanities	**.68***
	(.34)
Gender	.11
	(.23)
Right-handed	.39
	(.41)
Siblings	-.04
	(.07)
Birth-order	.09
	(.13)
Constant	**2.88****
	(1.03)
Log-likelihood	-204.90
Chi(2)	20.13
N. of obs.	127
Regressors include: incentives, risk-aversion, ambiguity-aversion, ambiguity-risk gap, and the interacting variables between incentives and risk/ambiguity-aversion. The creative style is a dummy variable that is 1 in case of "conceptual" creativity, and 0 in case of "experimental" creativity.	
*** significant at 1%; ** significant at 5%; * significant at 10%.*	