

Individual Differences in Cognitive Flexibility Predict Poetry Originality

Ivonne J. Figueroa and Robert J. Youmans

George Mason University
Fairfax, VA 22031, USA
ifiguero@gmu.edu

Abstract. To be successful at creative tasks, people are often required to think flexibly by selectively switching from one cognitive strategy to a more optimal strategy when presented with changing environmental cues [1]. In this study, we measured differences in students' cognitive flexibility, and then examined how well flexibility predicted performance on a subsequent creative task, a Haiku poem. Cognitive flexibility was measured using two variables found in the Wisconsin Card Sorting Task (WCST). Measures of cognitive flexibility predicted the Haiku poem's originality that students created. The results of this study suggest that cognitive flexibility may play an important role in creative writing and in predicting an individual's level of creativity. Implications are discussed.

Keywords: Individual differences, cognitive flexibility, creativity, poetry.

1 Introduction

A major goal of individual difference research is to develop stable measurements of people's traits, and then use those measures to predict differences in subsequent behaviors. Stable individual differences have been detected in peoples' ability to control their attention or hold information in working memory. Differences in these cognitive abilities have been shown to predict how people subsequently perform on vigilance [2], divided attention tasks [3] and attentional failures [4]. Though individual differences in cognitive abilities have been shown to be predictive of basic attention and perception tasks, recent research has the role of individual differences in more complex, higher-order behaviors like *creativity* [5].

Predictably, definitions of creativity vary widely among researchers; previous research has identified motivation [6], expertise [7], and regulatory focus [8] as behaviors that predict creativity. However, when it comes to measuring creative output, many researchers agree (e.g., [9], [10], [11]) that these can be measured along three dimensions: fluency, originality, and flexibility. Fluency is defined as an ability to generate large numbers of ideas, and measures of creative fluency include idea generation tasks that ask people to populate ideas or objects belonging to a particular category [10]. Originality is defined as the ability to generate novel ideas, and measures

of originality include the ability to generate rare or unique ideas within a given category. Finally, flexibility is the number of infrequent cognitive categories that are generated. While none of the three traits are thought to be the sole components of creativity, each trait is thought to represent a part of the multifaceted process that somehow facilitates creative breakthroughs [9], [11], [10].

Cognitive flexibility is defined as the ability to selectively switch from one cognitive strategy to a more optimal strategy when presented with changing environmental cues [1], [12]. Because individuals with high cognitive flexibility are thought to be especially proficient at changing strategies, it stands to reason that individual differences in cognitive flexibility may result in creative behaviors such as *fluency*, *originality*, and *flexibility*. Additionally, recent research has found that individuals who exhibit high flexibility are better at noticing subtle changes in a change blindness tasks [13]. Bilingual children have been able to demonstrate flexible thinking by creating original drawings of non-existent objects [14]. Furthermore, accounting for cognitive flexibility in constructive learning styles resulted in mastery of a subject, or ease of use of the task [15], [16].

The purpose of the present study was to objectively measure an individual's level of cognitive flexibility, and subsequently, to determine if cognitively flexibility predicted performance on an original thinking task, writing a Haiku poem. Although the WCST produces a large number of dependent variables, we utilized only two of the dependent variables that detect flexible thinking [17]. In this study we attempted to directly test whether individual differences as detected using one type of measure, the WCST, predicted creative behavior on a very different type of task, haiku poetry. The hypothesis being tested in this study was that individuals who exhibit a tendency to more easily switch between cognitive mental strategies (i.e., high cognitive flexibility) would produce more creative Haiku poems.

2 Method

2.1 Participants

Forty California State University, Northridge students participated in this study. Ten participants were male and 29 were female of varying ages ($M = 21.28$, $SD = 12.8$; one participant had incomplete data and was excluded from the analysis). Ethnicities reflected the diversity of the university (White/Caucasian = 7; Hispanic/Latino = 19; African-American/Black = 5; Asian = 6; other = 3). Participants were able to sign up for the study for course credit.

2.2 Materials

Wisconsin Card Sorting Task (WCST). The WCST was used to measure cognitive flexibility. The WCST requires a participant to sort through a deck of cards using three rules: color, shape, and number. Beginning with the first rule, participants must sort ten consecutive correct cards before the sorting rule is switched. Abandoning the sorting rule prior to ten consecutive correct sorts results in a failure to maintain set.

After ten consecutive correct responses, the rule for sorting is changed, and the number of perseverative moves, i.e. the number of moves attempting to sort by the previous, now inactive, rule, divided by the total number of errors yielded the percent perseverative error. The task is complete either if the participant runs out of cards to sort (128 cards), or if the participant completes six correct sorting categories (see [18]).

Haiku Poetry. The Haiku poetry task required participants to write a poem about their favorite season. Participants were given specific instructions about how to write a Haiku poem, which included a brief description of Haiku poetry:

“Haiku is a form of Japanese Poetry. It often centers around nature. Many Haiku themes include nature, feelings or experiences. A Haiku must “paint” a mental image in the readers mind. Usually they use simple words and grammar. The most common form for Haiku contains three short lines. Haiku Poems don’t rhyme; they follow a pattern. The pattern for haiku is the following:

Line 1 = 5 syllables

Line 2 = 7 syllables

Line 3 = 5 syllables”

Following the description portion, participants were shown a sample Haiku that was written about a rose. In case participants needed additional space, the following instructions were provided:

“Now it’s your turn. Pick your favorite season. That season will be your theme. For what purpose will you write? What mood do you want to convey? Brainstorm words that are about nature. Choose the words that you like from the list. Count the syllables (parts) of the words.”

Participants were not required to complete the brainstorming exercise. The instructions shown here were printed at the top of the page. This excluded the sample Haiku poem.

To assess Haiku originality, each word was assigned a number based on the total number of times it was used in all 39 poems. Once every word used was assigned a frequency count, we calculated the average score of each poem. Haiku poems with *lower* scores were most original signifying that less frequent words were used in those poems.

2.3 Procedure

Upon reading the informed consent, participants completed a demographics questionnaire. The WCST or the Haiku were presented in random, counter-balanced order. Prior to writing the Haiku poem, participants were given a description of the goals and rules of a Haiku. No time limit was given to complete the Haiku, but all participants completed the task within five minutes. Before completion of the WCST, the experimenter read a set of instructions that explained the rules, which stated that the only feedback that could be provided was whether the card was correctly,

or incorrectly sorted [18]. No time limit was given to complete the task. Following the completion of both tasks, participants were debriefed.

3 Results

Multiple regression analysis was conducted to test if individual differences in cognitive flexibility predict poetry originality. First, the data was checked for *skewness*. Two cases were excluded from the analysis because they were two standard deviations above the mean of both ‘failure to maintain set’ and ‘percent perseverative errors’.

We screened for multicollinearity and there was no correlation higher than 0.55 (VIF = 1.33). The combination of both predictors explained 22% of the variance (adjusted $R^2 = .22$; $F(2, 33) = 5.8$, $p < .01$) indicating that our overall model was predictive of Haiku originality ($M = 5.996$, $SD = 2.02$). There was no interaction effect between ‘failure to maintain set’ and ‘percent perseverative errors’ ($F(1, 6) = .64$, $p = ns$). We also identified a significant main effect for each predictor. ‘Percent perseverative errors’ ($M = 12.19$; $SD = 5.72$) significantly predicted Haiku creativity ($t(36) = 2.93$; $p < .01$) indicating that participants who switched from the old sorting rule to the new sorting rule in less moves wrote more creative Haiku. ‘Failure to maintain set’ ($M = .61$; $SD = .87$) also significantly predicted Haiku creativity ($t(36) = -2.98$; $p < .01$) indicating that participants who failed to maintain set without being prompted by the experimenter wrote more creative poems. (Figure 1 shows two Haikus, a low and high scoring poem. Also included are percent perseverative score, number of failures, and originality score.)

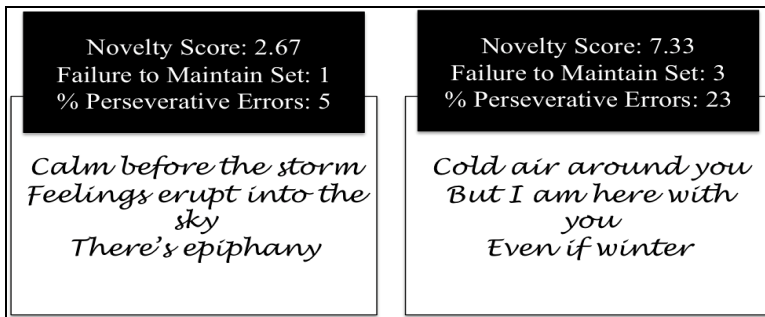


Fig. 1. Example of a low scoring (original) Haiku on the left and a high scoring (less original) Haiku on the right

4 Discussion

The goal of the present study was to determine whether individual differences in cognitive flexibility could predict performance on a creative task, Haiku poetry. We found that participants who exhibit higher levels of cognitive flexibility assessed by

the WCST, wrote more original Haiku. Both variables speak differently about how an individual who is cognitive flexible processes information.

The first variable that predicted creative performance, percent perseverative errors, indicated that overall, individuals who took a longer time to switch to the next sorting rule on the WCST, wrote less original Haiku poems. One possibility is that individuals who are more efficient at switching between cognitive strategies, and do not perseverate, are more likely to generate novel, infrequent and original ideas. The relationship between failure to maintain set and originality is more ambiguous. In this case, individuals who broke set in the WCST more often, and thereby performed worse on the WCST, wrote more original Haiku. It is unclear why failure to maintain set, which demonstrates poor performance on the WCST, correlated with creative performance. One explanation for this result could be that individuals who are failing to maintain set, are simply distracted from the task [19] thereby generating infrequently used words as a result of their distracted mindset. Further research is required to determine why a failure to maintain set leads to more creative performance.

One limitation of this study deals with the method chosen to score the originality of the poems. We admit to a certain degree of subjectivity in our measure of originality, but given the challenge of quantifying such a multi-faceted construct we feel that originality scores derived from word infrequency are at least somewhat objectively representative of originality. However, the researchers had to determine if certain words should be grouped together. For example, should 'rain' and 'raining' count as the same category? Should *colors* be grouped together (i.e., green, brown, yellow), or should they each be given a frequency score? Future research could combine objective and subjective measures that use inter-rater reliability as a way to determine creativity.

Second, some people might argue about what it means to be high or low along any individual difference dimension, or about the stability of individual difference measures in general. For example, can cognitive flexibility be improved over a lifetime? Can it be enhanced? In fact, research has shown that exercise enhances cognitive flexibility [20], and therefore it might not be safe to assume that cognitive flexibility is a measurement that is not entirely stable. Further research is required that uses other measures of cognitive flexibility (e.g., eye tracking) that can provide insight about why a person is cognitively flexible.

Finally, the results of this study raise questions about the impact of motivation on creativity not accounted for in our predictions. Previous research has linked individual's intrinsic motivation has to creative performance [6], [21]. That is, motivation may be the underlying factor that influences creativity and not cognitive flexibility. In this study, we did not measure motivation, mood, or other emotional traits. However, an argument against the effect of motivation is that individuals who failed to maintain set on the WCST were more creative. It seems inconsistent that a participant failing to maintain set out of boredom would be motivated to write a creative poem. However, we concede that different tasks might motivate people differently. Future research should include measures of mood and motivation in order to determine the effect, if any, of potential mediating variables.

The focus of this study was to assess how individual differences in cognitive processes such as those required in cognitive flexibility predict performance on a subsequent high order task, creativity. The implications extend to fields like Human Factors because it is often necessary to identify individual traits that will result in original and innovative performance. Employers, the military, design products teams, etc., might want to consider having teams who possess a range of complimentary individual differences, one of which will exhibit high levels of cognitive flexibility. Additionally, a heterogeneous team may consist of one focused or persistent member that is paired with a cognitively flexible member, which in turn, would be preferable to two flexible or focused people. Both types of individuals, each with their own level of creativity would work together to create novel, infrequent, and efficient strategies, ideas, or products.

References

1. Scott, W.A.: Cognitive Complexity and Cognitive Flexibility. *Sociometry* 25, 405–414
2. Shaw, T.H., Matthews, G., Warm, J.S., Finomore, V.S., Silverman, L., Costa, P.T.: Individual differences in vigilance: Personality, ability and states of stress. *Journal of Research in Personality* 44, 297–308 (2010)
3. Colflesh, G.J., Conway, A.R.: Individual differences in working memory capacity and divided attention in dichotic listening. *Psychonomic Bulletin & Review* 14, 699–703 (2007)
4. Unsworth, N., McMillan, B.D., Brewer, G.A., Spillers, G.J.: Everyday attention failures: An individual differences investigation. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 38, 1765–1772 (2012)
5. DeYoung, C.G., Flanders, J.L., Peterson, J.B.: Cognitive Abilities Involved in Insight Problem Solving: An Individual Differences Model. *Creativity Research Journal* 20, 278–290 (2008)
6. Amabile, T.M.: Motivation and creativity: Effects of motivational orientation on creative writers. *Journal of Personality and Social Psychology* 48, 393 (1985)
7. Ericsson, K.A., Krampe, R.T.: Institute of Cognitive Science
8. Herman, A., Reiter-Palmon, R.: The effect of regulatory focus on idea generation and idea evaluation. *Psychology of Aesthetics, Creativity, and the Arts* 5, 13–20 (2011)
9. Amabile, T.M.: The social psychology of creativity: A componential conceptualization. *Journal of Personality and Social Psychology* 45, 357 (1983)
10. Ward, T.B., Patterson, M.J., Sifonis, C.M.: The role of specificity and abstraction in creative idea generation. *Creativity Research Journal* 16, 1–9 (2004)
11. De Dreu, C.K.W., Baas, M., Nijstad, B.A.: Hedonic tone and activation level in the mood-creativity link: Toward a dual pathway to creativity model. *Journal of Personality and Social Psychology* 94, 739–756 (2008)
12. Dennis, J.P., Vander Wal, J.S.: The Cognitive Flexibility Inventory: Instrument Development and Estimates of Reliability and Validity. *Cognitive Therapy and Research* 34, 241–253 (2009)
13. Youmans, R., Figueroa, I., Kramarova, O.: Reactive Task-Set Switching Ability, Not Working Memory Capacity, Predicts Change Blindness Sensitivity. In: *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, vol. 55, pp. 914–918
14. Adi-Japha, E., Berberich-Artzi, J., Libnawi, A.: Cognitive flexibility in drawings of bilingual children. *Child Development* 81, 1356–1366 (2010)

15. Spiro, R., Feltovich, P.J.: Jacobson, Mi.J., Coulson, R.L.: Cognitive flexibility, constructivism, and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. Presented at the
16. Lowrey, W., Kim, K.S.: Online News Media and Advanced Learning: A Test of Cognitive Flexibility Theory. *Journal of Broadcasting & Electronic Media* 53, 547–566 (2009)
17. Figueroa, I.J., Youmans, R.J.: Developing an Easy-to-Administer, Objective, and Valid Assessment of Cognitive Flexibility. In: *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, pp. 944–948 (2011)
18. Heaton, R.K., Chelune, G.J., Talley, J.L.: Wisconsin Card Sorting Test manual: Revised and expanded. In: *Psychological Assessment Resources*, Odessa, Florida (1993)
19. Barceló, F., Knight, R.T.: Both random and perseverative errors underlie WCST deficits in prefrontal patients. *Neuropsychologia* 40, 349–356 (2002)
20. Masley, S., Roetzheim, R., Gualtieri, T.: Aerobic Exercise Enhances Cognitive Flexibility. *Journal of Clinical Psychology in Medical Settings* 16, 186–193 (2009)
21. Roskes, M., De Dreu, C.K.W., Nijstad, B.A.: Necessity is the mother of invention: Avoidance motivation stimulates creativity through cognitive effort. *Journal of Personality and Social Psychology* 103, 242–256 (2012)