A Study on the Convergence of Meaning and Creativity of the Generated Concepts in Design

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Method and Tools

We propose a method according this approach where: Divergence of concepts is aided by a visualization of connected words and convergence of concepts is aided by evaluation and feedback (Figure 1).

The design method employs the following steps:

• (Input): Task
• (Enhancement of Divergence) Performing searches and semantic network of related ‘searched-for’ meaning elements. The designer selects new meaning elements from this neighbourhood network;
• (Enhancement of Convergence) Evaluating new meaning elements based on the convergence (average degree of relations between the meaning elements).
• (Output): Formed design concept.

In order to implement these stages, the tool we used to perform the search was WordNet’s (v.2.1) Visuwords (v.2.02) visualization. The search is limited to the representation of the network neighbourhood of the semantically connected words. The process of evaluating the structure of meaning elements is based on the measures from WordNet: Similarity (WordNet: Similarity 2.01). Similarity is based on the principle of counting the semantic distance between concepts. The methodology uses this method as the evaluation criteria, based on convergence. Here, we define convergence, R, as the average of the similarities, S, derived from the shortest path in the WordNet database, of a limited set of meaning elements (Equation). The number of elements is n.

\[
R = \frac{1}{n} \sum_{i=1}^{n} S(i)
\]

Results

Other cases. Designer A formed the following design concepts:
(1) Ski device for an impaired person; controlled by a consumer. Person is in a ski/hiking suit and is using a computer to direct
(2) Cats: Cats with different elements are used in a creative design; the computer is a design tool.

Table 1. Process of concept formation of Designer B

<table>
<thead>
<tr>
<th>Pair</th>
<th>Input Word</th>
<th>Output Concept</th>
<th>Input Task</th>
<th>Output Formed Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cat–Piano</td>
<td>0.015</td>
<td>0.205</td>
<td>0.198</td>
<td>0.205</td>
</tr>
<tr>
<td>Cat–Blanket</td>
<td>0.005</td>
<td>0.194</td>
<td>0.194</td>
<td>0.194</td>
</tr>
<tr>
<td>Cat–Sea</td>
<td>0.015</td>
<td>0.198</td>
<td>0.198</td>
<td>0.198</td>
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<td>0.205</td>
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</tbody>
</table>

Convergence and Creativity

Figure 3 use meaning elements from the last column of Table 2 to present a comparison between the convergences of the input and output designs.

The resulting design ideas were evaluated by two experts on the criteria of originality and practicality (Table 3). The first—originality—is concerned with the quality of being new and original and not derived from something else with, and the second—practicality—is concerned actual use rather than theoretical possibilities (Finke, 1996).

Discussion

The assistance provided with regard to convergence in the conceptual design process allowed designers to find direction to themselves from the diverse generation of ideas. Therefore, it can be said that adding a convergence stage in the concept generation process could help designers to create design concepts more effectively. However, this needs further investigation.

In this study, we dealt with one of the characteristics of creative thinking in design. Dissimilar concepts (thus, probably the divergence of concepts) are regarded as being connected to creativity (Finke, 1996; Nagai and Taura, 2006). From the results of this study, a convergence is clearly expressed in the cases of more dissimilar pairs and the converged concepts are often with high originality (see cases (2A), (3B) and (4B) in Table 4). Thus, convergence can probably be associated with the process of creative thinking.

The limitations of the study are connected with the existing tools. The utility of the visual representation is limited by its general features. Excluding some of the information might improve the exploration process.

We introduced a formal approach to evaluate the convergence in the conceptual design process. The results indicate that this methodology will help designers in the convergence stage of design. Moreover, the findings are step towards our comprehension and enhancement of creative processes in the conceptual design process.

References


Figure 3. Convergence compared

Figure 2. Sketches of

Table 2. Process of concept formation of Designer B

Study

Table 1. Word pairs from design task

<table>
<thead>
<tr>
<th>Pairs</th>
<th>Convergence of pairs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cat–Piano</td>
<td>0.015</td>
</tr>
<tr>
<td>2. Cat–Blanket</td>
<td>0.005</td>
</tr>
<tr>
<td>3. Cat–Sea</td>
<td>0.015</td>
</tr>
<tr>
<td>4. Cat–Piano</td>
<td>0.015</td>
</tr>
</tbody>
</table>

Issue of convergence

Creativity in design is usually connected with divergent aspect of concept form. However, an important question is how convergence relates to creativity? Current studies not clarify how ideas are structured and formed from the diverse concepts; this gives rise to the question of how this gap in the design methodology can be addressed. The convergence is necessary in order to correctly ascertain the aspects of concept formation of the designed artifact.

We present a framework and approach to convergence as development of one strong creative concept from many others, similar to growing a tree.

According to the framework of this study, we explore concept formation of design as the process of building the structure of meaning elements, employing divergence and convergence. The conceptual design can be conceived as the dynamic creation of the structure by the designer. A set of single meaning elements, representing the mental image of the artifact, is diverged, converged and put together in a way that it forms a particular whole meaning of an artifact.

Aim

The aim of this study is to investigate the convergence integrated into conceptual design in a case study, by using the design methodology to support it. Moreover, we aim to find how this convergence relates to the creativity of the generated concepts in design.

We conducted a four-session experiment with three subjects (designers A, B and C, practicing engineering, industrial and media designer respectively). We evaluated the stages and the convergence in the concept formation process.

The goal in the case study was to integrate the convergence process into the designers’ thinking process. The assigned meaning element pairs (word pairs) are shown in Table 1. The four word pairs ranged from being highly converged (‘computer’–‘ski’) to very low converged (‘violin’–‘sea’).

The subjects followed the outlined methodology uncleirhed until the design concept was formed. In every session, a check to evaluate convergence was conducted one or two times. As an example, the design concepts that were formed by Designer B and his thinking path are illustrated as a process in Table 2 and Figure 2.

Table 2. Creativity Evaluation

<table>
<thead>
<tr>
<th>Pairs</th>
<th>Cat–Piano</th>
<th>Cat–Blanket</th>
<th>Cat–Sea</th>
<th>Cat–Piano</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convergence of pairs</td>
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<td>0.005</td>
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