CREATIVE REDUCTIONISM: HOW DECREASING LEVELS OF INFORMATION CAN STIMULATE DESIGNERS IMAGINATION

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ABSTRACT

This paper reports on research that investigates how reduced information of an object may stimulate design students' creative imagination processes. Humans have the ability to recognise the meaning and to generate a complete image of an object as a representation from an incomplete image, as long as appropriate visual clues are given. If an incomplete state of an object can prompt design students to visualise 'representation completeness', element reduction might be utilised as a trigger for further creative imagination. In order to understand the behaviour of design students towards the proposed reductive approaches, two experiments have been conducted with industrial design students at Northumbria University School of Design. In the first experiment, the researchers observed how the design students developed their object imagination using images of an object whose quality was reduced in a variety of ways. In a second experiment, we observed how the imagination process of the design students was affected by reducing the elements of material and composition information of an object. This second experiment was conducted using scaled-down components of Gerrit Rietveld's famous Red and Blue Chair designed in 1917. These two experiments have revealed patterns of imagination processes that design students follow when they are given reduced levels of information. By understanding the nature of reductionism in design better, we may be able to develop a series of reductive techniques that will enhance the design student's imagination and stimulate their creativity.

Keywords: Reductionism, design, imagination, creativity.

1 INTRODUCTION

Humans are able to find meanings using their imagination when amounts of visual information are removed or reduced. Human perception is capable of identifying a complete image of a 3D object even if some parts are reduced or removed, as long as appropriate visual clues are available (Biederman, 1987). We recognise meaningful objects from meaningless low-level features of information through forming patterns in both bottom-up and top-down strategies of our cognition (Ware, 2008). Evidence also shows it is possible to imagine an object's semantic property in archetypal categories of existing objects effortlessly, even if only very small portions of the object are seen (Athavankar, 1989). We are inherently capable of finding meanings using our imagination and manipulating our knowledge structures when we are presented with incomplete visual information. This fact appears to indicate that a clear representation of an object's visual identity can be built in our mind even if the original image is unclear.

In the early stages of a design process, reduced quality in terms of visual clarity plays an important role in stimulating the designer's imagination. Reduced clarity of visual information leads to multiple interpretations of what is possible and that enables designers to explore ideas. Goel (1995) mentioned that ambiguity is a useful factor in the sketching activity of designers where they explore ideas. Goldschmidt (1994) asserted designers discover unexpected meanings within spontaneous relationships among depicted elements in their sketch. The unintended relations and features are discovered even from the designer's sketch drawn for other purposes, and it prompts them to generate new ideas (Suwa and Tversky, 2002). At the preliminary stages of the design process, ambiguity and incompleteness of information can be regarded as a key factor for idea exploration for designers.

The authors believe that reducing information has great potential for inspiring a designer's imagination and can be deployed as an effective tool in the context of design. In order to better

understand how design students react with reductive approaches and how it impacts on their imagination processes, two experiments were developed. If incompleteness affects design students' imagination processes positively the reductive approach might be an opportunity to stimulate a designer's creativity. Thus, an important question is - what kind of elements do design students consider as significant for object imagination within a reductive approach?

2 THE FIRST EXPERIMENT

We conducted an experiment to observe the imagination processes of a group of design students when they are given images of an object whose descriptive information is reduced. The aim of this experiment was to understand patterns and characteristics in the design students' behaviour when given reduced levels of information in images. This study involved 17 undergraduate industrial-design students of Northumbria University School of Design. The group was composed of 4 students in the 2nd year and 13 in the 3rd year.

The study comprised 17 different types of image reduction of an everyday chair: animated, pixelized, dotted, removed, coded, outlined, pointilized, vandalised, cubismized, voided, technically described, painted, angled, sketched, dismantled, explored and roughly sketched (Figure 1). These exploratory image prompts were prepared randomly. The original image of the armchair used in this experiment was arbitrarily produced by the researchers. Accordingly, the participants have never seen this particular image of this chair before.
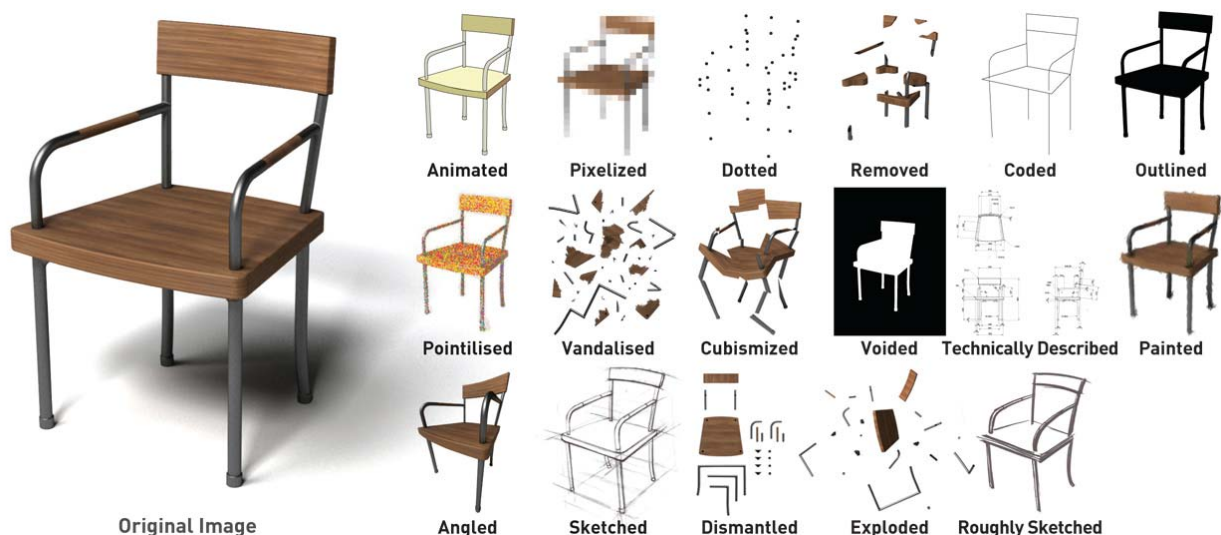

Figure 1. The original image of the chair (left) and the 17 reductive images provided for the participants

Each participant was given a specific reduced image, and asked to visualise the original object. The participants were asked to draw a sketch on an A3 sheet of paper and to make a model of what they imagined using materials provided by the researchers: A3 paper, pens, model making equipment and tools (e.g. clay, board, plastic sheet, balsa, craft knife, handsaw, pliers and glue). They were asked to complete all the processes within 30 minutes. After the completion of the drawing and model making exercises, each participant was interviewed (using a semi-structured format) to understand better their imagination processes.

2.1 Semi-structured Interview

The focus of the interviews was on exploring what kind of visual cues design students rely on for representation completeness when they imagine an object based on a reductive image. The participants were asked to respond to questions that focused on key themes such as:

- The first approach and the visual cues for sketching.
- The categorisation of the object they created.
- The reference to existing object.

2.2 Outcomes

Except for the participant who received the image of 'Vandalised', 16 students constructed a model representing a chair. Furthermore, 13 participants created chairs with arms, and 6 of these 13 produced models that are very similar to the original image of the object. A few outcomes (e.g. 'Exploded' and 'Dismantled') illustrate that the participants could build similar compositions of the object to the original even from the images where the components are dispersed. Only the image of 'Vandalised' in which the components are not identified easily enabled the participant to create a different object (desk) from the original armchair.
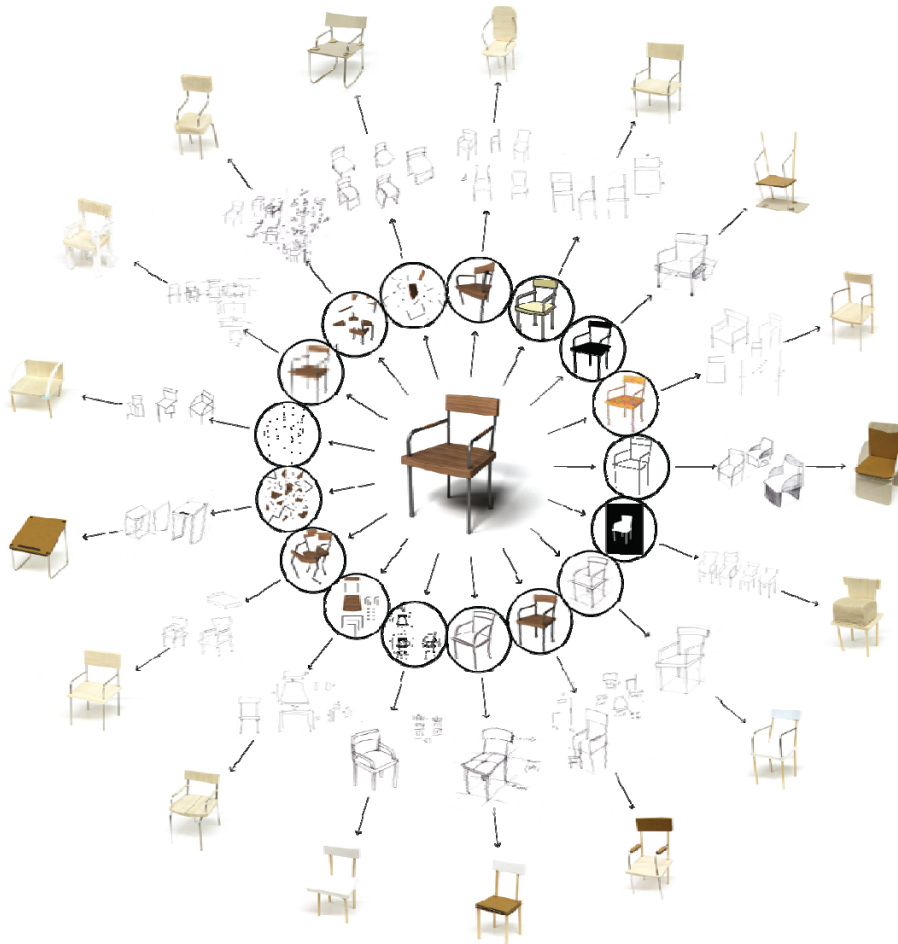

Figure 2. Development process including the sketches and the models of the 17 students

2.3 Findings

The transcribed contents of the interviews were analysed following a Grounded Theory approach (Glaser and Strauss, 1967). The contents were treated as raw data, and highlighted sentences were gathered and categorised through several coding processes. The results suggest that the 2 elements of 'materiality' and 'composition' played a significant role in the participants' imagination process inspired by the reductive images. Another fact the researchers discovered was the elements of both 'materiality' and 'composition' were heavily supported by prior-knowledge. In fact, many participants developed their imagination activating different types of prior-knowledge such as associations between particular colours and materials, past design experiences, general knowledge regarding the structure of objects, or understanding of the meaning of a specific component. Accordingly, the researchers proposed a framework of information based on the first experiment (Figure 3). The design students manipulated material and compositional information supported by prior-knowledge available in the reductive images to develop their imagination. In other words, this finding appears to suggest that it may be possible to prompt design students' imagination of an object by reducing the information of those 2 elements (materiality and composition).
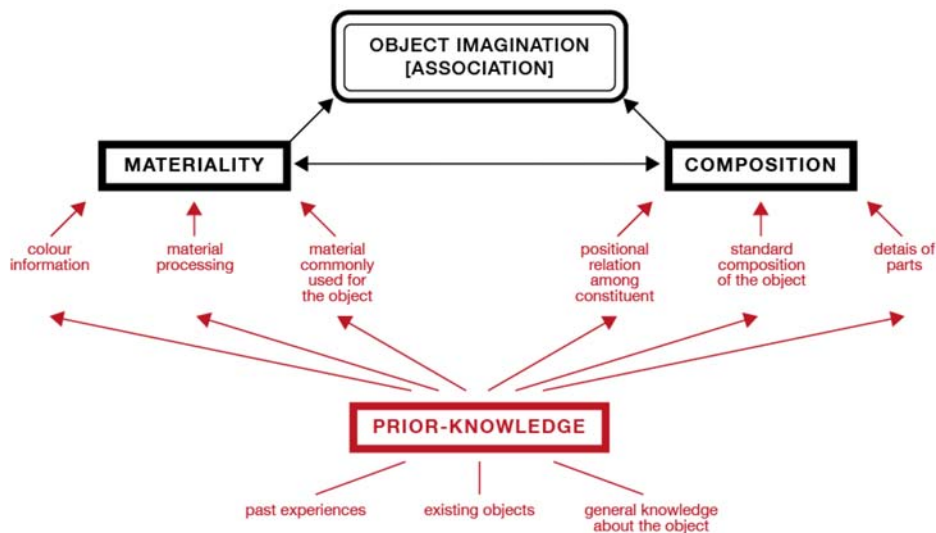
Figure 3. Framework that illustrates the elements the participants mainly used for their imagination process

3   THE SECOND EXPERIMENT

Following the findings of the first experiment, the researchers conducted another experiment. The researchers focused on observing how the imagination of the design students was affected by reducing the elements of 'materiality' and 'compositional' information of an object. Additionally, the researchers also observed how the reduction of these two elements of information impacted on the prior-knowledge of the participants (the analytical process of this experiment is currently in progress). The experiment was conducted using a one-tenth scale model of Gerrit Rietveld's famous Red and Blue Chair designed in 1917 (Figure 4). The parts of this chair consisting of simple linear material do not include any symbolic meanings. The researchers employed this object as a prompt for the experiment because this neutral characteristic enables us to focus on the differences of the participants' imagination processes in their reaction to various levels of reduction.

Figure 4. Red and Blue Chair designed by Gerrit Rietveld (1917)

In order to reduce the compositional information of the object, all the components were decomposed and arranged in the order of size. In addition, the material information was reduced with 3 different types of colours used (Figure 5). In the previous experiment, we learned that colour information is one of the significant factors that compelled the participants' imagination for materiality of an object (figure 3). Accordingly, the following 3 types of colour used here were;
 1.   Painted in the same colours as Rietveld's original Red and Blue Chair,
 2.   Painted in white that obscures material information, and
 3.   No colour information.

Figure 5. Provided 3 types of chair components (left to right – 1, 2, 3)

The components painted in the original colours offer some information of materiality to the participants and, therefore, it is considered as the most prescriptive prompt. Subsequently, the

components painted in white give them less clues for the materiality of the object. Finally, the components whose colour is completely removed are considered to have the least information for the materiality of the object. This observation has been conducted comparing those 3 reductive levels.

In the experiment, 18 industrial design students of Northumbria University School of Design in the 4th year were involved, and each of the three groups comprised six participants. Each design student was given the components of the deconstructed chair and asked to make a 3D model of their visualised object. The experiment was conducted individually, and each student was interviewed after his or her model making exercise.

3.1 Procedure

This experiment has been carried out according to the following procedure:
1. The deconstructed materials were provided.
2. The instructor (first author) informed the participant that the materials are scaled-down components of an object.
3. The participant was asked to visualise the object, and then to create a model of it using all the given materials. They were allowed to take as much time as they wanted to complete the task.
4. The participant was interviewed after the completion of the model making exercise.

3.2 Semi-structured Interview

Semi-structured interviews were conducted after the completion of the exercise. The focus was on understanding the participants' imagination processes and the outcomes. The participants were asked to respond to questions that focused on key themes such as:
- The objects creation and the way the object would be used.
- The generation of ideas and what clue(s) helped in imagining the object.
- The object's materiality.

After being asked these questions, the interviewer (first author) showed the complete scaled-down model of the original Red and Blue Chair to the participants. Then, the participants were also asked to describe the difference between the object they created and the original chair. All the contents of the interviews were transcribed for analysis.

3.3 Results

The results appear to indicate that as the reductive level of the colour coding increases, the types of outcomes become more diverse (Figure 6). In the group of the original colours (top row), 4 out of 6 participants created a chair, and 4 of them referred to the original Red and Blue Chair. One student mentioned Charles Rennie MacIntosh's chair during the interview. This suggests that the colour information provided prompted the participants' prior-knowledge to this design masterpiece. Furthermore, all participants created furniture related objects such as a chair or a table. In the group of one colour (white), 2 out of 6 participants made a chair, and 2 of them associated it with the Red and Blue Chair in their imagination process. This result shows that reducing colours down to one made a difference to the outcome. In the group of no colour, none of the students created a chair nor refer to the Red and Blue Chair. Moreover, the outcomes were created in a variety of object categories from an industrial switch to a massive opera house. Thus, the greater the information given to the participants the closer their imagined and produced object was to the original. By contrast, the types of outcome became more unpredictable when the students were given reduced information.

The analysis process is still in progress and the data will be analysed using a Grounded Theory approach. Further analysis will illustrate what kind of factors impact on the student's development of creative imagination when the materiality and compositional information of an object are reduced. Moreover, the influence of prior-knowledge under such a reductive condition will also be examined.

Figure 6. Outcomes

4   CONCLUSIONS

The results from both experiments appear to indicate that design students can develop their imagination of an object from reduced 2D/3D design prompts. The students considered the material and composition information of an object as a key element, and the reduction of these factors impacted on their imagination processes. The researchers also discovered that visualised outcomes became more varied according to the different reductive levels of material and compositional information of provided materials. A further study of the manipulation of reductive levels of these elements will contribute to the development of a tool for generating unpredictable ideas.

In the context of design education, providing too prescriptive design inputs (e.g. design briefs or visual prompts) may decrease students' creativity for imagination, and may lead them to predictable outcomes. On the contrary, giving them too little design-clues may not bring productive outcomes either. However, if the method is designed appropriately, a reductive approach potentially stimulates a student's creativity and offers diverse possibilities for their imaginative exploration. What is important here is finding out the optimum level of reduction of design inputs to prompt student's imagination.

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