Testing Ritual Knot Tracing for Cognitive Priming-Effects Rules Out Analytic Analogy

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INTRODUCTION

The most widely accepted hypotheses to date for the emergence of ritual knot patterns across cultures reduce their production to alienating experiences, such as trance-induced states initiated by some combination of social crisis, physiological trauma, ritual ceremony, and/or the use of narcotics (Lewis-Williams & Dowson 1988; Kluüver, 1966; Froese, 2013; Froese et al., 2013a). We find such explanations unsatisfactory since they tacitly exclude the general population and inhibit exploration of more meaning-centered explanations binding the social to the psychological, the person to the external manifestation. Creative cognition is often discussed in terms of blending and symmetry (Fauconnier & Turner 2002; Hofstadter & Sanders 2013; Wiseman & Paul 2014; Pelkey 2016): Could the reproduction of these patterns have related cognitive benefits? To find out, we approached this study with two primary hypotheses:

- ❖ That repeated tracing of a symmetrical knot design would correlate with enhanced performance on creative cognitive tasks.
- ❖ That these effects would be more apparent when traced mindfully.

METHODS

Study I

Participants

- 280 Ryerson undergraduate students recruited from two classes: Fall 2017 and Winter 2018 semesters
- Ages 17–37 (M=19.2, SD =2.23); randomly assigned to conditions using online randomizer

Design

- 3x2 (condition x testing time) mixed-ANOVA design
- Conditions randomly assigned: **Prime, Anti-Prime, or Control**
- Tested at two time points – pre- and post- tracing manipulation
- Dependent variables: participants' responses on RAT, VAT, RST, and AFT (Note: see column at right for abbreviation definitions)

Procedure

- Three Sections: 1) pre-test, 2) demographic questionnaire and FFMQ, and 3) post-test (see Figure 1).
- Four tasks pre-test: RAT, VAT, RST, and AFT
- Followed by demographics questionnaire and FFMQ
- During post-test, participants presented second version of task set
- Prime and Anti-Prime conditions: Each measure in post-test preceded by 90-second tracing exercise (see Figures 2 and 3, respectively)
- Control condition: no image tracing exercise

Figure 1. Visual representation of order of measures completed in study.

Study 2

Participants

- 190 Ryerson Undergraduate students recruited from 3 classes Fall 2018 and Winter 2019 semesters
- Participant ages 17–28 (M: 19.66, SD: 2.40); randomly assigned to conditions using same online randomizer tool as in Study I

Design

- As in Study I: 3x2 (condition x testing time) mixed-ANOVA design
- Dependent variable: participants' responses on AFT only

Procedure

- Identical to Study I, with two exceptions: (1) Pre- and Post- Tests used AFT measure only, (2) In Prime and Anti-Prime conditions, post-test AFT measure preceded by shorter 60-second tracing

MATERIALS

Tracing: Participants in Prime and Anti-Prime conditions provided with on-screen image (Figure 2 or 3) to trace manually between measures in post-test:

Figure 2: Tibetan Eternal Knot traced in Prime condition

Figure 3: Team-Created asymmetrical image traced in Anti-Prime condition

Reciprocal Syntax Test [RST]

- Developed by local team in order to assess individuals' preferred mode of reflexive syntax (sub-hypothesis: chiasitic ABBA syntax preferred?)
- Four images presented at pre-test, four at post-test four types of reflexive syntax as in Figure 2 (order randomized per-participant).

Figure 4: RST (Reciprocal Syntax Test) example

Figure 5: AFT (Analogy Finding Task) example

Analogy Finding Task [AFT] – Weinberger et al. (2016), Green et al. (2016)

- Measure designed to assess creative reasoning
- Two sets of 5 partial analogies with 20 possible word pairings to complete analogy.
- Each partial analogy, has 3 or 4 matching valid analogies (see Figure 3)
- First set of 5 partial analogies presented during pre-test, second post-test.

Remote Associates Test [RAT] – S. Mednick & M.T. Mednick (1962)

- Sixteen-problem measure divided between pre- and post- test
- Assessing creativity and lexical associations
- Example: for [elephant, lapse, and vivid] the correct response is [memory].

Verbal Analogies Test [VAT] – Carriedo (2016)

- Measure assessing analogical reasoning with two six-question sections: first in pre-test; second in post-test.
- Participants presented incomplete analogies and asked to fill in blanks.
- Example: [_____ is to PUPPY as CAT is to _____.]

Demographic questionnaire. Participants asked to self-report age and gender, plus questions regarding language proficiency + acquisition

Five Factor Mindfulness Questionnaire [FFMQ] – Baer et al. (2006)

Measures five dimensions of mindfulness: observing, describing, awareness, non-judging of internal experience, non-reacting to internal experience

RESULTS

Study I

Table 1

Means and standard deviations of variable scores from pre-test to post-test across all three conditions. Mean values of demographic variables for all three conditions also reported.

Variable	Prime		Condition Anti-Prime		Control	
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
RAT	0.03 (0.09)	0.19 (0.14)	0.05 (0.09)	0.18 (0.15)	0.06 (0.11)	0.20 (0.17)
VAT	0.67 (0.14)	0.70 (0.17)	0.64 (0.15)	0.69 (0.16)	0.65 (0.17)	0.67 (0.22)
RST	0.33 (0.20)	0.16 (0.21)	0.29 (0.22)	0.19 (0.21)	0.36 (0.21)	0.21 (0.23)
AFT (TSD)	415.22 (267.13)	432.92 (272.50)	399.37 (245.34)	393.93 (232.44)	459 (305.59)	437.92 (243.55)
AFT (CDS)	210 (250.34)	255.94 (261.05)	196.93 (212.48)	203.65 (212.20)	246.67 (276.94)	233.77 (229.29)
Age	18.92 (1.97)		19.24 (2.68)		19.41 (1.68)	
Gender (% female)	84.3%		70.7%		78.4%	
FFMQ	.66 (.08)		.64 (.08)		.62 (.08)	

RAT. Significant main effect of time, $F(1, 170) = 206.84, p < .001$ indicates all three conditions provided more correct responses at Time 2 compared to Time 1.

- No significant main effect of Condition, $F(2, 170) = .52, p = .60$
- Time and Condition: no significant interaction $F(2, 170) = .62, p = .54$.

VAT. Significant main effect of time, $F(1, 174) = 6.19, p = .01$ indicates all three conditions had higher percentage of correct analogical reasoning at Post-test compared to Pre-test.

- No significant main effect of Condition, $F(2, 174) = .44, p < .65$
- Time and Condition: no significant interaction, $F(2, 174) = .268, p < .77$

RST. Significant main effect of time, $F(1, 174) = 40.64, p < .001$ indicates decrease in participants' preference for answers that used explicitly chiasitic syntax from Pre-test to Post-test.

- No significant main effect of Condition, $F(2, 174) = 1.20, p = .30$
- Time and Condition: no significant interaction $F(2, 174) = 1.13, p = .33$.

AFT. No significant main effect of Time or Condition obtained for either total or creative semantic distance scores; no significant interaction between Time and Condition.

Study 2

Table 2

Means and standard deviations of participants' AFT scores from pre-test to post-test across all three conditions. Mean values of demographic variables for all three conditions also reported.

Variable	Prime		Condition Anti-Prime		Control	
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
AFT (TSD)	485.20 (301.73)	487.04 (324.65)	456.04 (285.79)	486.76 (326.81)	441.98 (310.29)	474.43 (291.31)
AFT (CDS)						
Age	19.66 (2.40)		19.48 (1.98)		19.80 (2.27)	
Gender (% female)	74%		74%		70%	
FFMQ	62.03 (7.98)		62.75 (7.88)		63.44 (7.42)	

AFT. No significant main effect of Time or Condition on either total or creative semantic distance scores; no significant interaction between Time and Condition.

Figure 2: Study One (UL), Study Two (UR): comparison of TSD from S1 to S2 (same scale); Study I (LL), Study 2 (LR): Comparison of CDS from S1 to S2 (same scale)

DISCUSSION

- ❖ Contrary to our primary hypotheses, these two studies reveal no correlation between basic measures of analogical pattern solving, creative cognition and mindful tracing of a ritual knot design.
- ❖ Something most of our tests share in common, however, is a preference for analytic or deductive logical reasoning processes.
- ❖ More complex modes of creative cognition that are less analytic may still be related and should be tested.
- ❖ Notably, the study provides strong supporting evidence across most measures for learning effects even after brief practice separated by a short intervening task.
- ❖ A surprising finding related to the RST test is the significant effect of time on a dis-preference for chiasitic syntax in reciprocal constructions.
- ❖ Cognitive affordances of manual knot tracing may still exist, and these affordances may still be related to other, less analytically oriented modes of creative blending. Visual tracing should be tested too.

REFERENCES

- Baer RA, Smith GT, Hopkins J, Krietemeyer J, Toney L. Using Self-Report Assessment Methods to Explore Facets of Mindfulness. *Assessment*. 2006 Mar 1;13(1):27–45.
- Carriedo N, Corral A, Montoro PR, Herrero L, Ballestrino P, Sebastián I. The Development of Metaphor Comprehension and Its Relationship with Relational Verbal Reasoning and Executive Function. *PLOS ONE*. 2016 Mar 8;11(3):e0150289.
- Fauconnier G, Turner M. *The way we think: conceptual blending and the mind's hidden complexities*. New York: BasicBooks; 2003.
- Froese T. Altered states and the prehistoric ritualization of the modern human mind. In: Adams C, Waldstein A, Luke DP, Sessa B, King D, editors. *Breaking Convention: Essays on Psychedelic Consciousness*. London: Strange Attractor Press; 2013. p. 10–21.
- Froese T, Woodward A, Ikegami T. Turing instabilities in biology, culture, and consciousness? On the enactive origins of symbolic material culture. *Adaptive Behavior*. 2013;21(3):199–214. 2.
- Green AE, Spiegel KA, Giangrande EJ, Weinberger AB, Gallagher NM, Turkeltaub PE. Thinking cap plus thinking zap: tDCS of Frontopolar Cortex improves creative analogical reasoning and facilitates conscious augmentation of state creativity in verb generation. *Cereb Cortex*. 2017;27(4):2628–39.
- Hofstadter D, Sander E. *Surfaces and Essences: Analogy as the Fuel and Fire of Thinking*. New York: Basic Books; 2013. 530 p.
- Kluüver H. *Mescal and Mechanisms of Hallucinations*. Chicago: University of Chicago Press; 1966.
- Lewis-Williams JD, Dowson TA, Bahn PG, Bandi H-G, Bednarik RG, Clegg J, et al. The Signs of All Times: Entoptic Phenomena in Upper Palaeolithic Art [and Comments and Reply]. *Current Anthropology*. 1988 Apr 1;29(2):201–45.
- Mednick S. The associative basis of the creative process. *Psychological Review*. 1962 May;69(3):220–32.
- Pelkey J. Symbiotic modeling: Linguistic anthropology and the promise of chiasmus. *Reviews in Anthropology*. 2016 Jan 2;45(1):22–50.
- Pelkey J. *The semiotics of X: chiasmus, cognition and extreme body memory*. London ; New York, NY: Bloomsbury Academic, an imprint of Bloomsbury Publishing; 2017.
- Weinberger AB, Iyer H, Green AE. Conscious augmentation of creative state enhances “Real” creativity in open-ended analogical reasoning. *PLoS ONE*. 2016 Mar 9;11(3):e0150773.
- Wiseman B, Paul A, editors. *Chiasmus and Culture*. Oxford: Berghahn Books; 2014. 264 p. (Studies in Rhetoric and Culture).

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