The Effects of Mental Imagery with Ocean Virtual Reality on Creative Thinking

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Abstract
Mental imagery in creativity has been regarded as facilitating insight in creative thinking, but several issues remain to be addressed to clarify the extent to which forms, abilities and strategies of imagery affect creative idea generation (Palmiero, Piccardi, Nori, Palermo, Salvi, & Guariglia, 2016). In this study, the issue of whether if Mental Imagery with Ocean Virtual Reality (MIOVR) can be an effective external support for creative thinking was explored. Participants (n = 30) were graduate students in the course of Teaching for Creativity in National Taiwan Ocean University. Creative thinking skills were assessed via the administration of the Abbreviated Torrance Test for Adults (ATTA; Goff & Torrance, 2002). 20 participants finished two tests, separated by a week. Before the second test, they saw an 8-minute virtual reality film of the underwater world, and at the same time they were free to create Mental Imagery. After seeing the film, they had three minutes to paint any images in their mind. Findings indicated that a significant difference ($p < .05$) between two tests existed, with post-test scoring higher than the pre-test on Creativity Index (CI), pre-test scoring as covariates. Narrative interviews and document analysis revealed that Mental Imagery with Ocean Virtual Reality could be used effectively to relax and involve in the mindfulness status. Finally, the differences of student creative performances on the ATTA test and their creative interests in daily life were discussed.

Keywords: Mental Imagery, Virtual Reality, Creative Thinking

Introduction

Creative ideas and individuals are often described as “imaginative”. Mental imagery has been regarded as facilitating insight in creative thinking, but several issues remain to be addressed to clarify the extent to which forms, abilities and strategies of imagery affect creative idea generation (Palmiero, Piccardi, Nori, Palermo, Salvi, & Guariglia, 2016). Mental imageries vary in style and content, in this study, we explore the relationship between mental imagery and creative thinking, and formulate hypotheses about the mechanisms through which types of mental imagery facilitate insight in creative thinking.

Psychological “Distance”

Recent research approach about insight has been the use of neuroimaging methods. Kounios & Beeman (2009) indicated direct stimulation of right frontal-temporal cortex coupled with inhibition of left frontal temporal cortex enhanced solving of insight problems. They found insight-related resting-state brain activity might also provide a link to recent social psychological research on construal level. According to construal level theory, psychological “distance”—thinking about things that are far away in space or time, or about people that are different from oneself—engages abstract thinking (Trope & Liberman, 2010). This inspired us to investigate whether the mental set effect of right frontal temporal cortex can be increased by distance stimulation. Could beautiful underwater world stimulate insight depends relatively more on psychological “distance”?

Attentional Selection and Remote Associations

In creative tasks, people need to flexibly switch between different processes, associations, or goals (Kounios & Beeman, 2014). Sometimes we need flexibly switch perception, demand relaxation of task shielding and keep open mind to distraction. Rowe, Hirsch, & Anderson (2007) argued that perceptual and conceptual attentions are closely linked. They indicated positive affect increase the breadth of attentional selection. Are stimuli in the Ocean Virtual Reality related to the breadth of attentional selection? Can Mental Imagery with Ocean Virtual Reality (MIOVR) make some change in the breadth or narrowness of attentional selection to include or exclude remote associations? This makes us curious.

Internal Focus of Attention

Zedelius and Schooler (2016) indicated there is evidence that shifting to an internal focus of attention increases the likelihood of insights. Specifically, it was found that more frequent blinking while problems were visually displayed to participants predicted insight solutions as compared to analytic solutions. Participants also looked away from the problems more before insight compared to analytic solutions. Will this be possible to enhance students' creative thinking if we allow students to have more opportunities to shift to an internal focus of attention?

Method

In this study, the issue of whether if Mental Imagery with Ocean Virtual Reality (MIOVR) can be an effective external support for creative thinking was explored. Creative thinking abilities were assessed via the administration of the Abbreviated Torrance Test for Adults (ATTA; Goff & Torrance, 2002; Chinese Revised by Charng-Yi Chen, 2006). All tests were scored by 2 research assistants (graduate students of education), trained in creativity tests scoring.

Participants

Participants (n = 30) were graduate students in the course of Teaching for Creativity in National Taiwan Ocean University, minimum 25 years old, maximum 57 years old. The participants were informed about the study and could withdraw at any time.

Intervention

20 participants finished two tests, separated by a week. Before the second test, they saw an 8-minute virtual reality film of the underwater world, and at the same time they were free to create Mental Imagery. After seeing the film, they had three minutes to paint any images in their mind. Through quantitative and qualitative data analysis, we compared the differences between two tests, and explored the differences of creative thinking between students.

Quasi-experiment design

Limited to natural educational settings, the participants are not randomly assigned. This study adopted the time-series experiment involved taking measures of a single group for a predetermined period of time, then giving the group the experimental intervention, and then again taking measures of them. One group (n=24) accepted pre-test, experimental intervention, and post-test. The other group (n=6), no experimental intervention, only took the test once.

The Qualitative Data

The Abbreviated Torrance Test for Adults (ATTA; Goff & Torrance, 2002; Chinese Revised by Charng-Yi Chen, 2006) test yields results for four norm-referenced abilities: Fluency, Originality, Elaboration and Flexibility. It also provides criterion-referenced creativity indicators for (a) verbal responses: Richness and Colorfulness of Imagery; Emotions/Feelings; Future Orientation; Humor-Conceptual Incongruity; Provocative Questions, and (b) figural responses: Openness-Resistance to Premature Closure; Unusual Visualization-Different Perspective; Movement and/or Sound; Richness and/or Colorfulness of Imagery; Abstractness of Titles; Context: Environment for Object, Articulateness in Story telling; Internal Visual Perspective; Expressions of Feelings and Emotions; Combination/Synthesis of Two or More Figures; and Fantasy.

The Quantitative Data

All students work together to build a web-sharing platform (Facebook: Creative Mind), free to publish the ideas or creative thinking cases found around the world. Through narrative interviews and document analysis, their interests of creative thinking in daily life were explored.

Major Findings

Students' Creative Thinking abilities

Table 1 shows the descriptive statistics of participants' creative thinking.

Table 1 Descriptive statistics of participants' creative thinking abilities

		N	*Minimum*	*Maximum*	*M*	*SD*
1st test	Fluency	29	13.0	19.0	16.9	1.8
	Originality	29	13.0	19.0	17.5	1.7
	Elaboration	29	13.0	19.0	17.5	1.6
	Flexibility	29	12.0	19.0	15.3	1.9
1st test	Norm-referenced score	29	56.0	76.0	67.2	5.1
	Criterion-referenced score	29	.0	10.0	5.7	2.9
2nd test	Fluency	21	14.0	19.0	16.6	1.7
	Originality	21	15.0	19.0	17.8	1.1
	Elaboration	21	17.0	19.0	18.2	0.9
	Flexibility	21	12.0	19.0	15.1	2.2
2nd test	Norm-referenced score	21	59.0	76.0	67.7	4.2
	Criterion-referenced score	21	1.0	18.0	10.8	4.1
1st test	Creativity index	29	57.0	85.0	72.9	7.4
	Creativity rank	29	3.0	7.0	5.8	1.5
2nd test	Creativity index	21	60.0	89.0	78.5	7.2
	Creativity rank	21	3.0	7.0	6.5	0.9
	N (Completely excluded)	20				

Differences between pre-test and post-test

Table 2 shows the differences between pre-test and post-test. Wilcoxon Signed-ranks test indicated that post-test scoring higher than the pre-test on Creativity Index (CI), $Z = -2.339$, $p < .05$. There is no significant difference on Norm-referenced score.

Table 2 Summary of Wilcoxon Rank Signed test on participants' creative thinking

2^{nd}-1^{st}test		*N*	*Mean Rank*	*Sum of Ranks*	*Z*	Asymp. Sig. (2-tailed)
Fluency	Negative Ranks	9	8.39	75.50	-1.469[a]	.142
	Positive Ranks	5	5.90	29.50		
	Ties	6				
	Total	20				
Originality	Negative Ranks	7	6.93	48.50	-.255[b]	.798
	Positive Ranks	7	8.07	56.50		
	Ties	6				
	Total	20				
Elaboration	Negative Ranks	2	6.25	12.50	-1.249[b]	.212
	Positive Ranks	7	4.64	32.50		
	Ties	11				
	Total	20				
Flexibility	Negative Ranks	10	7.50	75.00	-.882[a]	.378
	Positive Ranks	5	9.00	45.00		
	Ties	5				
	Total	20				
Norm-referenced score	Negative Ranks	9	11.17	100.50	-.656[a]	.512
	Positive Ranks	9	7.83	70.50		
	Ties	2				
	Total	20				
Criterion-referenced score	Negative Ranks	2	4.25	8.50	-3.609[b**]	.001
	Positive Ranks	18	11.19	201.50		
	Ties	0				
	Total	20				
Creativity index	Negative Ranks	5	7.40	37.00	-2.339[b*]	.019
	Positive Ranks	14	10.93	153.00		
	Ties	1				
	Total	20				
Creativity rank	Negative Ranks	4	4.00	16.00	-1.218[b]	.223
	Positive Ranks	6	6.50	39.00		
	Ties	10				
	Total	20				

* $p < .05$ ** $p < .01$

a. Based on positive ranks

b. Based on negative ranks

Differences between different pre-test CI score groups

Consider pre-test may also be a possible source of testing effect, participants were divided into three groups according to the pre-test CI scores (less than 27%, higher than 73%, and the middle). Table 3 shows the summary of Kruskal Wallis test on creative thinking between different pre-test CI score groups.

Table 3 Summary of Kruskal Wallis test on creative thinking between different pre-test CI score groups

2^{nd}-1^{st}test differences	Group[a]	*N*	*Mean Rank*	*Chi-Square*	*df*	Asymp. Sig.
Creativity index	1	3	13.83	6.14	2	.05*
	2	6	14.25			Group2>3
	3	11	7.55			
Fluency	1	3	15.5			
	2	6	11.58	3.70	2	.16
	3	11	8.55			
Originality	1	3	14.83			
	2	6	12.75	4.47	2	.11
	3	11	8.09			
Elaboration	1	3	16.5			
	2	6	10.83	5.13	2	.08
	3	11	8.68			
Flexibility	1	3	13			
	2	6	12.67	2.64	2	.27
	3	11	8.64			
Norm-referenced score	1	3	16.33	7.44	2	.02*
	2	6	13.33			Group1>3
	3	11	7.36			Group2>3
Criterion-referenced score	1	3	9.17	5.06	2	.08
	2	6	15			
	3	11	8.41			

a. Group 1, pre-test CI score less than 27%
Group 2, pre-test CI score between 28%-72%
Group 3, pre-test CI score higher than 73%

Analysis of Kruskal Wallis test showed a main effect of pre-test CI score on Creativity index and on Norm-referenced score. Post hoc analyses indicated that Group 2 was higher than Group3 on 2^{nd}-1^{st} test difference of CI score. It showed that participants with average pre-test CI score made greater progress ($p< .05$) on CI Score. And Group 1& 2 was higher than Group3 on 2^{nd}-1^{st} test difference of Norm-referenced score. It showed that participants with lower pre-test CI score made greater progress ($p< .05$) on Norm-referenced score. The other creative thinking indicators did not differ significantly between participants with different pre-test CI score.

Content Analysis of Students' Creative Interests

During this semester (February to June, 2017), all students worked together to build a web-sharing platform (Facebook: Creative Mind), they were free to publish the ideas or creative thinking cases they found. Table 4 shows the percentage of major themes of students' creative interests. There are more than 300 articles in total (ongoing). Facilitate convenience/practical orientation, Create fun/surprise, Life Aesthetics, Hands-on Handmade are most popular themes. Many cases involve these four themes: practical, aesthetic, technology and environmental protection. Many cases are just for fun.

Table 4 Percentage of major themes of students' creative interests

Themes	*N*	*%*
Facilitate convenience /practical orientation	59	21
Create fun / surprise	43	14
Life _Aesthetics	29	10
Hands-on Handmade	25	8
Life-technology application	16	5
Unusual Uses	14	5
Innovative teaching / creative teaching	11	4
Paper creation	10	3
Tools of creative thinking	8	3
Design thinking _ creative problem solving	7	2
Environmental reengineering _ public/visual arts	7	2
Environmental protection _ actual action	6	2
Multi-media innovation performance	6	2
Maverick	6	2
Future Thinking	5	2
Creative advertising/ propaganda	4	1
Cross-border thinking	3	1
Maker education	3	1
Other: e.g., Learning experience	40	13

N=305

Conclusion

Psychologists have long hypothesized that mental imagery may facilitate creative thinking, but like creativity, mental imagery is a multifaceted concept. Mental imageries vary in style and content, and not all kinds of mental imagery are likely to have the same effects on creative thinking. This study is the first step to explore the relationship between mental imagery and creative thinking. According to the literature, we formulated a hypothesis about the mechanism of Mental Imagery with Ocean Virtual Reality (MIOVR), emphasized psychological "Distance", attention breadth, remote associations, and internal focus of attention**.**

Findings indicated that a significant difference ($p < .05$) between two tests existed, with post-test scoring higher than the pre-test on Creativity Index (CI), pre-test scoring as covariates. Participants with average pre-test CI score made greater

progress ($p< .05$) on CI Score, and participants with lower pre-test CI score made greater progress ($p< .05$) on Norm-referenced score.

We also analyzed the major themes of students' creative interests. There are more than 300 articles posted on the website (ongoing). Facilitate convenience/practical orientation, Create fun/surprise, Life Aesthetics, Hands-on Handmade are most popular themes. Many cases involve these key points: practical, aesthetic, technology and environmental protection. Many cases are just for fun.

Limited to natural educational settings, this study was a quasi-experimental design; the researcher didn't control over the assignment to conditions and completely manipulate the causal variable of creative thinking. Such limitations need to be reminded to readers. Future work will concentrate on different medium, such as different 3D movies presenting natural underwater world or unnatural horizons; detect the breadth of intentional selection and measures of neurophysiological activity; explore more individualized intervention or mechanism that can facilitate special students' creative thinking.

References

Goff, K., & Torrance, E. P. (2002). Abbreviated Torrance Test for Adults manual. Bensenville, IL: Scholastic Testing Service. (Chinese Revised by Charng-Yi Chen, 2006)

Kounios, J. & Beeman, M. (2009). The Aha! Moment: The cognitive neuroscience of insight, Current Directions in Psychological Science, 18, 210-216.

Kounios, J., & Beeman, M. (2014). The Cognitive Neuroscience of Insight. Annual Review Of Psychology, 65(1), 71. doi:10.1146/annurev-psych-010213-115154

Palmiero, M., Piccardi, L., Nori, R., Palermo, L., Salvi, C., Guariglia, C., eds. (2016). Creativity and Mental Imagery. Lausanne: Frontiers Media. doi: 10.3389/978-2-88919-994-5

Rowe, G., Hirsch J. B., & Anderson, A. K. (2007). Positive affect increases the breadth of attentional selection. Proc. Natl. Acad. Sci. USA 101:383–88

Trope, Y., & Liberman, N. (2010). Construal-level theory of psychological distance. Psychol. Rev. 117:440–63

Zedelius, C. M., & Schooler, J. W. (2016). The Richness of Inner Experience: Relating Styles of Daydreaming to Creative Processes. Front. Psychol. 6:2063. doi: 10.3389/fpsyg.2015.02063

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