Meaning Structure Modeling: A Methodology for Creative Design of Shapes

Georgi V. Georgiev† **Yukari Nagai**† **Toshiharu Taura***† **Junya Morita**†

†School of Knowledge Science, Japan Advanced Institute of Science and Technology, 1-1 Asahidai, Nomi, Ishikawa 923-1292 Japan

* Graduate School of Engineering, Kobe University, 1-1 Rokkodai, Nada-ku, Kobe, 657-8501 Japan

{georgiev, ynagai, t-taura, j-morita}@jaist.ac.jp

Abstract

In this paper it is proposed methodology for support creative design of shapes. The methodology is focused on the importance of meanings in design process, their role and connection to shape space. The processes of building meanings' structure in shape is connected with concept dictionary. In conducted survey, the key features of meanings are analyzed by concept dictionary WordNet. The coordination, respectively relatedness of meanings of a shape is clarified as an important characteristic of successful shape.

Keywords:
Shape, Meaning, WordNet, Relatedness, Graphic design

1 Introduction

1.1 Background

Meanings of shapes are general research problem in product design. In this paper, research on meanings' characteristics of symbols is related to their likeability, defining the characteristics with the greatest importance for success. It appears that meanings' concept connections are more important than simplicity, for creating the image, and there is an increasingly stronger connection with increasing number of meanings. The major finding is that meanings' relations are important for higher evaluation, thus meanings relations can be associated with more highly creative results. In this way, meanings relations are important for the design process and its analysis, and controlled usage is one method to achieve creative designs.

These meanings' connection characteristics are used for a design support methodology. This methodology is based on a structural approach to meanings to expand design creativity. Both parallel structure between visual and concept spaces and structure of shape design are used in this new approach. Those supporting methodology characteristics are the key to creativity in design process of shapes.

Graphic design is an area with explicit and straight connection between meanings and shape. Meanings should be communicated in direct and uninterrupted way. In designing symbol designer is exploring broad range of meanings-shape associations. This is the process which is critical for success of design task.

On other hand, research into the design process is increasingly revealing the role of concepts and their connections. A large part of design research is focused on expanding the area of concepts – in efforts to expand design creativity [9, 7].

In design, the desired impression, sense, and creation of meaning often can have different results. Some research on visual components suggests the importance of shapes' meanings, and connects them to some other design characteristics [2, 3], but future research on measurement of meanings is suggested. Other research was done on logo image-word combination responses [4], but however, no extensive research on the meanings characteristics was done. A majority of logotype design tasks are focused on creating symbols or shape with a strong message, making a distinct impression and sense in mind.

1.2 Aim

The research's aim is to develop a method for supporting meanings' use in order to expand concept space and increase creativity in the design process. A part of that is answering the question: What meanings' characteristics and features are important for a successful shape?

Analyzing later conducted survey results on ex-

plicit examples, we can define the characteristics of shape meanings and their relations. To answer which characteristics have the greatest importance to its successful image?
This research establishes a methodology for supporting the creative design process generally.

2 Meaning modeling for creative design support

2.1 Methodology

We are proposing a methodology of expanding creativity on design concept level. It is based on structuring of meanings. The support method will use WordNet concept dictionary and database with meaning-shape abstract associations.
Concept dictionary is a network of meaningfully connected concepts in semantic structure. In the example of the design task, the reasoned meanings should be compared to that semantic structure.
The support method includes extraction of the optimal semantic structure from concept dictionary on two stages – restructure (abstraction and closure) and coordination (Figure 1). In this way the best combination of meanings is found. Exploring possibilities of meanings' matching on different levels will give more creative results and better meaning integration.
For example, especially if the concept dictionary connections are represented in morphology structure of the shape, this will give a coordinated and creative design.
The support system will provide better synthesis of initial concepts in the final shape. Furthermore, it will provide new possibilities for synthesis by expanding the space of concepts. Conceptual synthesis is a key to creativity in the design process [7, 1]. Using this meaning modeling methodology, we believe that the support of meanings' coordination will contribute to design creativity.
The approach is based on a parallel structure between concepts and shapes [10], through connecting language meanings and the creative design process (Figure 2).

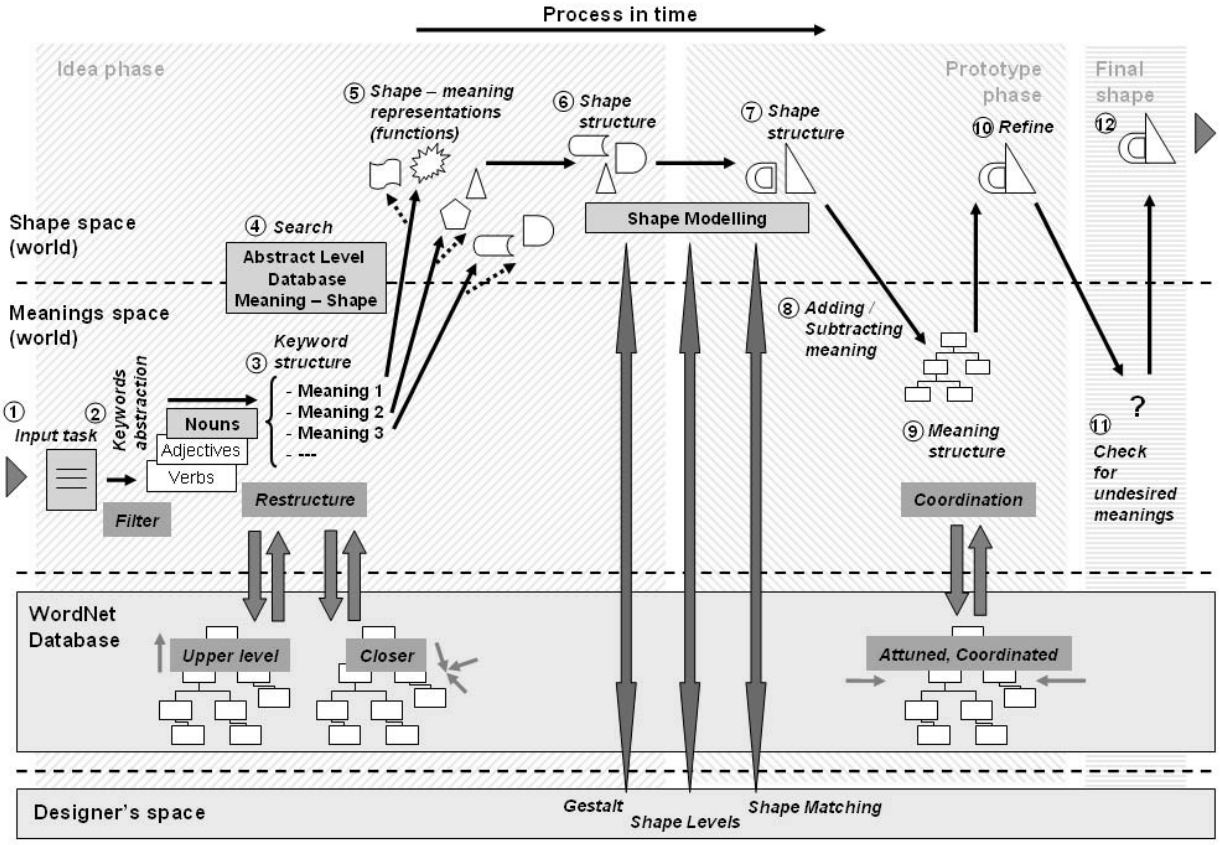

Figure 1. Steps of Meaning modeling methodology. Shape space, Meanings space, WordNet Database and Designer's space are differentiated.

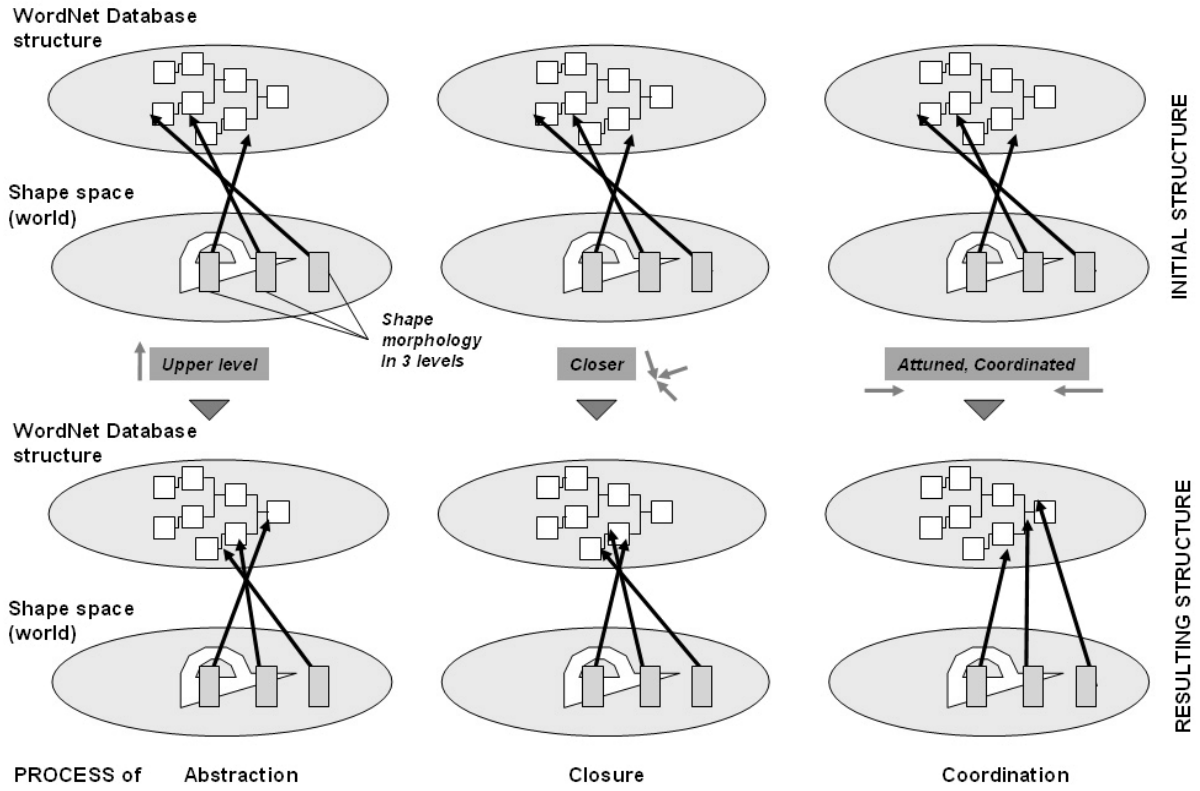

Figure 2. Processes of using meanings in WordNet and its connection to Shape space. From left to right: Finding upper level concepts (meanings), finding closer meanings and coordination (attuning) of meanings.

2.2 Shape morphology levels

In graphic design different classifications are widely used in symbol design.
Here we propose a shape morphology classification by three levels (Figure 3 and 2) for description of meanings.

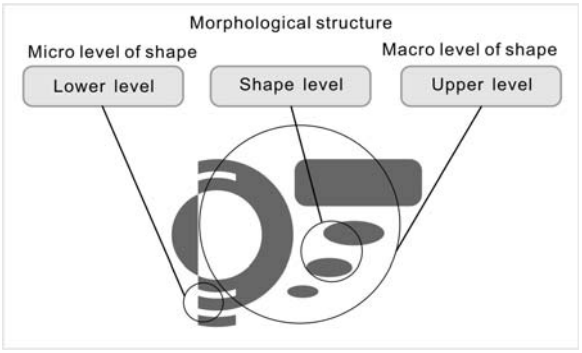

Figure 3. Example shape morphology levels for describing meanings

This classification is focused on Gestalt perception of shapes, building whole image:

1. First level is lower level. It describes a part of a shape, sub-shape and element.
2. Second level is a single closed shape level. It describes interaction and space between elements of shape.
3. Third level is upper level. It describes combinations of shapes, relations and perception of image as a united whole.

This is a logical structure, based on morphology [11], and it utilizes the coordination of meanings for support of design process. It is possible, that some shape examples have not 3, but only 2 levels, or even 1 level, but the tree morphology levels structure is applicable in most of the examples.

2.3 Traditional design process and meaning structure modeling

The design process begins with a defined need of meanings, suggestions, abstract ideas to be designed into shape (Stage 3-4 in Figure 1). On this point creativity is essential, but many restrictions

on the design task are present. On other hand meaning structure modeling on parallel structure between shape and concept spaces and distinguishes meanings on morphological levels in symbol design. We connect verbal concepts with shape sense, using a database with meaning-shape connections.
For clarifying what meanings' characteristics and features are important for a successful shape, we conducted interpretation survey.

3 Survey of meanings characteristics

3.1 Method

The method of this interpretation research is questionnaire that collects information about the evaluation and the meanings perception of symbol examples given. The final results present the connection between discovered meaning's differences and evaluation of logotypes. Based on the questionnaire results, a comparison between the values of evaluation and meanings distances for every sample is made.
A sample of 40 logotype symbols is chosen, from different countries of origin, resources, with varying construction elements, proportions, elaborateness and color schemes. This selection covers a broad range of symbol design and applications.
Eleven graduate school students were participants. The Questionnaire contained questions on Evaluation and Discovery of Meanings. It should be noted that Question 2 included the instruction to write down as many discovered meanings as possible for every example logotype.

3.2 Analysis

The results from the questionnaire were used to investigate the connection between logo evaluation and participants' viewpoints on meanings. Primary observed parameters are Average evaluation score and Average number of discovered meanings (Respectively for Question 1 and Question 2). Secondly, calculations of Relatedness between meanings of the examples were made. Total answers (including all participants) for every logotype symbol meanings varied between 8 and 19 words. This defines a space of users' concepts for every example.
The relevant nouns were extracted from answers to Question 2. Although not specifically required, most of the answers were nouns or adjective – noun pairs, in which case only the noun is analyzed.
For the meanings difference analysis, knowledge structure of noun organization in hierarchy of the WordNet 2.1 [5] concept dictionary was used. This is a measure of semantic distance between concepts, for our research – relatedness between discovered meanings in logotype image.

3.3 Result

No strong positive correlation between Average number of meanings and logotype Average evaluation is observed – 0.117 (Table 1). All shown variables are average calculations for all examples and participants' answers.

Correlations	*Relatedness between meanings (Q 2)*	*Average number of meanings (Q2)*
Average evaluation score (Q1)	0.448 *(Figure 4)*	0.117
Average number of meanings (Q2)	0.107	_

Table 1. Summary of variables' correlations

However the connection between Relatedness of discovered meanings and Average evaluation score of symbols is strongly positive (Figure 4), and this is statistically significant – $r(38) = 0.448$, $p<0.01$. The close concept connection between meanings gives a better evaluation.
These results show a connection between practical meanings (concepts) and their likeability.

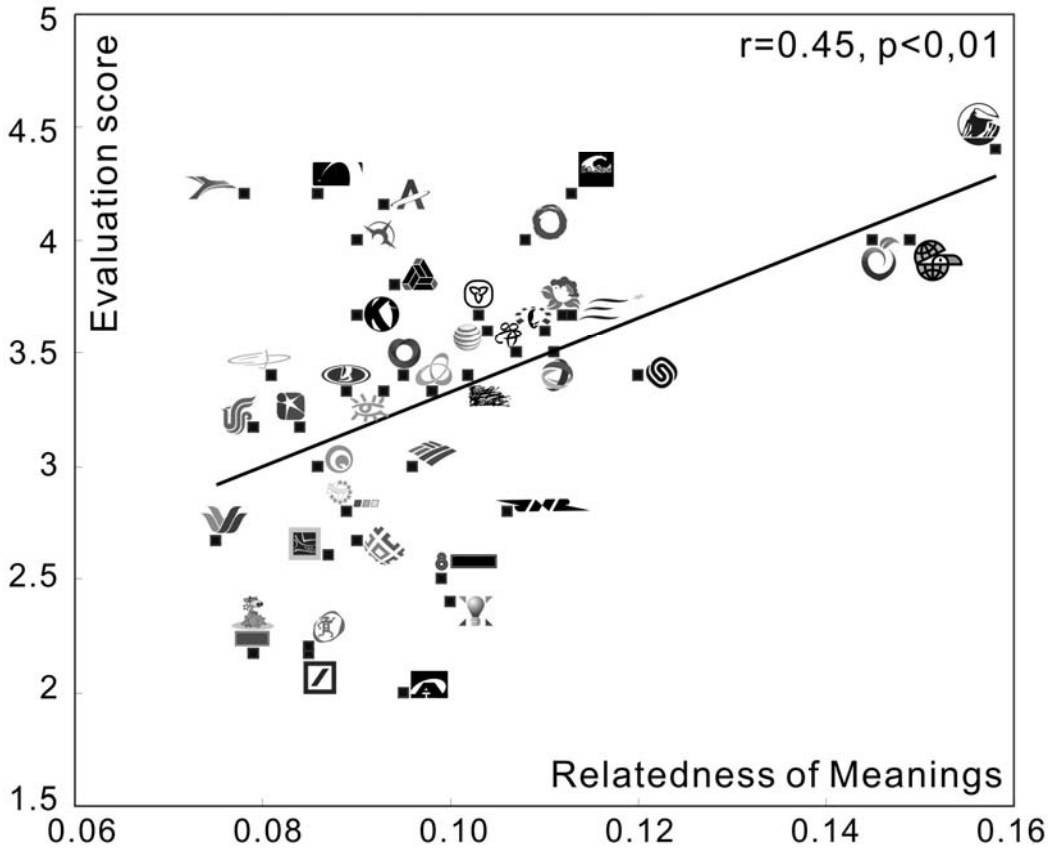

Figure 4. Average evaluation score as a function of Relatedness between meanings

3.4 Discussion

The participants' interpretation of meanings is important for likeability. Well evaluated symbols are meaningful and sense-related. The main point is that concentrated and coordinated meanings' characteristics with highest importance for usage must be studied from the design process view-point.

Higher evaluation involved meanings with better user 'definition' of shape, extraction from back-ground, straightforward meaning, and finally better user's image.

3.5 Example

Here we present clarify the steps of our model-ling in the context of findings from our survey results. For that purpose we describe an example of design process according to Figure 1.

The example design using Meaning modelling methodology begins with extraction of nouns from design task (steps 1-2). This set of meanings is restructured in step 3 to get closer meanings and in some cases more abstract shape. Closer meanings means bigger relatedness between them, according to the survey conducted (see point 3.2 and 3.3) this gives more successful image.

Example of such initial set of keywords with meanings "crane" and "flame". Their relatedness is 0.125, which is not sufficient according figure 4. But the set of keywords, received after closure and abstraction (Figure 2) stage 3 is "bird" and "fire", with relatedness 0.2. This relatedness possibly gives better result than initial set.

Concerning next step 4 we intend to develop our method further at this point of the process. Steps 5 to 8 refer to the traditional steps of graphic design, mainly depending on designer's abilities. After steps 4-8, in step 9, we again use the same approach from point 3, to additionally coordinate and attune the meanings in the already developed to a prototype symbol. Here the meanings are coordinated with the morphology levels structure of the shape (Figure 3). The consequent steps

10-11 refine shape and finally check for undesired meanings associations. This gives a final symbol in the step 12 (Figure 1).
With developing this approach to the meanings modelling, using WordNet, we apply in practice results form our findings.

4 Conclusion

Shapes that create the best impression should have integrated meanings. This means that participants in our study estimate highly the symbols with narrow meanings (that is not strongly connected with the total number of meanings). Even though evaluation is better with multiple meanings present, their concepts should be connected closely. The widely recognized meanings are likeable, and narrow, readily apparent concepts of shape meanings are very well estimated.
How can the results of creative design process be improved by meanings structure modeling? The methodology of design explores meanings' structure and connections. It expands creative results of design by restructure (abstraction and closure) and coordination. The final result should be a higher number of creative ideas and better matched meanings in designed shape. This knowledge about determination of meanings contributes to creative design.

References

[1] Lawson B., *How Designers Think: The Design Process Demystified.* Architectural Press, Oxford, 2006

[2] Henderson P.W., Cote J., Leong S. and Schmitt B. *Building Strong Brands in Asia: Selecting the Visual Components of Image to Maximize Brand Strength,* International Journal of Research in Marketing 20 (2003) pages 297-313

[3] Henderson P.W. and Cote J. *Guidelines for Selecting or Modifying Logos,* Journal of Marketing, April 1998, vol. 62, 14-30.

[4] Haase S.J. *Understanding corporate logos: Lexical and analogical considerations.* Genetic, Social and General Psychology Monographs, 1996, 122:3, 309-327.

[5] <http://wordnet.princeton.edu/>, WordNet Release 2.1, Cognitive Science Lab, Princeton University, accessed December 2006

[6] Pedersen T., Patwardhan S. and Michelizzi J. *WordNet::Similarity – Measuring the Relatedness of Concepts.* In Proceedings of Nineteenth National Conference on Artificial Intelligence, 2004, Numb 19, pages 1024-1025

[7] Taura, T., Nagai, Y. and Tanaka, S., *Design Space Blending - A Key for Creative Design.* In Proceedings of International Conference on Engineering Design. ICED '05, Melbourne, August 15-18. 2005

[8] Nagai Y. and Taura T. *Formal Description of Concept-Synthesizing Process for Creative Design.* In Proceedings of Second International Conference on Design Computing and Cognition, 2006

[9] Finke R. Imagery, *Creativity and Emergent Structure.* Consciousness and Cognition 5, pages 381-393 (1996)

[10] Miura, S., Utiyama, M., Takeuchi K., Isahara, H., Nagai, Y. and Taura, T., *Translation between Linguistic Structures and Shape Structures for Bidirectional Design.* In Proceedings of International Design Conference – Design 2006, Dubrovnik, Croatia, 15-18 May 2006.

[11] Georgiev, G. V, Nagai, Y, Taura, T, 2006. *Method of Creative Graphic Design Focusing on Multiple Meanings: A systematic approach to meanings of symbols.* Proceedings of The 53rd Annual Conference of JSSD 30.06 – 02.07.2006, Ishikawa, Japan, pages 16-17