

Creativity Enhancing Performance on Dual-Task Tests

Honors Project

In fulfillment of the Requirements for

The Esther G. Maynor Honors College

University of North Carolina at Pembroke

By

Joey C. Dupree

Major Department: Psychology

May 1, 2013

Joey C. Dupree  
Name

Honors College Scholar

May 2, 2013  
Date

William D. Collier  
Name

Faculty Mentor

May 2, 2013  
Date

Mark Milewicz  
Mark Milewicz, Ph.D.

Dean, Esther G. Maynor Honors College

5/2/13  
Date

## Acknowledgments

I would like to gratefully acknowledge the support, assistance and expertise of Dr. William Collier.

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## ABSTRACT

### CREATIVITY ENHANCING PERFORMANCE ON DUAL-TASK TESTS

By:

Joey C. Dupree

Bachelor of Science in Psychology

The University of North Carolina at Pembroke

May 4, 2013

There has been extensive research conducted exploring the connections between creativity and cognitive functioning. However, little research has examined various subtypes of creativity and their influences on specific cognitive tasks. The present study found that Self/Everyday had a negative impact on the controlled-processing task in a dual-task. This negative impact finding is not yet fully understood and more research is needed in elaborating the construct of Self/Everyday creativity. The current study also found evidence to support the proposition of various distinct types of creativity. There were also strong correlations between the subtypes of creativity and overall creativity.

## **Introduction**

Can there ever be a concise, scientific definition of creativity, and consequently an adequate measurement of the construct? Psychometrics has little consensus or consistency in determining the parameters of the construction of creativity. Creativity can indeed be quantified by utilizing psychometric assessments of novelty, appropriateness and impact (Piffer, 2012). These three outcome features of creativity are much more salient, and therefore more quantifiable, than previously constructed characteristics of creativity (Karlins, 1967). An important distinction can be made between usefulness and appropriateness, with usefulness representing the pragmatic component of creative outcome measurement and the appropriateness being assessed by a perceptual public acceptance component (Piffer, 2012). Therefore, appropriateness of a creative product actually surpasses the usefulness of the product on a conceptual level. So, creativity should be evaluated on all three dimensions (novelty, appropriateness and impact), while taking into consideration that usefulness cannot always be assessed in every product, especially if the product is of an artistic or aesthetic nature (Glaveanu, 2012). Artistic or aesthetic creative endeavors are therefore more difficult to assess due to their subjective usefulness, and the assessment of such creations must rely more heavily on appropriateness criteria.

Bink and Marsh (2000) propose that everyday, or daily, cognitive processes are the very same type of processes that facilitate creative endeavors. So, everyday cognitive processes are not only relevant for successful problem-solving skills, memory and knowledge acquisition, but also quite pertinent in the analysis of understanding the underpinnings of creativity. Generative processes draw from retrieval cues, which in turn derive information from long-term memory, which eventually provides cognitive sorting mechanisms in deciding novelty in synthesis

processes (Bink & Marsh). The serial cognitive processing reveals approximately the same pattern whether the outcome is everyday problem-solving tasks or novel creative endeavors.

Zabelina and Robinson (2010) posited that creative individuals differ in automatic and controlled-processing performance. The major difference between creative and noncreative individuals is the ability of creative individuals to exhibit flexible cognitive performance. Flexible cognitive performance can be defined as the ability to alternate between controlled and automatic-processing styles or techniques depending on the varying contexts (Zabelina & Robinson, 2010). Therefore, creative individuals would elicit more overall flexibility in assessing possible solutions to problems or events, or various stimuli when constructing a holistic approach or artistic endeavor. Creative individuals could thereby adjust their cognitive styles (e.g., controlled vs. automatic processing) according to the contextual demands of the situation. Zabelina and Robinson (2010) showed significant results supporting their hypothesis that high levels of flexible cognitive control were a predictor of higher levels of creative originality. Of course, this line of research inherently calls to attention rather or not originality is a facet of creativity (Mastandrea, Bartoli & Carrus, 2011; Madjar, Greenberg & Chen, 2011). Both creative and noncreative individuals were shown to demonstrate some level of flexible cognitive control, but the higher individuals ranked on creative originality the higher they also ranked on flexible cognitive control (Zabelina & Robinson, 2010). Presumably, creative individuals would utilize cognitive flexibility more frequently with approach motivational characteristics versus those with avoidant motivational characteristics (Roskes, De Dreu & Nijstad, 2012). In other words, motivational styles also influence creativity.

Approach and avoidant motivational approaches elicit differential creative styles. On the one hand, approach motivation instigates a more flexible cognitive processing thusly increasing

the chances for genuine originality in creative endeavors (Roskes, De Dreu & Nijstad, 2012). On the other hand, avoidant motivational approaches toward creative tasks will entail more perseverance and cognitive stamina in the pursuit of creative tasks, especially those concerning a problem-solving component. Although, both approach and avoidant motivational styles toward creativity are successful in formulating creative ideas (Bink & Marsh, 2000), ultimately approach motivational styles are more beneficial in terms of flexibility, originality and inventive idea generation. It is important to note that both motivational styles will produce creative outcomes, albeit by different pathways. Avoidant motivational styles are more suitable for long-term, problem-orientated tasks that involve a creative component, but not as suitable for tasks for the sole purpose of creative idea generation (Roskes, De Dreu & Nijstad, 2012).

Framing procedures are commonly employed as a means to instigate approach or avoidance motivational responses. For example, Roskes, De Dreu and Nijstad (2012) instructed participants to “not make a bad first impression on a potential interviewer” (avoidant motivation), compared to “try to make a good first impression on the interviewer” (approach motivation). In both instructional cases the actual event is the same, only the framing of the event is different in order to facilitate either approach or avoidant motivational outcomes. If a given task had a specified purpose, or if goal setting is introduced, creativity is facilitated among avoidance-motivated individuals. If there is a clear purpose for a task, such as performing well on a final exam in order to get an “A” in the course, creativity will be facilitated for both avoidance- and approach-motivated individuals (Roskes, De Dreu & Nijstad, 2012). Eventually, over time, individuals will learn which motivational styles to employ in order to get the best results. So, learning from past experience will also lead to better creative outcomes in the future.

Yet another factor that can enhance creative processes is experience, or a certain amount of wisdom from past experiences (Nielsen, Pickett & Simonton, 2008). The experienced person has a definite advantage when solving novel problems over the inexperienced person. Conceptual creative methods involve systematic evaluation and planning in order to solve a problem or invent something (Madjar, Greenberg & Chen, 2011; Mastandrea, Bartoli & Carrus, 2011; Glaveanu, 2012). Conceptual creative thinkers would also rely heavily on past experiences and be more consistent and stable in their decision-making processes, they would plan and prepare for tasks. In contrast, experimental creative methods involve an ever-changing, trial-and-error approach toward problem-solving tasks. Experimental creative thinkers are more inconsistent, and consequently more spontaneous, in their decision-making processes compared to conceptual creative thinkers (Nielsen, Pickett & Simonton, 2008). The experimental approach is more effective for solving convergent tasks, which are tasks that have only one precise answer or solution. Divergent tasks do not have a specific right answer or solution (Karlins, 1967), but instead require more inventiveness in response. So, both conceptual and experimental creative thinkers would need to use trial-and-error problem-solving strategies. In other words, both types of thinkers would essentially utilize experimental methods. Conceptual and experimental creative techniques are most adequately placed on a continuum because many creative thinkers will alternate between conceptual and experimental methods depending on the situation or task. This seems to contradict theorists that equate creativity to personality types because personality types are consistent and stable over time. Individuals would not alternate between different personality types given different situations. Instead personality, if it changes at all, does so over long periods of time (Funder, 2010).

Many assessments and definitions of creative works are dependent on cultural and societal interpretations. Whether a particular society or culture deems a creation as creative depends, albeit indirectly in many instances, on the previously mentioned dimensions of novelty, appropriateness and impact (Piffer, 2012). Since these three dimensions of assessing creativity span across cultures and time periods they constitute a degree of universality. Creativity has been studied from both a cognitive and personality psychological perspective. Cognitive psychology seeks to identify and define creativity based upon delineating types of creative processes and their experimentally measurable outcomes (Mastandrea, Bartoli & Carrus, 2011; Nielsen, Pickett & Simonton, 2008). Personality psychology seeks to ascertain the array of traits and characteristics that constitute a presumed creative personality within an individual (Glaveanu, 2012). It is important to note that the cognitive perspective concentrates more on determining creative processes and the personality perspective is more concerned with identifying creative individuals, such as the next Mozart or Einstein. Working from a cognitive paradigm anyone can engage in creative activities; in essence creativity becomes more commonplace. Intuitively, anecdotal accounts of creativity tend to discount, or outright ignore, the commonality of creativity. Indeed, laypersons' interpretations of creative endeavors are subsumed by the looming presence of anomalous and/or extraordinary individuals. The creative processes are neglected and pale in comparison to the enormous aura and essence of the creative individual, connoting an essentialist view of creativity instead of a procedural and systematic view. Many creativity researchers argue or even equate academic, or other intellectual accomplishments, as predictive of creativity. However, it is interesting that many individuals that the general public would rate as highly creative would not meet such criteria. In fact, many individuals within the entertainment industry may have indeed done very poorly academically but nonetheless are

ranked as highly creative according to public opinion. Many creativity researchers are ignoring the social relevance of creativity (e.g., appropriateness and usefulness) (Piffer, 2012), and restricting creativity to narrow academic criteria in an attempt to study it scientifically. It is important to operationally define creativity in order to study it scientifically, however, researchers should remain more cognizant of potentially important elements of creativity being lost in translation. A good example of this intellectual/creativity paradox is Albert Einstein. Einstein was a brilliant physicist who had a tremendous impact on society, but the general public would not necessarily deem him as creative within other dimensions, such as artistic creativity. After all, Einstein was also a music enthusiast who faithfully played the violin and yet never truly excelled musically. In other words, even though Einstein was a scientific genius he was never a musical genius. So, if *IQ*, or some other *g* factor, is truly predictive of creativity or creative accomplishment, why do so many highly intelligent individuals, such as the likes of Einstein, Hawking and Newton, never succeed at other creative endeavors? Is it due to just a lack of interest or effort, or are there various distinctive types of creativity? Just as there has been postulated to be multiple intelligences (Gardner, 1991), there may also be various types of creativity. This would answer the question as to why highly intelligent individuals do not succeed at every endeavor they attempt. It would also shed light on why some individuals are creative in one domain while simultaneously non-creative in other domains. Creativity, as intelligence, is domain specific.

Although, there are many aspects of creativity, this study will focus on: Self/Everyday, Scholarly, Performance, Mechanical/Scientific and Artistic. The current study will focus on these 5 subtypes of creativity and overall creativity because all 5 subtypes are very distinctive and different from one another, and all 5 subtypes also strongly correlate with overall creativity.

Kaufman (2012) proposed five distinctive subtypes of creativity, so it stands to reason that different types of creative thinkers will perform differentially depending on the cognitive task at hand. The present study seeks to examine how different subtypes of creative thinkers will perform on a computer-simulated dual-task. Past studies have tested creativity's influence on various cognitive tasks, but none have specifically examined creativity's influence on dual-tasks. Hypothesis 1 is: There will be no difference between high and low creative individuals' performance on the automatic-processing segment of the dual-task. Hypothesis 2 is: Highly creative individuals will perform better at the controlled-processing segment of the dual-task.

## **Methods**

### **Participants**

Participants were 19 undergraduate students (males,  $N = 10$ , females,  $N = 9$ ), ranging in age from 18 to 24 ( $M = 19.58$ ,  $SD = 1.50$ ). Participants received course credit in their introduction to psychology course. Most participants were freshmen ( $N = 13$ , 68.4%), while sophomores, juniors and seniors accounted for 10.5% each of the remaining sample. The majority of the sample identified as Caucasian 42.1%, followed by African-American 31.6%, and Other/Native-American 26.3 percent. Majors varied widely ( $N = 19$ ,  $SD^2 = 23.89$ ) with biology majors representing the majority ( $N = 4$ , 21.1%). The relationship status of most participants was single ( $N = 17$ , 89.5%). Most participants checked yes to playing video games ( $N = 14$ , 73.7%) with the majority of participants playing video games 1-3 hours a day ( $N = 13$ , 68.4%) followed by 4-6 hours a day ( $N = 1$ , 5.3%). One participant's data was pulled from the original sample due to lack of data on the dual-task test, and another participant's data was pulled because it was an outlier and could potentially skew the results. This brought the original sample of 21 to 19 participants for the present study.

## **Measures**

A 6-question demographic measure assessed the following variables: age, gender, ethnicity, video gaming habits, year in college, major and relationship status.

The Kaufman Domains of Creativity Scale (K-DOCS) is a 50-item questionnaire utilized to assess 5 different subtypes of creativity: Self/Everyday, Scholarly, Performance, Mechanical/Scientific and Artistic. An additional overall creativity score was also calculated in the final analysis based upon combining the scores of the 5 K-DOCS subtypes. On the K-DOCS each subset of items comprised a subtype of creativity, for example items 1-11 comprised the Self/Everyday creativity score, 12-22 comprised the Scholarly creativity score and so on. Scores on all 5 subtypes of the K-DOCS were combined and averaged to create an overall creativity measure.

The Dual Task Experiment (DTE) test, created by Hanover College, was retrieved from: [http://psych.hanover.edu/JavaTest/CLE/Cognition/Cognition/dualtask\\_instructions.html](http://psych.hanover.edu/JavaTest/CLE/Cognition/Cognition/dualtask_instructions.html). Hanover College is a private liberal arts college located in Indiana. The DTE consisted of the automatic-processing task, which was the easy task, and a controlled-processing task, which was the difficult task. The automatic-processing task consisted of tracking a dot on a computer monitor with a box using the mouse, which was considered the easier task. The controlled-processing task consisted of clicking the mouse when the “X” target appeared. The “X” target appeared in random intervals and so constituted the more difficult task. The DTE was calibrated for 5 practice trials followed by 30 test trials. At the end of the last test trial 4 average scores were provided for: Practice Track Error, Average Tracking Error (ATE), Proportion of Target Response (PTR) and Proportion of Non-target response (PNR). The ATE was a measure of the

automatic-processing component of the dual-task and the PTR was a measure of the controlled-processing component of the dual-task.

## **Procedures**

First participants signed a consent form to participate in the study and receive course credit. Next participants were instructed they would be taking part in a computer-simulated dual-task test. They were informed that there would be 5 practice trials followed by 30 test trials. They were then instructed to push the space bar to start and to subsequently push the space bar between each trial in order to start the next trial. It took participants approximately 20 minutes to finish all trials of the dual-task portion of the study. After the participants finished all of the trials they were instructed to raise their hand to receive the K-DOCS questionnaire.

The next phase of the study consisted of participants completing the demographic measure followed by the K-DOCS questionnaire. A debriefing form was attached at the end of the questionnaire informing them as to the true nature of the study. After completion of all the measures and reading the debriefing form participants could leave. The entire study took approximately 30-40 minutes to complete.

## **Results**

First, we examined the K-DOCS measure. It was determined that all 5 subtypes of creativity on the K-DOCS measured different types of creativity, because none of the 5 subtypes correlated significantly with one another (see Table 1). However, all 5 subtypes had strong significant positive correlations with the overall creativity score (see Table 1).

### **Hypothesis 1**

The first hypothesis proposed no difference between high and low creative individuals' performance on the automatic-processing segment, the easy task, of the dual-task. This

hypothesis was supported from the findings. Correlational analysis revealed no significant positive or negative correlations between the 5 subtypes of creativity measured by the K-DOCS and the Average Tracking Error (ATE) (see Table 1). The ATE was the measurement of the automatic-processing task.

## **Hypothesis 2**

The second hypothesis predicted that highly creative individuals would perform better on the controlled-processing segment, the difficult task, of the dual-task. This hypothesis was not supported, however the correlational analysis revealed a strong significant negative correlation between participant scores on Self/Everyday creativity and Proportion of Target Response (PTR) ( $r = -.59, n = 19, p < .01$ ). This significant correlation prompted a further analysis. A linear regression with Self/Everyday creativity as the predictor and Proportion of Target Response (PTR) as the dependent variable (DV) found that Self/Everyday creativity accounted for a significant amount of the variance in PTR,  $R^2 = .344, F(1, 18) = 8.91, p < .01$ .  $R^2$  indicates the amount of variance in PTR that is influenced by Self/Everyday creativity. So, .34% of PTR is explained by Self/Everyday creativity.

## **Discussion**

The present study did not find a positive or advantageous influence of creativity on the controlled-processing task. We also found no difference between high and low creative individuals' performance on the automatic-processing task. However, the particular subtype of Self/Everyday creativity appeared to have an adverse impact on the performance of the difficult controlled-processing task that required greater attention in the computer-simulated task. A possible explanation of this finding could be that creative thinkers become bored easily and consequently perform worse on a controlled-processing task. Self/Everyday creative thinkers

may be more susceptible to boredom due to their tendency of constantly seeking out novel ways to entertain themselves and others. Perhaps, this particular type of creative thinking would be expected to be a disadvantage when it comes to difficult, controlled-processing tasks.

Essentially, Self/Everyday creative thinkers would be less able to focus their attention and perhaps more likely to interpret the difficult, controlled-processing task as being repetitive and boring.

Self/Everyday creativity could be a great advantage in other less restricted and less structured settings. This subtype of creative thinkers could indeed flourish and excel in an environment where spontaneity and intuitiveness are the keys to success. In the present study, the controlled-processing task used seemed to have no real impact on other subtypes of creative thinkers for better or worse. Nevertheless, this type of difficult, controlled-processing task deeply influenced the performance of Self/Everyday creative thinkers. In retrospect, it makes sense that those high in Self/Everyday creativity would be less able to stay focused on the controlled-processing task because they would be constantly seeking novel stimuli to entertain themselves.

### **Implications**

Exploring the links between creativity and cognitive functioning can benefit educators and researchers alike by calling attention to different types of creativity. If educators are informed as to how certain individuals best acquire and retain knowledge it could help them tailor educational techniques to better suit those individuals. For example, if it is known that Self/Everyday creative thinkers are more likely to succeed in open, unstructured settings then educators can implement a less structured classroom environment that would facilitate their learning. These types of creative thinkers could have more flexibility in arranging their schedules

and class time. Of course, it is possible that other types of creative thinkers would learn better in more structured, conventional classroom settings.

There is still much research needed to explore the connections between creativity and cognitive functioning. Defining creativity and dividing it into its constituent subtypes is a monumental task in itself. However, establishing connections between these various types of creativity and their corresponding cognitive styles is important. The knowledge gained through exploration of the connectivity of cognition and creativity can ultimately help individuals adjust their learning styles and environments accordingly.

### **Limitations**

A major disadvantage of the current study was its relatively small sample size. A larger sample size has the potential for more significant findings. Also, the present study only explored one particular cognitive task, that of dual-task performance involving one automatic-processing easy task and one controlled-processing difficult task. Future research could be more fruitful by exploring other cognitive tasks, such as knowledge acquisition, memory, problem solving, perception and attention and their respective links to the various types of creativity. This study's findings may not generalize to other cognitive tasks or other controlled-processing tasks. Additionally, future research would also benefit from utilizing multiple measures of creativity. Although the K-DOCS is a fairly valid measure in distinguishing between 5 basic subtypes of creativity, other creativity measures could distinguish an even broader array of different types of creativity. It is not presently known just how many types of creativity exist and how they connect to, and may facilitate performance in cognitive tasks.

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Appendix A

Table 1

*Intercorrelations between the subtypes of creativity and overall creativity (N = 19)*

	1	2	3	4	5	6	7	8	9
1. Avg. Track Error	–	-.506*	.545*	.320	-.067	.189	-.031	-.155	.076
2. Target Response		–	-.157	-.586**	-.434	-.023	-.135	-.117	-.359
3. Non-Target Response			–	-.093	-.105	.160	.392	-.110	.073
4. Self/everyday				–	.342	.226	-.101	.264	.517*
5. Scholarly					–	.312	.085	.204	.608**
6. Performance						–	.142	.275	.716**
7. Mechanical/Scientific							–	.432	.471*
8. Artistic								–	.722**
9. Overall									–

\*  $p < .05$

\*\*  $p < .01$