

Comparison of Non-stimuli, WordNet and Related Search Terms in Creative Concept Generation

*Huh, Yoon Jung

*College of Arts, School of Fine Arts, Kookmin University, JeongNeung - Ro,
SeongBuk - Gu, Seoul 136-702, Korea
huh0900@kookmin.ac.kr*

Abstract

This paper examines the effect of related search term stimuli during concept generation in the game graphic design process by comparing the creativity of three conditions: non-stimuli, WordNet, and related search terms. The results indicated Google-related search terms are most effective, producing creative results among the three conditions. Thus, intelligent results that are based on collective knowledge are more effective than no stimuli and WordNet, which is organized into synonym sets, each representing one underlying lexical concept.

Keywords: *Google-related search terms, stimuli, creativity*

1. Introduction

Successful concept generation is invaluable, and many exercises and efforts are underway to secure it. The demand for concept generation has produced many techniques and methods for developing creative ideas to generate concepts, and there are numerous and significant empirical studies examining methods to enhance this process. This paper is motivated not only by the importance of concept generation but also by the idea that language can help design output that is visual in the game graphic design process. Language stimuli can help generate concepts. Since language is linked to thought and related to reasoning, it may be possible to use language or a single word as a design tool. Moreover, employing language and reasoning in concept generation may encourage the creative cognitive processes. This paper examines the effect of stimuli during concept generation under the following conditions: non-stimuli, WordNet, and related search terms.

2. Stimuli in Concept Generation

Past research that focused on the effects of related search terms' stimuli implies that related search terms enhance design creativity when compared to concept generation without any stimuli [1]. Huh (2013) suggested that related search terms were more effective than WordNet as stimuli in concept generation. The scores for the creativity of the responses generated with related search terms stimuli were significantly higher [2]. This paper examines the effects of stimuli during concept generation under three conditions. WordNet is a lexical database that groups words into sets of synonyms called synsets; provides short, general definitions; and records the various semantic relations between these synonym sets. The purpose is twofold: to produce a dictionary and thesaurus in one, which is more intuitively usable, and to support automatic text analysis and artificial intelligence applications [3]. WordNet design is inspired by current psycholinguistic theories of human lexical memory. English nouns, verbs, and adjectives are organized into synonym sets, each representing one underlying lexical concept. Different relations link the synonym

sets [4], which is very different from a dictionary. Most synonym sets are connected to other synsets via a number of semantic relations. These relations vary based on the type of word and noun: **Hypernym**: Y is a hypernym of X if every X is a (kind of) Y (canine is a hypernym of dog). **Hyponym**: Y is a hyponym of X if every Y is a (kind of) X (dog is a hyponym of canine). **Coordinate terms**: Y is a coordinate term of X if X and Y share a hypernym (wolf is a coordinate term of dog, and dog is a coordinate term of wolf). **Holonym**: Y is a holonym of X if X is a part of Y (building is a holonym of window). **Meronym**: Y is a meronym of X if Y is a part of X (window is a meronym of building) [4].

Glass box, Science box, Ping-pong ball, Song, Assembling manual, Pandora, Frog origami, Flower mobile, Fortune box, Cradle, Free fortune, Ball, Paperwork	Plastic, Building waste, Waste tire, Recycled mark, Abandoned resource, Recycled paper, Oil, USA, Pet bottle, Importation, Waste, Building materials
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Figure 1. Search Terms Related to “Box” and “Recycle”

House holder, Cap, Village headman, The military, Owner, Headman, Host, Conductor, Leader, Husband, Hubby, Traveler	Crane, Parrot, Duck, Owl, Sparrow, Red-crowned crane, Pigeon, Sea gull, Smart dresser, Cuckoo, Bat, Chicken
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Figure 2. Search Terms Related to “Chief” and “Penguin”

Covering, Handling, Load and unload, Collection, Repair, Assembly, Facilities, Deal with, Ornament, Use, Transportation, Rehabilitation	Coin bank, Submarine, Ballot box, Ham, Rice-bin, Case, First-aid box, Medical kits, Chest, Safe, Cash box, Pack
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Figure 3. WordNet Terms “Recycle” and “Box”



Figure 4. WordNet Terms “Chief” and “Penguin”

To examine which stimuli contributes more to the creativity of concept generation, game design students in the concept generation stage were given non-word stimuli, related search terms, and WordNet stimuli. 60 participants were divided into three groups: group A, group B, and group C. Group A performed the task under the non-word stimuli condition; group B performed the task with related search terms; and group C performed the task under the WordNet stimuli condition. In condition 2, the task involved related search terms that were searched via five levels. Figure 1 shows the related search terms that resulted from the searches for “recycle” and “box,” while Figure 2 shows related search terms that resulted from searches for “chief” and “penguin.” In condition 3, the tasks were executed with WordNet stimuli. Figure 3 shows a synonym set connected to other synsets based on hypernyms, hyponyms, coordinate terms, holonyms, and meronyms of “recycle” and “box.” Figure 4 shows a synonym set connected to other synsets based on hypernyms, hyponyms, coordinate terms, holonyms, and meronyms of “chief” and “penguin.”

3. Setup of Experiment

Each participant was asked to solve a design problem. The task was to design the character of “recycling box” and “head of penguin.” Twenty minutes were allotted to the development of each idea. Participants were first asked to generate and explain their concepts in words and then to sketch the concepts on sheets of A4-sized paper. In this research, the creativity of the responses was evaluated from the viewpoint of practicality and originality based on Finke’s creativity evaluation. Following Finke (1990), creativity is defined as practicality and originality [6]. Whether the idea seems appropriate and has expandability of function gauges its practicality, and whether the idea is novel and innovative determines its originality. Finke’s method employed a combined creativity score by adding the originality and practicality scores.

4. Results

The participants produced sketches and wrote down their concepts and explanations. Two judges, experts with ten years’ experience in the field of art and design, individually evaluated the originality and practicality of each design response. The results of the judges’ evaluations were averaged. Concepts and sketches were analyzed in accordance with creativity. Based on Finke’s creativity evaluation, the responses were evaluated from the viewpoint of practicality and originality. Scores were given on a scale of 1 to 5, where 1 is low and 5 is high.

4.1. Practicality of 3 Conditions

The homogeneity of variance of practicality (Table 1) shows that it is not significantly valuable ($P < .05$).

Table 1. Homogeneity of Variance of Practicality

Levene Statistic	df1	df2	Sig.
3.697	2	57	.031

However, the Duncan test of practicality (Table 2) shows that the related search terms condition is distinguished from the non-stimuli and WordNet conditions. In the ANOVA test of practicality (Table 3), a significant difference between practicality scores for the related search terms condition and the other conditions was found ($F = 14.168$, $p < .05$).

Table 2. Duncan Test of Practicality

	N	Subset for alpha = .05	
		1	2
WordNet	20	1.850	
Non-stimuli	20	2.038	
Related Search Term	20		2.938
Sig.		.394	1.000

Means for groups in homogeneous subsets are displayed.

a. Users Harmonic Mean Sample Size = 20.000

Table 3. ANOVA Test: Practicality of 3 Conditions

	df	F	Sig.
Non-stimuli	Between Groups = 2 Within Groups = 57 Total = 59		
Related Search Term		14.168	.000
WordNet			
Total			

4.2. Originality of 3 Conditions

The homogeneity of variance of originality (Table 4) shows that it is not significantly valuable ($P < .05$), whereas the Duncan test of originality (Table 5) indicates the related search terms condition is distinguished from the non-stimuli and WordNet conditions. In the ANOVA test of originality (Table 6), a significant difference between practicality scores for the related search term condition and the other conditions were found ($F = 21.657$, $p < .05$).

Table 4. Homogeneity of Variance of Originality

Levene Statistic	df1	df2	Sig.
4.055	2	57	.023

Table 5. Duncan Test of Originality

	N	Subset for alpha = .05	
		1	2
WordNet	20	1.775	
Non-stimuli	20	1.850	
Related Search Term	20		3.150
Sig.		.751	1.000

Means for groups in homogeneous subsets are displayed.

a. Users Harmonic Mean Sample Size = 20.000

Table 6. ANOVA Test: Originality of 3 Conditions

	df	F	Sig.
Non-stimuli	Between Groups=11.954 Within Groups=.552		
Related Search Term		21.657	.000
WordNet			
Total			

4.3. Creativity of 3 Conditions

The homogeneity of variance of creativity (Table 7) shows that it is not significantly valuable ($P < .05$).

Table 7. Homogeneity of Variance of Creativity

Levene Statistic	df1	df2	Sig.
4.368	2	57	.017

Table 8. Duncan Test of Creativity

	N	Subset for alpha = .05	
		1	2
WordNet	20	1.850	
Non-stimuli	20	1.906	
Related Search Term	20		3.044
Sig.		.798	1.000

Means for groups in homogeneous subsets are displayed.

a. Users Harmonic Mean Sample Size = 20.000

Table 9. ANOVA test: Creativity of 3 Conditions

	df	F	Sig.
Non-stimuli	Between Groups = 9.07 Within Groups = .478		
Related Search Term		18.96	.000
WordNet			
Total			

Yet, the Duncan test of creativity (Table 8) shows that the related search term condition is distinguished from the non-stimuli and WordNet conditions. In the ANOVA test of creativity (Table 9), a significant difference between creativity scores for the related search terms condition and the other conditions were found ($F = 18.964, p < .05$).

Table 10. Mean of Practicality, Originality, and Creativity

	Condition	Mean	SD	Total Mean
Practicality	Non-stimuli	2.038	.6503	
	Related Search Term	2.938	.9028	.8307
	WordNet	1.850	.4398	
Originality	Non-stimuli	1.775	.7205	
	Related Search Term	3.150	.9333	.9688
	WordNet	1.850	.5156	
Creativity	Non-stimuli	1.906	.6525	
	Related Search Term	3.044	.8962	.8774
	WordNet	1.850	.4545	

Table 10 shows the mean of the originality, practicality, and creativity scores of the concepts for the three conditions. ANOVA tests were used to compare the practicality, originality, and creativity scores under different conditions. The mean scores are the highest with the related search terms condition among the three conditions. The originality score of the related search terms condition, in particular, is distinguished from that of the other conditions.

5. Conclusions

In this study, WordNet and related search terms were compared as stimuli in concept generation. To examine which stimuli contributes more to the creativity of concept generation, non-word stimuli, related search terms, and WordNet stimuli were given in the concept generation stage. ANOVA tests were used to compare the practicality, originality, and creativity scores under different conditions. The mean scores were the highest for the related search terms condition among the three conditions. The originality score of the related search terms condition, in particular, is distinguished from that of the other conditions.

In sum, the related search terms stimuli enhanced design creativity when compared to WordNet stimuli. This experiment aimed to examine which stimuli

contributes more to the creativity of concept generation. As a result, Google-related search terms are effective, thus producing creativity. Further, intelligent results that are based on collective knowledge are more effective than WordNet, which is organized into synonym sets, each representing one underlying lexical concept. In essence, related search terms can enhance and inspire the creativity of concepts.

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Author



Huh, Yoon Jung, Prof. Huh, Yoon Jung, Dr.-Ing. is a professor at Department of Art in Kookmin University where she teaches media art. She has worked in the area of digital media, both as an artist and as a researcher. Her research interests include media, creative visual ideation and serious game.

