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Creative puzzlement: how deconstructing elements of object facilitates industrial design student's imagination

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Abstract: This paper reports on a study that investigates how deconstructing the elements of an existing object prompts the industrial design student's imagination. Design researchers have revealed that designers often keep their design representations e.g. idea sketches less resolved for exploring multiple interpretations or innovative ideas. Dealing with incomplete information is significant for their design imagination. What if industrial design students are given an image of object and asked to reduce/deconstruct its elements to explore different design concepts? Could it be an opportunity for their design imagination? In the study reported on this paper, two groups of design students were respectively given 2 different fidelity levels of the image represented the same French classical clock, and asked to explore new design concepts reducing/deconstructing its elements. The results revealed the patterns of the participants' thinking process. Also, the different levels of visual fidelity appeared to lead each group to different approaches.

Keywords: Student's Imagination, Deconstruction, Ambiguity, Visual Stimuli

1. Introduction

Previous studies revealed that designers are skilled in manipulating uncertain, incomplete and ambiguous information within their imagination. This is more prominent in their early design process. Fundamentally, dealing with lack of resolution of ideas is common practice for designers throughout the processes (Lawson, 1980). Designers conceive novel and unexpected solutions tolerating uncertainty and working with incomplete information (Cross, 1990). The initial state of the design process in which designers mostly face ill-defined problem (Goldschmidt, 1994; Cross, 2004; Lawson & Dorst, 2009) is usually vague and the goal state is either unknown or ambiguous (Goldschmidt, 1997). Generally, when designers conceptualise ideas at the early stage of design process, it is important to explore and develop multiple ideas as solution in parallel (Lawson, 1980;

Dorst, 2003). For the sake of discovering multiple ideas, they need to leave a space for the possibility in their imagination by deliberately making their visual representations ambiguous. Designers inevitably lean how to handle this ambiguity, and conceive solution concepts as necessary but imprecise and incomplete (Cross, 1999). In the process, for example, of idea sketching in which designers have reflective conversation (Schön, 1983 & Goldschmidt, 2003), indeterminate and ambiguous nature of visual representation plays an important role for designers since crystallising ideas too early hinders design development (Goel, 1995). Tseng and Ball (2010) assert that increased levels of visual ambiguity presented to designers facilitate their interpretative activities and effective concept design behaviours. The ambiguous nature derived from indeterminate sketches encourages designers to develop multiple interpretations of their ideas (Do & Gross, 1996). Thus, keeping information that designers deal with indeterminate, incomplete and/or ambiguous is essential for their imagination at early phase of the design process, and they are exploited as a driving force for their idea exploration. Although there are researches that focused on the role of ambiguity in the design process, little study has been conducted to investigate how the ambiguity derived from deconstructing meanings of an existing object by industrial design-students themselves impacts on their imagination or thinking processes.

The theory of deconstruction coined by Derrida (1976) has influence across a wide range of design practices such as architecture, graphic design, products and fashion, imbued with ambiguous futuristic overtones (Lupton et al., 1994). Lupton et al. (1994), argued that deconstruction per se is a mode of questioning through and about the technologies, formal devices, social institutions and founding metaphors of representation. Lupton et al. then concludes that design can critically remake the grammar of communication by discovering structures and patterns within the material media. In the context of deconstructivism in architecture, designers fragmented volumes into their constituent components and experimentally reassembled the exploded and fragmented forms (Collins & Papadakis, 1989). The approach of, however, deconstructivism is not merely architecture of decay or demolition, but rather challenging the very values of harmony, unity and stability (Johnson & Wigley, 1988). If this "questioning mode" is deployed in industrial design education, does the approach provide the opportunity for students to critically deconstruct the meaning of existing objects and creatively explore new design concepts? Does ambiguity created by the act of deconstruction encourage their design imagination? In order to better understand the potential value of deconstruction for design students, a study was conducted using an existing object. The research questions are: how do industrial design students create dialogue with the existing object presented through the act of deconstruction? What do design students learn through the deconstructive thinking and how do they explore new design concepts?

2. Methodology

The study was conducted by giving an individual task in which the industrial design students were asked to deconstruct the elements of an existing object and conceive a new design proposal as a conclusion. In the study, the image of French classical clock was used as visual prompt and the two sheets where the participants can use for idea sketching and expressing the final design idea were provided.

Additionally, two different levels of visual fidelity of the same clock were prepared in order to compare and observe the impact of richness of the visual prompt provided to the participants' imagination. Accordingly, the participants were divided into 2 groups and each group was provided with a different visual prompt of the same object: the photographic image and the dotted line drawing. Except for the difference of the visual prompt provided, both groups were given exactly the

same task. The participants were asked to speak aloud during the process of idea exploration, and this verbal data was recorded by video recording the participants.

2.1 Original Object Selected As Prompt

The selection of the object as prompt used in the study was carefully chosen. The prompt needs to contain a certain variety of attributes that give opportunity for the participants to deconstruct. The choice of the prompt was made following the selection criteria outlined:

- The prompt should be identifiable and still be familiar as a product in the present day.
- The prompt should have certain functionality.
- The prompt should have a form that represents cultural contexts beyond its functionality.

In accordance with these criteria and after much consideration, a classical French bracket clock (designed in circa 1746) was selected (Figure 1).

Figure 1. A small ormolu bracket clock by Stollework of Paris (c. 1746). (Photo: Bob Loosemore).

This clock is highly ornamental and a cultural object that represents a particular period of time in art history. The rich ornamentation on the surface of the object represents more than what is essential to utility or function of the product, but reveals more about its cultural context. Also, the participants can readily identify what the object is, because of its essential visual elements e.g. the clock face.

2.2 Prompt Provided In The Study

Based on the image of the clock aforementioned, two types of visual prompt that represent the same object were prepared (Figure 2). Both images have different fidelity in the image quality. Image

A was a photographic image of the bracket clock, without background, printed in full colour. Image B was the image of the same bracket clock depicted with dotted lines. The dotted image was digitally made tracing the contour lines of the photographic image of the clock used for group A by the researcher (second author).
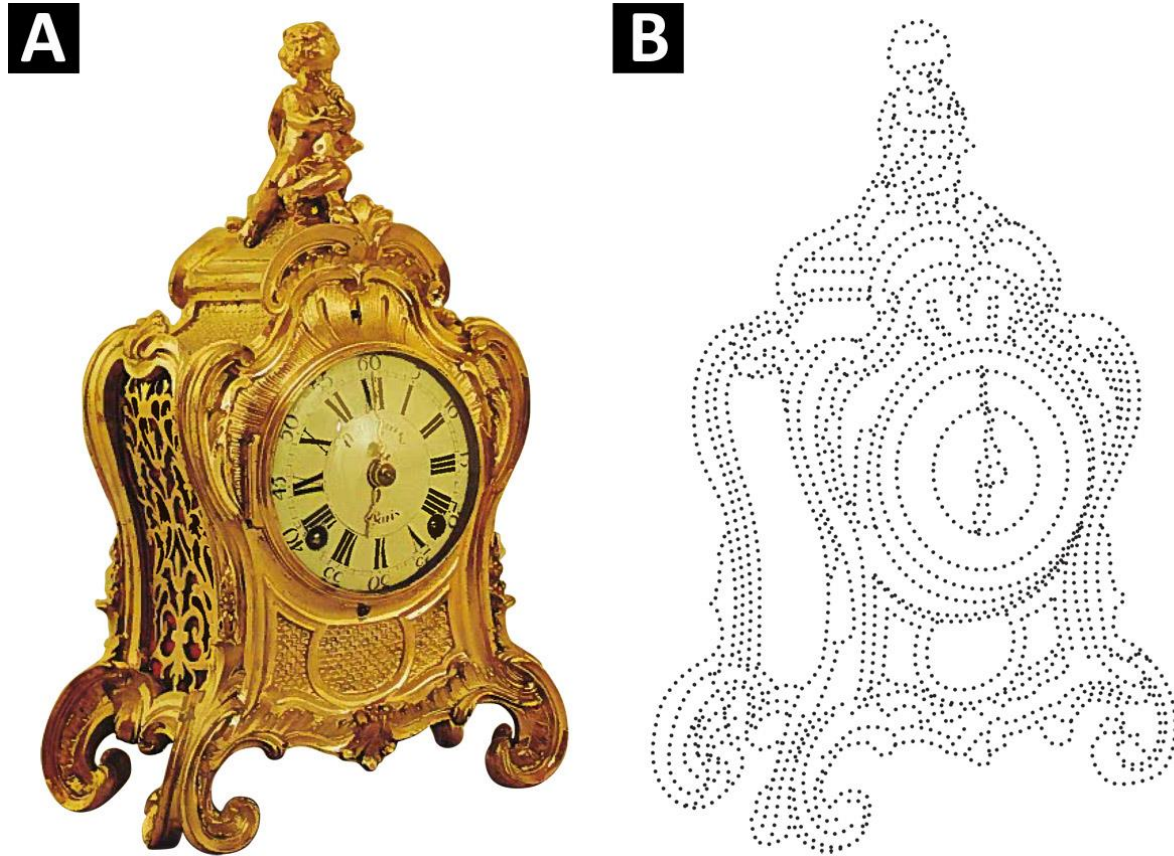

Figure 2. Two different visual fidelities provided to each group.

The photographic image contains a multiple set of attributes and information of the object e.g. colour, materiality, ornamental details and so on. It is regarded as the visual prompt that involves richer information. On the other hand, the image of the clock represented with dotted lines provides limited attribute information to the participants. Both visual prompts were provided In printed form and provided during the study (Figure 3).
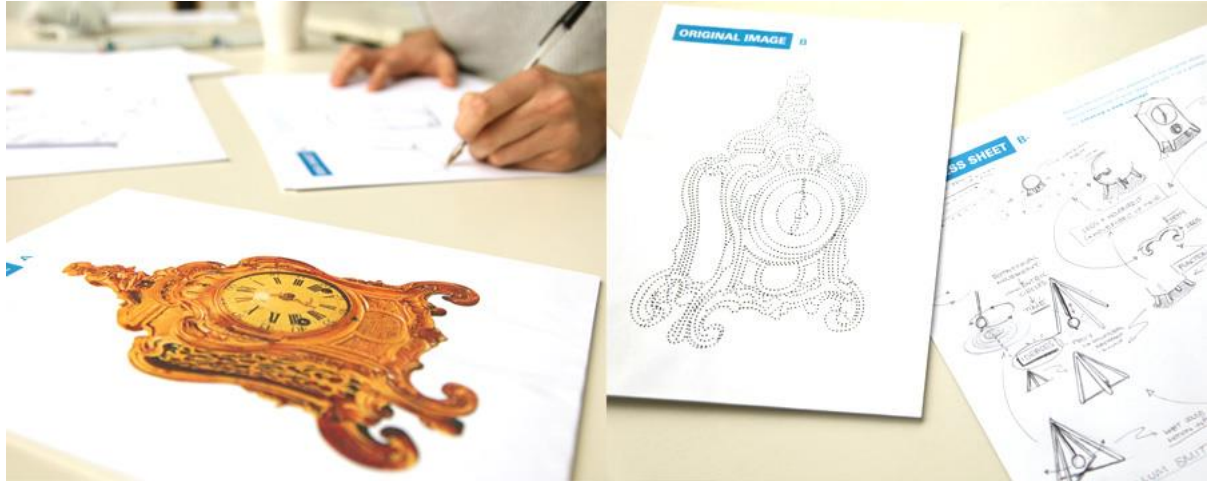
Figure 3. Printed visual prompts.

2.3 Process Sheet And Idea Sheet

In order to visually capture their idea-exploration process and the final idea as an outcome of the task, two types of recording sheets were prepared.

The first sheet was named the Process Sheet, allowing the participants to explore through ideas sketching or making notes (Figure 4). The scaled-down image of the original object is placed at the centre of the Process Sheet. The participant was asked to reduce/deconstruct the elements of the original object step by step using arrows that indicate the process and flow of the reduction/deconstruction. The participants were allowed to develop the process of deconstruction in their own style.
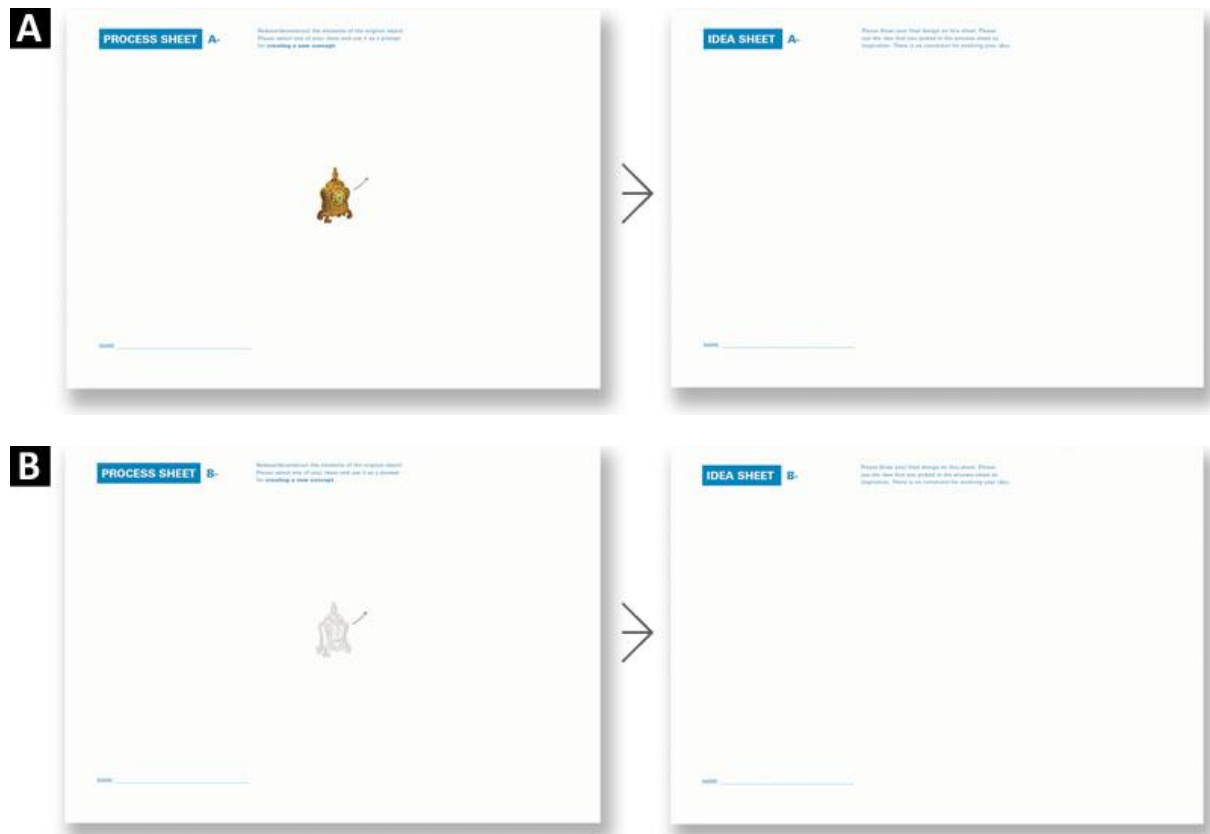

Figure 4. The process sheet (left) and the idea sheet (right) provided.

The second sheet provided in conjunction with the Process Sheet, is called the Idea Sheet. The participants were asked to select one of their evolved ideas from the Process Sheet, and then to finalise this idea as a final design proposal. The participants were asked to complete the Process Sheet as a first task and then to move on to the Idea Sheet. Both these sheets were formatted in A3.

2.4 Participants

In this study, 8 voluntary participants of Northumbria University were involved. All the participants were the industrial design students in their final year. They were split into two groups, and each one comprises four participants in the study.

2.5 Study Environment

The study was conducted in a quiet, closed and familiar space (Figure 5). The video camera was set up next to the participant.

Figure 5.   The study environment

2.6 Procedure

The study was conducted according to the following procedure:

1. The visual prompt and two sheets were provided to the participants.
2. The instructor explained the instruction of the task to the participant.
3. The participant was asked to explore new design concepts deconstructing/reducing the elements of original object on the process sheet. He/she was also required to speak aloud throughout the deconstructive process.

4. The participant was asked to select one of the ideas he/she evolved for the final proposal and move to the idea sheet to finalise the selected idea as a conclusion.

2.7 Data Analysis

The recorded verbal data captured during the deconstructive process was transcribed. Along with the verbal protocols, the behaviours of participants captured in the video recordings were analysed. The process of protocol analysis was conducted following the verbal analysis method (Chi, 1997). All the transcribed verbal data were segmented and coded. The identified codes were, then, summarised. The summary of the detected patterns is described in the following results section. Additionally, the process drawings that visually represented their idea exploration process depicted on the process sheet (Figure 6) were also used for the interpretation as supportive data.
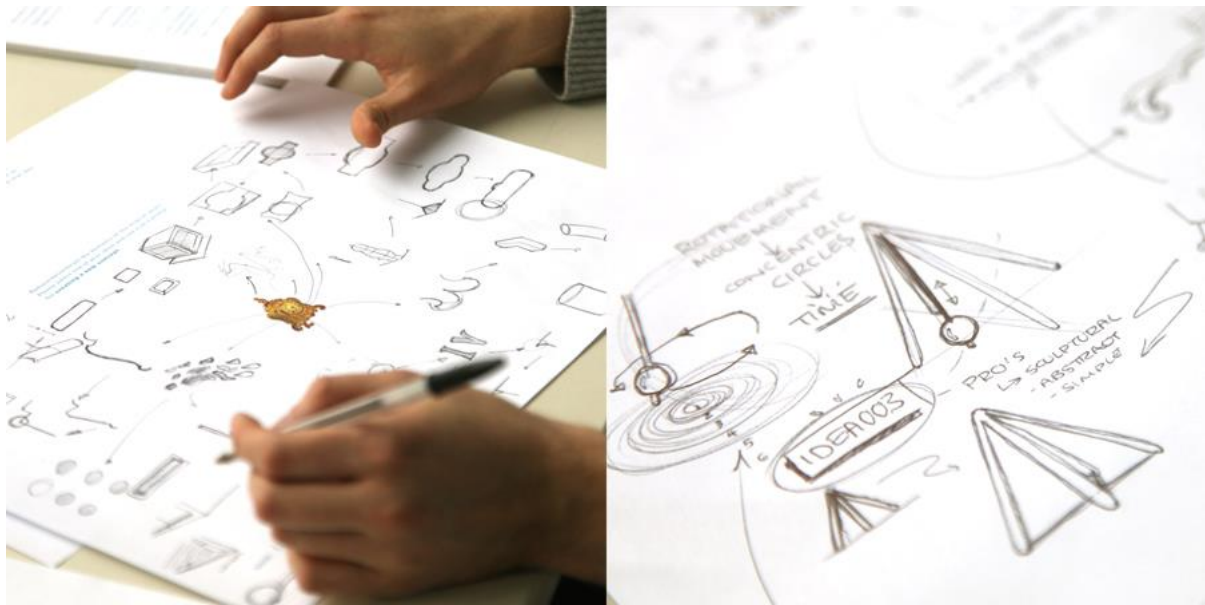

Figure 6.   The drawings depicted on the process sheet.

3. Results

3.1 Outcomes

The final design proposals of each of the participant are presented here. In the outcomes of the group A (Figure 7), all participants created a table clock except for the participant A3. The participants of the group A largely created outcomes that maintained the same functionality as the original clock. Three out of four participants actually produced a clock in different forms. In other words, group A show that the participants had a tendency to "re-design" the original clock maintaining the same functionality and typology of the object. The participant A1 designed a desk clock in which the three elements discovered from the original clock were separated into three clock displays. A2 designed an ultimately simplified clock. A3 designed a speaker station that contains portable speakers. A4 designed a table clock that contains the profile of the original form that subtly suggests the reference of the French rococo clock at the back of the design.
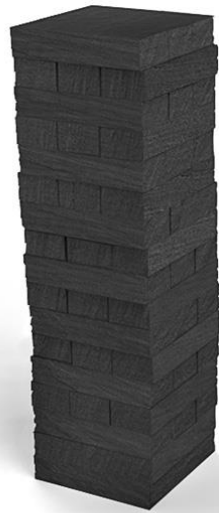
A1 — Clock

A2 — Clock

A3 — Speaker Unit

A4 — Clock

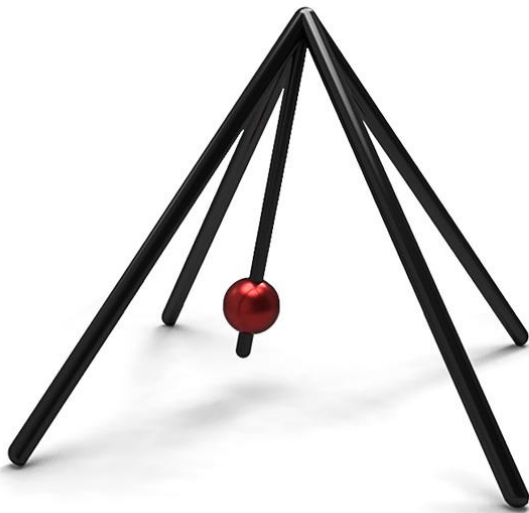*Figure 7.   The reproduced rendering images of the final design proposals of the group A.*

On the other hand, the participants of group B designed objects focusing on different aspects (Figure 8). Although three out of four participants designed time-related objects the ideas are rather more interaction focused. The participant B1 redesigned an existing game, Jenga, whose material is replaced by charcoal material. By replacing its material from durable wood which is normally used to fragile charcoal, it creates additional tension for the players. B2 created a timer that behaves like a human being. As time passes by the timer falls over mimicking a tired person. B3 designed a timepiece that tells time by the rotational movement of the pendulum hung from the top of the tetrapod structure. B4 designed a sundial whose shape of the gnomon refers to the original French clock. The gnomon has a void in its centre part the abstracted top figurine is used as a time indicator.

B1 — Charcoal Jenga　　　**B2** — Timer

B3 — Pendulum That Tells Time　**B4** — Sundial
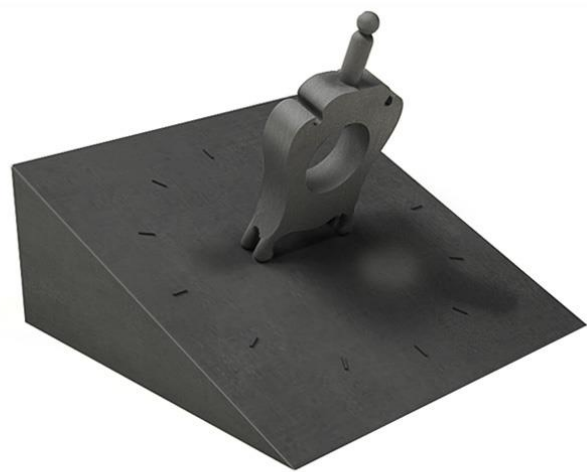
Figure 8.　The reproduced rendering images of the final design proposals of the group B.

3.2 Summary of the Group A's Design Approach

There are some similarities and differences identified between the two groups. The approach of the participants provided with the high fidelity visual prompt (group A) took, can roughly be divided into three phases: understanding of the original object, idea generation, and making decision for final idea (Figure 9).

Figure 9. The approach of the participants of group A.
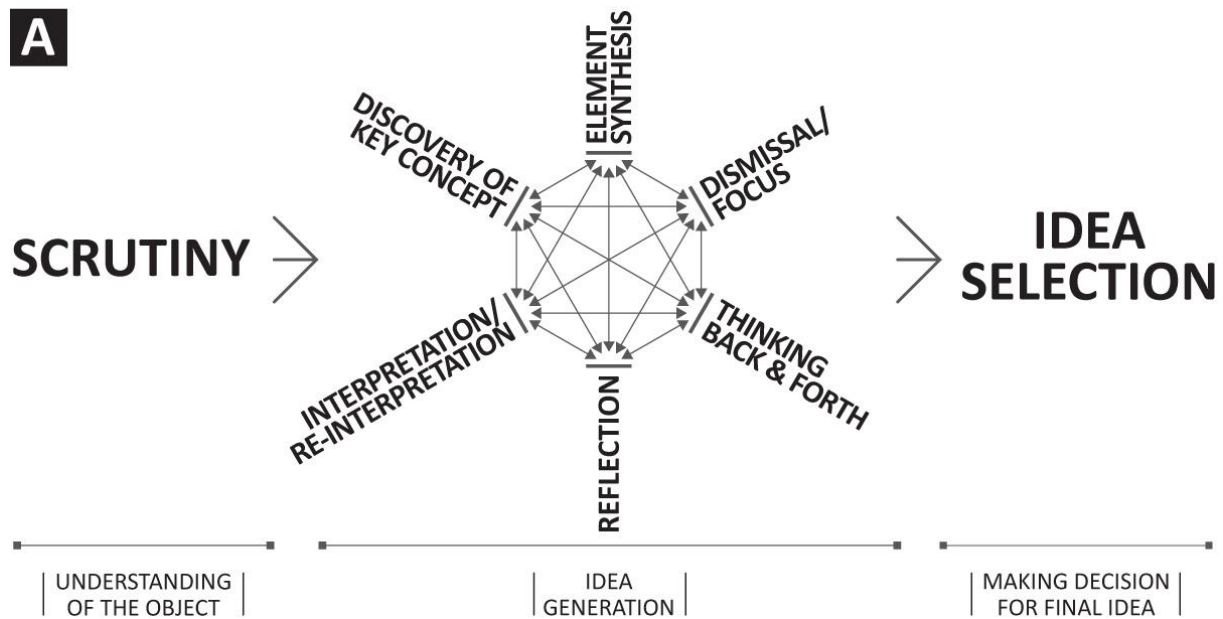
The participants of this group attempted to understand what the original object is as the first step. They had a tendency to scrutinise the characteristics of the original object through looking or sketching. During the process, the participants particularly focused on aspects such as the following: form, structure, specific components, design intention, functionality, surface texture, ornamental elements, the impression he/she receives, section view, problems the object involves and so on. This group critically scrutinised the attributes of the original clock, looking at its image from multiple perspectives.

Subsequently, six prominent behaviours were identified when the participants deconstructed the information to explore design ideas:

- Discovery of key concept
- Dismissal/focus
- Interpretation/reinterpretation
- Thinking back and forth
- Elements synthesis
- Reflection

These behaviours were constantly seen over and over throughout the process of the idea generation phase. Also, they occurred throughout the task in a non-linear manner. The idea development was fostered within these six behaviours.

First behaviour is "discovery of key concept". The participants constantly discovered key concepts, phrases, sentences or words and use them as a cue for generating ideas. For instance, the participant A1 discovered three key concepts that were "technical", "ornamental" and "cultural" and these became the polestar for the final idea. Participant A4 found the key concept, "revealing object through reduction", and used it to conceive the idea of "controlling user's attention" that became the core concept of the final design. The act of finding key concepts has been seen at every phase of idea's generation and the ideas conceived, based on them.

The second behaviour is "dismissal/focus". When the participants reduce/deconstruct the attributes of the original object, there was a pattern of prioritising the information gained. The more important

information of each participant became focused and other elements were dismissed as unimportant. The participant A1 described the importance of putting information captured in a hierarchical order to understand the elements that should be focused on or disregarded:

> "I guess the hierarchy to me is the key to reduction. Highlighting the most important things and (…) removing unnecessary information or placing it in the form where you can really understand what is more significant (A1 00:25:46)."

Although the concepts that the participants focused on were varied, the prioritisation of information became the important strategy for reduction/deconstruction.

The third behaviour is "interpretation/reinterpretation". Interpretation and re-interpretation has also been a constant throughout the idea generation phase. The participants interpreted the particular details of form or ornamentation of the original object, or how the original object might be perceived within the modern context. Additionally, the idea or the new forms of objects that the participants conceived, based on their previous interpretations, were also reinterpreted. The outcome of any interpretation became a clue for better understanding, or further interpretation for generating new ideas. The participant A2, for example, found that the particular detail of form of the original object firmly dictates the impression A2 perceives about it:

> "This… such a big (…) broad shoulder (…). it's quite masculine shape so if you take little curves it doesn't reduce masculinity. It's just a very strong block piece (A2 00:02:31)."

The fourth behaviour is "thinking back and forth". In this this reductive/deconstructive process for idea generation the participants' processes were neither systematic nor consistent. Rather, the approaches were flexible and opportunistic. The attention of the participants frequently moved, crossing over several thinking avenues. The participants did not stay at a single thinking avenue for long. They quickly moved to other thinking avenues when they felt satisfied with the exploration or were simply bored. Then, they moved back to the thinking avenues previously developed and paused. The result appears to suggest that the participants had a tendency to develop multiple thinking avenues simultaneously. The participant A3 described the moment when A3 moved back to the idea previously evolved:

> "I'm thinking of going to revisit the washing machine. (…) I got bored of the speaker. I did satisfy my needs. (…) I'm jumping from one to the other, but it feels right about what I am doing (A3 00:15:36)."

The fifth behaviour is "elements synthesis". Generated ideas of any kind were integrated at any stage of the process. The participants often evolved ideas by combining different concepts and/or visual elements discovered. The participant A1 stressed that the act of reduction per se is not merely eliminating elements but reintegrating essential elements that A1 had discovered:

> "(…) it's kind of picking up distinct parts (of the original object) to me. They might be graphic (graphical elements on the clock face) I guess, but it's how do you translate those graphic elements to something more integrated into it. I guess it's reduction of superfluous parts, but not just removing things. I'm trying to reintegrate them (A1 00:11:36)."

The sixth behaviour is "Reflection". The participants reflected their processes of idea development at certain stages. The processes were looked over, and they reconfirmed how they had evolved their thinking avenues, or identified what the prominent ideas were. By reflecting on the previous thinking avenue, the participant A3 was able to move forward on the process:

"I started looking over what I have done. It's a big mess of stuff, where I just did a washing machine or radiator. There are so many products here, but I think I like the speaker route (A3 00:37:04)."

The participants of the group A appeared to foster their ideas through those behaviours.

3.3 Summary of the Group B's Design Approach

The approach of the participants provided with the low fidelity visual prompt (group B) was different from the results of the group A (Figure 10).
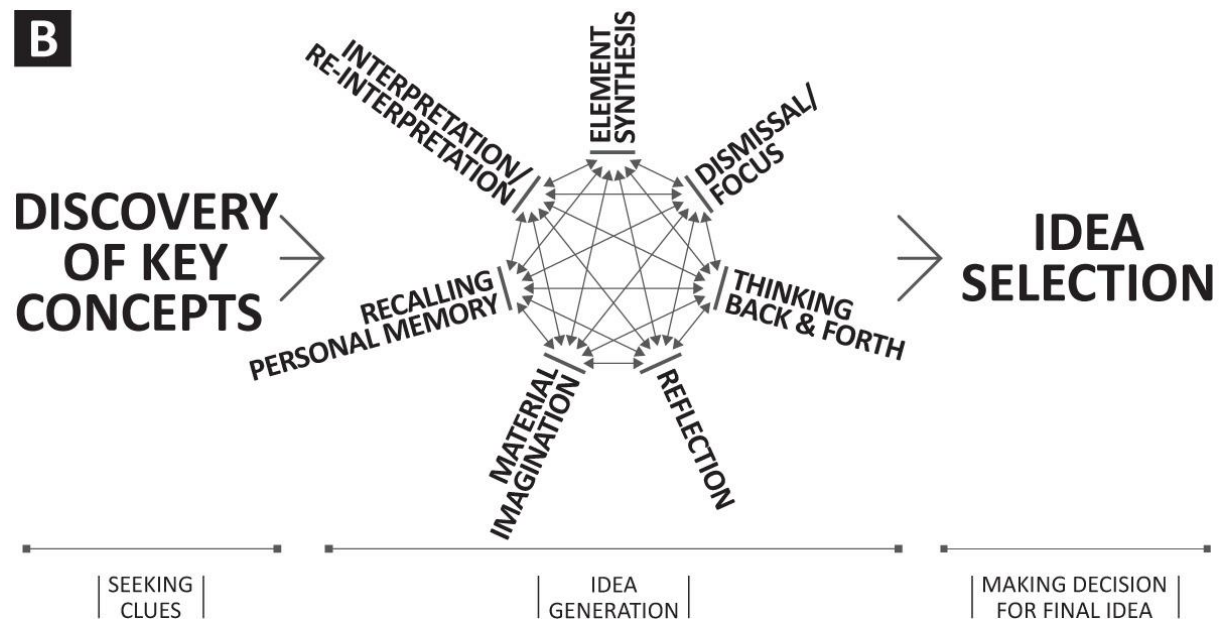

Figure 10.   The approach of the participants of group B.

The approach can be divided into three phases in this group: "seeking clues", "idea generation" and "making decisions for final idea". Although the participants of the group A started with scrutinising the original object, the participants of the group B sought out key concepts as a first step of the reduction/deconstruction. The participants showed a tendency to discover words, sentences and/or questions relevant to the original object as key clue from the original object to take forward for further development. The derived key concepts were, for example, about essential elements, materiality, or relevant notions that the original object implies. The result appears to suggest that the limitation of the visual information given to them, encouraged the participants to focus more on the conceptual aspects that the original object involves. The key concepts identified were used for further idea generation processes.

The following seven behaviours were identified:

- Dismissal/focus
- Interpretation/reinterpretation
- Thinking back and forth
- Elements synthesis
- Reflection
- Recalling personal memories
- Material imagination

The results of group B shared some similarities with the ones of the group A in terms of their behaviour during the idea generation phase. In particular, the behaviours of "dismissal/focus", "Interpretation/reinterpretation", "Thinking back and forth" "element synthesis" and "reflection" have been commonly seen in the results of group B. These overlapped categories can be considered as common behaviours in reduction/deconstruction of the original object given, regardless of levels of visual fidelity.

The two different features, however, have been identified in group B: "recalling personal memories" and "material imagination".

The first of the two is "recalling personal memories". The participants recalled their personal memories, such as a conversation with a craftsman or a particular experience he/she had with an object, during the idea generation phase. The participant B4, for example, recalled the words told by B4's former teacher at a sculpture class and subsequently used it as a key phrase for idea development:

> "(…) my teacher used the phrase saying 'you are drawing in 3D' (…) that phrase 'drawing in 3D' I think it could be a good one to think about. (…) if it was a wireframe that represents all of the dotted lines… with represented by a wireframe. It could be 3D printed or wire bent (…) (B4 00:30:52)."

This result appears to suggest that when the visual fidelity level of the object presented is low, the design student has a tendency to reflect his/her personal episodic memories (Tulving, 1972) more often as a clue for imagination.

The other behaviour is "material imagination". The image of the object represented with low visual fidelity appears to encourage the participants to envisage from their imagination types of materiality. The visual prompt of the original object represented with dotted lines does not show its material qualities. In particular, the two participants seemed to be encouraged to envisage the materiality of the original object and used their material knowledge as clue for their idea development. This characteristic has not been seen in the results of group A. The participant B4 evolved the idea of what degrades the quality of material as part of reduction/deconstruction:

> "What material is this? It seems it's made of wood (…) because it looks old. (…) kind of like 17th century? (…). The fact that it's got the figure on the top suggesting classical something. If I imagine if it's made from wood, I think about reducing that wood, so I take wood veneer (B4 00:18:01)."

The limitation of materiality in the visual prompt presented, encouraged the participants to focus more on the material aspect of the object. This fact corresponds to the findings of the author's previous study (Inoue et al., 2017) that the visual prompt whose materiality is obscured prompted the design student's material imagination.

4. Findings

In both of the groups it was clear that their imagination was engaged through being able to access the visual prompt. The industrial design students were able to explore new design concepts by reducing/deconstructing the elements of the original object.

Group A. All the participants given the high fidelity visual prompt tended to scrutinise and understand the original object to begin with. Following this, ideas were generated through the seven behaviours identified:

- Discovery of key concept
- Dismissal/focus
- Interpretation/reinterpretation
- Thinking back and forth
- Elements synthesis
- Reflection

The focus of most of the participants' final design proposals was on redesigning the original clock.

Group B. All the participants given the low fidelity visual prompt had a tendency to discover key concepts as cue for further idea exploration at the preliminary phase of the process. Many of the behaviours identified during the idea exploration phase were similar to the ones of the group A:

- Dismissal/focus
- Interpretation/reinterpretation
- Thinking back and forth
- Elements synthesis
- Reflection

However, the participants of this group relied on personal memories recalled as a clue for imagination. Additionally, their imagination of materiality was also prompted as a prominent characteristic during the idea generation phase. The aspect of interactivity between an object and a user was the prominent focus in their design proposals.

5. Conclusion

This paper reveals that the two object prompts used in the study created different impact in the interpretation and outcomes, of the students' developed ideas.

Both the patterns of the industrial design students' behaviours when they are asked to deconstruct the elements of an existing object and the impact of different levels of visual fidelity as a prompt on their imagination were shown.

Providing industrial design students a photographic image of objects, and asking them to deconstruct the elements encouraged them to have an in-depth conversation with the prompt. This approach potentially provides industrial design students an opportunity to discover/rediscover the aspects of existing objects that they have not considered before, and use the awareness for exploring new design concepts.

Further, giving them an image of an object whose visual fidelity is limited and its deconstruction encouraged conceptual driven, and self-reflective thinking process during their idea exploration. This approach potentially provides industrial design students an opportunity to interpret/reinterpret conceptual aspects that the object involves, for obtaining clues for idea generation.

Thus, the act of deconstructing elements of an existing object impacted on the students imagination in a variety of ways. If the object as prompt is carefully selected this approach potentially becomes the way to prompt the design students' design imagination effectively. What the authors believe is that the prompts as described in the paper have generated high level of concept ideation within the students. This disruption appears to add values to the students' creative thought process in concept development phase.

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