# 언어기반 게임그래픽 디자인 발상의 창의적 인지에 관한 연구☆

# A Study on Creative Cognition of Language based concept Generation of Game   Graphics

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## 요        약

본 연구는 디자인발상 과정에서 구글의 연관 검색어를 언어 자극으로 제공했을 경우 디자인 결과에 어떠한 결과를 주는지 그리고 그러한 과정에서 창의적 인지 과정이 어떻게 사용되는 지를 분석하였다. 디자인 발상 과정에 구글의 연관 검색어를 자극제로 5단계에 걸쳐 제공하였다. 구글 검색어는 다수의 사용자의 참여와 공헌에 의해 새롭게 재창조된 지식과 정보를 제 공하는 집단지성에 기반을 두고 있다. 실험을 위해 두 가지 과제를 연관 검색어들과 함께 제공하였다. 디자인 발상실험 후 연관검색어의 사용여부와 빈도수 그리고 핀케의 12가지 제네플로어 모델이라는 3가지 기준에 의해 분석하였다. 본 연구의 결과를 요약하면 다음과 같다. 여러 단계의 연관 검색어들을 사용했으나, 초기 연관 검색어와 연관성이 높은 상위 단계의 검 색어가 하위 단계의 검색어보다 더 많이 사용되었다. 또한 상위 단계와 하위 단계의 검색어들을 함께 사용했을 때 더 창의적 의 결과가 나타났다. 핀케의 제네플로어 모델의 12가지 인지 과정에 따라 실험결과물을 분석한 결과 창의적 결과물은 단순히 연관 검색어를 사용하기 보다는 여러 단어들을 연합하고 변형하였으며 또한 창의적인 결과에는 12가지 인지 과정 중 개념적 해석, 기능적 추론과 맥락적 전이와 같은 인지 과정이 사용되었다.

## ABSTRACT

In this paper it is hypothesized that word stimuli that are presented by Google's search word, would improve the quality of the design solution, so this research examines the effect of related search word stimuli in concept generation and analyzes the results through the processes of creative cognition. In the process of concept generation, words are given as stimuli which are generated through Google's related search and these search words are given by 5 levels. Google search is based on the collaboration philosophy. People's participation and contribution recreate knowledge and information, so these renewed and related search words update in real time by people are used as stimuli. Two problems are provided with related search words. After the design concept generation the results are analyzed by 3 bases: the usage of related search words and those of frequency, creativity, and Finke's 12 Geneplore model. These are the results of the research.

Many levels of related search words are used in design concept generation but especially higher levels which are more related to search words are more used than lower levels. The usage of multi words and conjunction with higher levels and lower levels words are observed in creative results. On the creative cognitive processes, it is more creative when using association and mental transformation with the related search words than using the related search words simply. Creative outputs also use conceptual interpretation, functional inference, and contextual shifting of creative cognitive processes of Finke's 12 Geneplore model.

☞ keyword : 디자인발상(Design concept generation), 단어자극(Word Stimuli), 연관검색(Related Search), 창의적 인지(Creative Cognition)

# 1. INTRODUCTION

In this study it is hypothesized that word stimuli would improve the quality of the design solution.

The studies of creativity have done through design process, creative cognition and attitude of creativity. This research aims to improve creativity in design generation by using words, particularly from Google's related search words, as stimuli. Furthermore the results of experiments would be analyzed through the processes of Finke et al's Geneplore model which focuses on specific cognitive processes and structures that contribute to creative results, and this paper would defined which cognitive processes are used effectively in successful results in the word based design generation.

In Section 2, Wonderwheel model is described, which is used as a tool in the experiment and it is related to Google's related search word. And Finke et al.'s Geneplore model is described, which is used as analysis tool. Section 3 describes experiments, and Section 4 presents analysis method and experimental evaluation of the result.

# 2. METHOD

## 2.1 WORD STIMULI

In design reasoning words play an important role. Words contribute in mind as the flow of consciousness, and words lend themselves to play in relation to other words like association. In the design concept generation the major advantage of words is that there is no fixation to a specific shape or form possible. Other researchers also recognize the importance of language to the design and have studied the words based creative concept generation.

Lui et al represented a divergent - convergent idea generation process model and proposed that word
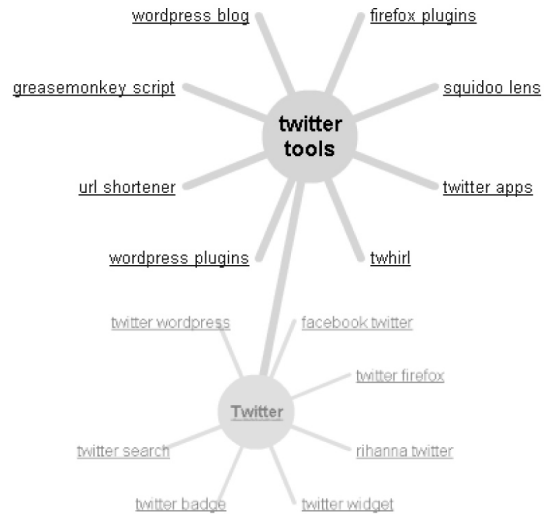


(Figure 1) Wonderwheel.

stimuli enhance this process [1].

Chui and Shu searched for biological analogies for design in natural-language format using lexical linguistic relationships. They used these relationships in engineering problems to recover relevant biological phenomena as stimuli. The production of lexical relationships, such as within the framework of WordNet expresses the continuing reasoning and thought processes [2]. Chui and Shu investigated how designers use verbs as stimuli in Wordnet hierarchy, and resulted that transitive verbs tended to result successful and complete concept [3]. Segers et al presented 'word graph' which is a computer-aided design system for architectural design. This effort is also motivated by evidence that designers annotations can be structured within a language framework. They investigate the effects of offering feedback to annotations, namely by presenting word graphs that contain the architect's annotations and semantic associations based on these words. and it is found that using words as stimuli for concept generation, can stimulate design through 'word graph'. But they cannot find a significant increased creativity of the
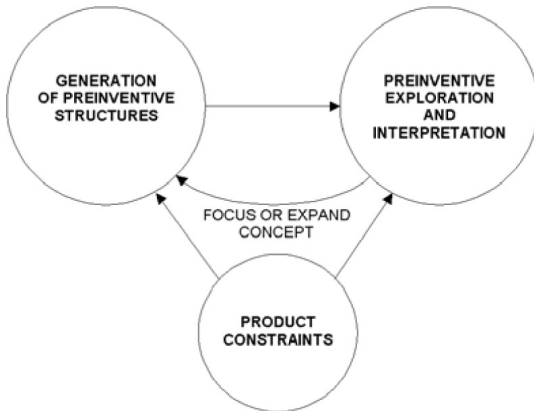
(Figure 2) The basic structure of Geneplore model

result, or a significant reduction of fixation [4].

Goldschmidt and Sever proposed the textual stimuli may be useful as part of the design process. For this study they provided texts to designers that include ideas from fields that are closely related to the design problem field. There is a significant difference in originality between the work had not been exposed to any text stimuli and the work done with text stimuli, regardless of whether the texts were closely related to the assignment [5].

In this study Google's related search words are used for stimuli. There is Wonderwheel service which shows the related search words like the form of mind map. (Fig. 1) shows the result and it is easy to search other related search words.

Google search is based on the collaboration philosophy. People's participation and contribution recreate knowledge and information, so these renewed and related search words which are updated in real time by people are used as stimuli.

## 2.2 CREATIVE COGNITION

The study of Creative cognition, the goal of which is to use methods of cognitive science to understand how creative ideas are generated to explore the mental processes and structures that emphasize creative thinking has been done through design researchers.

Thought processes are the part of research field of cognition. Finke et al propose Geneplore model as creative cognitive processes shown in (Fig. 2), which focuses on specific cognitive processes and structures that make available to creative results and products. The Geneplore model distinguishes between generative and exploratory cognitive processes in developing creative ideas. Both generative and exploratory cognitive processes are applied to preinventive structures which are generated, explored, regenerated, and modified by generative and exploratory processes. [6].

Geneplore model is a combination of generation processes and exploration processes which are shown in **Table 1**. and **Table 2**. The results of the experiment are tested by an introspective analysis of these 12 cognitive processes.

## 3. EXPERIMENT

### 3.1 DESCRIPTION OF PARTICIPANTS AND PROBLEMS

A total of 40 game planning students participate in this experiment. Participants are enrolled in a design course at the time of this experiment. Two problems are given to them. First one is 'chalk soldier of board world' and second one is 'madam player in community Olympic'.

### 3.2 DESCRIPTION OF RELATED SEARCH WORD STIMULI SETS

Two problems are given with related search words which are searched by 5 levels through Wonderwheel. (**Fig. 3**) and (**Fig. 4**) show the words level hierarchy.

〈Table 1〉 Generation processes 〔Finke et al.〕〔7〕

| | |
|---|---|
| Memory Retrieval | It means retrieval of existing structures from memory, like recalling words or objects from memory. Mostly this process is quickly and automatically done. |
| Association | It implies formation of associations among retrieved existing structures. For example, several words or objects could be associated in novel ways, resulting in new simple types of preinventive structures. |
| Mental Synthesis | Mental Synthesis of component parts or single concepts can be combined to form more complex concepts resulting in preinventive structures, with the meanings of the initial concepts being altered. Parts can be mentally rearranged and reassembled. |
| Mental Transformation | Component parts, single concepts, or the more complex concepts that result, can be rotated or altered in shape by means of this. |
| Analogical Transfer | A relationship in one context is transferred to another, resulting in preinventive structures that are analogous to those that are already familiar. |
| Categorical Reduction | It is mentally reducing objects or elements to more primitive categorical descriptions. It can involve for instance looking at an object |

〈Table 2〉 Exploration 〈and interpretation〉 processes 〔Finke et al〕〔7〕

| | |
|---|---|
| Attribute Finding | It is a systematic search for unexpected or sprouting features in the preinventive structures. |
| Conceptual Interpretation | Generally it means that in a preinventive structure an abstract, Metaphorical or theoretical interpretation is searched for. This technique is often used while or after one transforms or combines preinventive structures. |
| Functional Inference | Functional Inference refers to the process of exploring potential uses or functions of a preinventive structure. This often implies imagining oneself actually trying to use the object in various ways. |
| Contextual Shifting | It is considering a preinventive structure in new or different contexts as a way of gaining insights about other possible uses or meanings of the structure. |
| Hypothesis Testing | In this, one seeks to interpret the structures as representing possible solutions to a problem. One explores implications of these structures for solving the problem. |
| Searching for Limitations | In this, one determines which ideas will not work or what types of solutions are not feasible. This process helps to restrict future searches and focus creative exploration in more promising directions. |
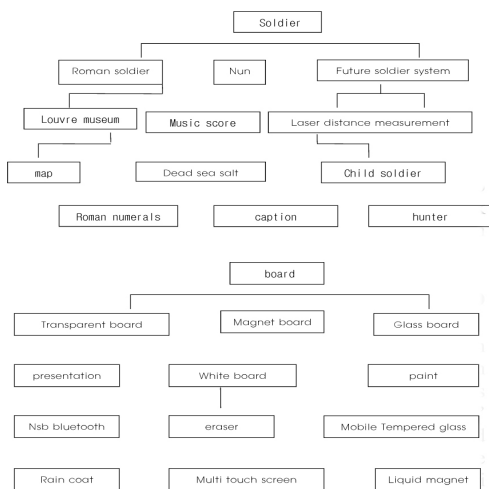


〈Figure 3〉 5 level hierarchy of related search word
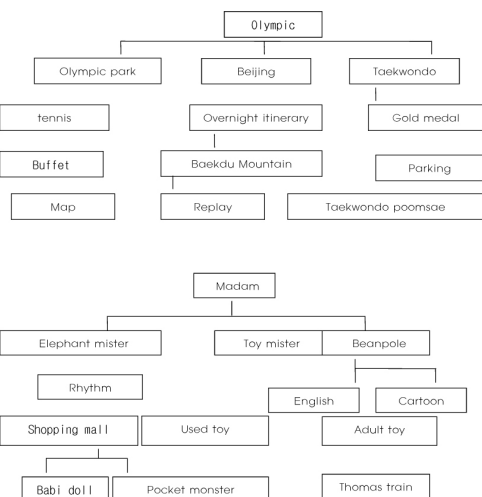


〈Figure 4〉 5 level hierarchy of related search word

(Table 3) Conjunction with higher levels and lower levels in first class.

| Levels<br>No. | Level 2 | Level 3 | Level 4 | Level 5 |
|---|---|---|---|---|
| No.1 | O | O | | |
| No.2 | O | | | O |
| No.4 | | O | | O |

In the first problem, words 'soldier' and 'board' are searched, and in the second problem, the word 'Olympic' and 'madam' are searched. Each problem set consists of 24 stimuli which allow multiple words from different levels but places stimuli not in hierarchy. We ask participants to generate their concepts first in words and second in sketches within the allotted time. And also ask to use stimuli provided if they want.

# 4. RESULTS AND ANALYSIS

## 4.1 ANALYSIS METHOD

We analyze responses by these standards.

1) Completeness – if the concepts and sketches are related to the problems, the concepts are examined for completeness. 2) Frequency of usage of related search word in levels - especially the first and second search words are called 'higher level' words and the third and fourth search words are called 'lower level' words. The higher level words are more related to the first word and lower level words are less related to it. 3) Analysis by the 12 processes of Geneplore model. 4) Creativity – The creativity of the concepts are evaluated from the viewpoint of practicality and originality based on the creativity evaluation by Finke et al [7]. At last we examine the relations among 2), 3), and 4).

## 4.2 ANALYSIS METHOD

1) In the view of completeness, 8 responses are excluded from the analysis because their concepts and sketches are less related to the problems. 32 responses are analyzed for the experiment and they are divided into 3classes by creativity and results are shown in (Table 4). 2) Many levels of related search words are used in design concept generation but especially higher levels which are more related to search words are more used than lower levels. Higher levels are used for 27 times and low levels are used for 12 times. 3) On the creative cognitive processes, it is more creative when using association and mental transformation with the related search words than using the related search words simply. 4) In the first class, usage of multi related search words and conjunction with higher levels and lower levels words are found and it is most related to creativity.

# 5. CONCLUSIONS

This research aims to improve creativity in design concept generation by using words, particularly from Google's related search words, as stimuli. Furthermore the results are analyzed through processes of Finke et al.'s Geneplore model which focuses on specific cognitive processes and structures that contribute to creative results, and define which processes are used in successful and creative results. Many levels of related search words are used in design concept generation but especially higher levels which are more related to search words are more used than lower levels. The usage of multi words and conjunction with higher levels and lower levels words are most related to creativity. On the creative cognitive processes, it is more creative when using association and mental transformation with the related search words than using the related search words simply. In creative

outputs, conceptual interpretation, functional inference, and contextual shifting of creative cognitive processes are also used. This paper is upgraded version of the conference paper of 2010 ICONI.Segers, N. "Computational representations of words and representations of words and associations in architectural design, development of a system support creative design," *Ph.D. Thesis. Technische Universiteit Eindhoven*, 2004.

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관심분야 : 디자인, 아이디어 발상, 기능성 게임

〈Table 4〉 Evaluation of the results

| class | no. | concept | Related search word | Memory Retrieval | Association | Mental Synthesis | Mental Transformation | Analogical Transfer | Categorical Reduction | Attribute Finding | Conceptual Interpretation | Functional Inference | Contextual Shifting | Hypothesis Testing | Searching for Limitations | practicality | originality | evaluation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 class | 1 | Taegwan monkey | Taekwando, overnight itinerary | o | o | o | o | | | | | | | | | o | o | Use many processes(use Mental Transformation in transforming to monkey) |
| | 2 | Pocket monster madam | Pocket monster, Taekwando | o | o | o | o | | | | | | | | | o | o | Use many processes( use Mental Transformation in using slippers for weapon) |
| | 3 | Sousage madam | | o | o | o | | | | | o | | | | | o | o | Use Conceptual Interpretation with sausage |
| | 4 | Roman chalk soldier with eraser sheild | Roman sodier, eraser | | o | o | | | | | | o | o | | | o | o | Use Functional Inference & Contextual Shifting(use eraser as a shield) |
| | 5 | Soldier who fight with eraser for scribbling queen | Eraser | | o | | | | | | | o | | | | o | o | Use Association and Functional Inference |
| 2 class | 6 | Olympic madam | Olympic park | | o | | | | | | | | | | | | | Use Association |
| | 7 | Lucky or unlucky madam | Overnight itinerary | o | o | | | | | | | | | | | | | Use Association from TV program |
| | 8 | Shopping mall concept | Beanpole, Shopping mall, babi doll | | | o | | | | | | | | | | | | Use Association from Beanpole, babidoll |
| | 9 | Transformation | Olympic park, Overnight itinerary, Baekdu mountain, Beanpole, Toy mister, Elephant mister | | o | o | | | | | | | | | | | | Use Mental Synthesis with related words |
| | 10 | Simple block character | | o | | | | | | | | | | | | | | Use Memory Retrieval with toy |
| | 11 | Shopping Olympic | Beijing Olympic | o | o | | | | | | | | | | | | | Use Association from Memory Retrieval |
| | 12 | Simple figure character | Roman soldier | | o | o | | | | | | | | | | | | Use Association from Roman soldier |
| | 13 | Bucket with chalks | | | | | | | | o | | | | | | | | Use Attribute Finding(chalk is easy to break) |

| class | no. | concept | Related search word | Creative cognitive processes | | | | | | | | | | | | practicality | originality | evaluation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Memory Retrieval | Association | Mental Synthesis | Mental Transformation | Analogical Transfer | Categorical Reduction | Attribute Finding | Conceptual Interpretation | Functional Inference | Contextual Shifting | Hypothesis Testing | Searching for Limitations | | | |
| | 14 | Use his body and powder to fight | White board, roman figure4 | | o | | | | | o | | | | | | | | Use Association and Attribute Finding |
| | 15 | Taekwondo Madam | Taekwondo poomsae | | | | | | | | | | | | | | | |
| | 16 | The order of battle | Nun, roman soldier, laser distance measurement, map, roman figure4 | | o | o | | | | | | | | | | | | Use Association and Mental Synthesis |
| | 17 | Battle of eraser and chalk | Eraser | | | | | | | | | o | | | | | | Use Functional Inference |
| 3 class | 18 | Check soldier | | | | | | | | | | | | | | | | |
| | 19 | Madam for baekdu mountain trip | Baekdu mountain trip | | o | | | | | | | | | | | | | Use Association |
| | 20 | Fitness madam | | o | | | | | | | | | | | | | | Use Memory Retrieval |
| | 21 | Board world | Transparent board, glass board, magnet board | | o | | | | | | | | | | | | | Use Association |
| | 22 | Broom madam | | o | | | | | | | | | | | | | | Use Memory Retrieval |
| | 23 | Board marker & chalk | Whiteboard | | | | | | | | | | | | | | | |
| | 24 | Boring soldier | | o | | | | | | | | | | | | | | Use Memory Retrieval |
| | 25 | Eraser& chalk soldier | Eraser | | | | | | | | | | | | | | | |
| | 26 | Roman chalk soldier | Roman soldier | | | | | | | | | | | | | | | |
| | 27 | Salt assassin and chalk soldier | Dread sea salt | | | | | | | | | | | | | | | |
| | 28 | Roman soldier | Roman soldier | | | | | | | | | | | | | | | |
| | 29 | Ordinary madam | Olympic park | o | | | | | | | | | | | | | | Use Memory Retrieval |
| | 30 | Permanent and bald hair | | o | | | | | | | | | | | | | | Use Memory Retrieval |

| class | no. | concept | Related search word | Creative cognitive processes | | | | | | | | | | | | practicality | originality | evaluation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Memory Retrieval | Association | Mental Synthesis | Mental Transform ation | Analogical Transfer | Categorical Reduction | Attribute Finding | Conceptual Interpretation | Functional Inference | Contextual Shifting | Hypothesis Testing | Searching for Limitations | | | |
| | 31 | Korean woman | | o | | | | | | | | | | | | | | Use Memory Retrieval |
| | 32 | Black and white board world | whiteboard | | | | | | | | | | | | | | | |