Visual Knowledge Media

Generating implications for design in practice: How different stimuli are retrieved and transformed to generate ideas

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Abstract
Design idea generation is a significant part of a designer's work and most frequently associated with creative problem solving. However, an outstanding challenge in design is translating empirical findings into ideas or knowledge that inform design, also known as generating implications for design. Though great efforts have been made to bridge this gap, there is still no overall consensus on how best to incorporate fieldwork data into the design idea generation process. The generation of design ideas is a process that is rooted in individual knowledge and is often considered a precedent-based type of reasoning, where knowledge is continuously transformed to produce new knowledge and this creative leap across the divide is very difficult. And it is believed that designers could potentially benefit from external stimuli that would provide a starting point or trigger and make the ideas generation more efficient. Most researchers have examined when and what type of stimuli designers used to support design idea generation. Nevertheless, it is still not clear how the different types of stimuli are retrieved and transformed during idea generation phases, and the knowledge transformation during this phases need to be clarified. In order to resolve this issue I conduct an open-ended semi-structured qualitative interview to learn about student and professional designers' knowledge on how they select stimuli and transform it into design ideas, then compare with professor's opinions. The interview would be conducted in terms of one-on-one face to face or online interview depending on the availability and accessibility of the interview respondents which would be audio recorded. Knowing more about how different designers, especially professional designers, to retrieve and transform preferred stimuli into ideas, and the design thinking involved in the process, is a significant step towards investigating the influence of stimuli during idea generation. Ultimately, I intend to build a general mechanism for designers to conduct an appropriate selection of functionally useful stimuli to transfer empirical findings to knowledge that inform design. The results try to help professional designers get more scientific structure, give student designers

more practical guidance, but also help design education refine design idea generation methods and improve resulting techniques to discover a dynamic balance among theory and practice.

Keywords – stimuli for design, design idea generation, empirical findings, implication for design, student and professional designer

Paper type – Academic Research Paper

1 Gap between empirical research and design ideas generation

From the point view of Tim Brown (2009), CEO of IDEO, design projects normally develops through three stages: inspiration, ideation and implementation. Inspiration means gathering insights from every possible source and identifying an opportunity, whereas ideation translates insights into ideas and conceive general solutions. The function of research in the design idea generation process, which is from "inspiration" to "ideation", is to ensure the evidence and insight obtained enables the designer to answer the initial question as unambiguously as possible (De Vaus, 2001). This ultimately affects the design process because it helps define the challenge, and the way problems are solved (Singer, 2003). Within the design thinking tradition, it is the designer who generates, selects, tests, and refines ideas as a means to refine the design problem and arrive at an effective solution. Thus, it is important for designers to understand how they influence this process via generating a creative and innovative design idea (Gonçalves & etl, 2014). This is crucial as design idea generation is the activity most frequently associated with creative problem solving. As the ideas generated in this stage are used throughout the creative process, taking the idea generation phase seriously is central to the success of the creative problem solving process (Herring & etl, 2009).

Nevertheless, an outstanding challenge at the beginning stage of design process is translating empirical findings into ideas or knowledge that inform design, also known as generating implications for design (Meneweger & etl, 2012; Obrist & etl, 2012; Crabtree & Rodden, 2002). The challenge has led to a perceived gap between empirical studies and design idea generation (Paay, 2008). This creative leap across the divide is very difficult, and more structured methods are needed to guide the process of envisioning design from fieldwork outputs. Generating meaningful and actionable implications from empirical research is a significant part of a designer's work in the design process. However there is still no overall consensus on how best to incorporate the results of fieldwork data into the design idea generation processes. Despite many research efforts, bridging the gap between fieldwork data and design idea generation still remains a matter of concern to designers today (Diggins & Tolmie, 2003).

2 Sources and types of design implications from empirical findings

Implications for design are a specific type of design knowledge for which prior work has referenced two contrasting sources from empirical findings: fieldwork-, design practice-, (Sas & etl, 2014). These two sources and their specific types of design knowledge are reviewed below to acknowledge the unique value of each of these two sources.

2.1 Fieldwork-informed design implication

2.1.1 Requirements

Requirement gathering is a common method for generating design knowledge, but critiqued for its lack of capturing the richness of social settings (Crabtree & Rodden, 2002). Requirements result from fieldwork in order to support a situated design in a specific setting. It captures product goals that lead to incremental improvements to existing products and inspirations to new products in well-understood settings (Sas & etl, 2014). Overall, requirements are highly prescriptive and implementable but are difficult to generalize beyond the investigated settings.

2.1.2 Thick Descriptions

As its core, ethnography studies human behavior and their culture: how people experience and make sense of what they themselves and others do in specific social settings (Masten & Plowman, 2003). They address the limitations of requirements gathering methods and are typically used in settings where complex social factors exist. These methods representatively use analytic approach that generates rich descriptions of social settings.

2.1.3 Scenarios

Scenarios capture narratives describing users' activities in terms of product goals, and users' context of activity. They are described from the perspectives of users and tend to be highly situated (Guren, 2000). To review a design in a systematic way, it is better to put it into an actual scenario rather than independently analyzing its different factors. The scenario-based design can support the characterization of users behavior and use the information for design (Kusano & etl, 2013), but also an application of the visual dialog to envision of conceptual models or as an effective tool to formulate uncertainty.

2.2 Design practice-informed design implication

A typical approach to generating design heuristics is to critically analyze the successful product and design process in practice. Design heuristics are design-oriented rules of thumb to guide practical product design. They are usually derived from designers' expertise and reflections on successful prior practice of product design (Dix & etl,

2004). The objectives of design heuristics are to improve specific product rather than to design new product and they are typically generative knowledge in interaction design, e.g. Nielsen's principle of "minimalist design" and "visibility of system design". Additionally, a profound thinking would be highly needed regarding how and to what extent the design heuristics could be applied in the intended product design in practice.

After reviewing the prior work of the sources and types of design implications, it was found that they have a respectively different scope of application along with various advantages and disadvantages in different settings. It is valuable to know how to make good use of them and to put this design knowledge into practice to generate design ideas. Before that, it is essential to know about what is the current state of research in design idea generation area.

3 The current state of research about design idea generation

Regarding the current state of research in design idea generation, I can see that varying papers focus on different aspects of design ideas generation. Some discussed the idea generation in different professional areas such as interaction design, fashion design, architectural design, game design and mechanical design and so on (Sas & etl., 2014; Hagen, 2009). Meanwhile, other discussed different types of design implications that identify a broader range than previously described, and then proceed the roles and types of design implications (Sas & etl., 2014). Some other researches discuss when inspiration and design ideas emerge (Cross, 2011), who thought that the inspiration comes when hard work sessions are alternated with periods of mental relaxation. Rapanta and Cantoni (2014) identified the end users as the primary trigger for design idea generation, aiming at showing how to plan for reducing the design problem complexity by empathizing with users. Some other studies showed the influence factors during generation of design ideas, such as how student designers tend to use reflection to reconstruct experiences relating to the generation of design ideas (Hutchinson & Tracy, 2015). Furthermore, there is also research focusing on what stimuli trigger the awareness or formation of design ideas, which would be discussed as follows.

4 What external stimuli are used during design idea generation

The generation of design idea is a process that is rooted in individual knowledge and is often considered a precedent-based type of reasoning, where knowledge is continuously transformed to produce new knowledge (Gonçalves & etl, 2014). During idea generation, designers use their background experience, skills, as well as different types of external stimuli in their surroundings include pictorial, verbal, audible or tangible stimuli. Designers have defined inspiration in design as a process

that can integrate the use of any entity in any form that elicits that formation of creative solutions for existing problems (Eckert & etl, 2000). However, the overwhelming amount of possible stimuli a designer could use adds to the complexity in understanding how inspiration influences the outcome of a solution. Presently, there are some articles about different types of stimuli designers reportedly prefer to generate design ideas.

Research has shown that designers have a preference for visual stimuli (e.g. Gonçalves, 2014; Malaga, 2000), which provide straightforward and intuitive cues that do not require translation between different perceptual modalities. Visual stimuli is one of the most important instruments to stimulate knowledge building, and the enrichment of reasoning and idea forming (Cross, 2011). Visual stimuli is a significant way for designers to acquire a deep understanding of a problem and to explore the board space of design solutions (Meyer, 2013). There are several common visual stimuli including sketching (Chansri & Koomsap, 2014), collages (Saunders, 2009; Mckay, 2006), prototypes (Gerber, 2012) and storytelling (Quesenbery & Brooks, 2008), which the designers usually use to explore and inspire during the idea generation process.

4.1 Sketching

Sketching has been introduced to support creativity in idea generation process, a natural and intuitive visual procedure to demonstrate empirical findings, initial idea expression or capture relations to pre-given requirements. Sketches help designers generate ideas (Pan & etl, 2013) by helping to refine creative concepts. This echo Remko's statement showing that the function of sketching is to support a re-interpretive cycle in the individual thinking process or to enhance the access to earlier ideas. Besides the immediacy and flexibility of traditional sketching (Chansri & Koomsap, 2014), which allows controlled vagueness and natural interaction, the emerging digital sketching tools have advantages in following ways: mix aspects of sketching and full annotation are supported, they are portable and easily navigable, and the allowance of duplication and transfers between different tool-environments, the ability to work on more details and try different effects easily, but with less room for imagination and creativity as paper sketching.

4.2 Collages

Collage is a technique of an art production, where the artwork is made from an assemblage of different materials (e.g. magazine clippings, handmade papers, photographs) thus creating a new whole (Saunders, 2009). It has more recently been used by designers to investigate feelings and emotions of users to capture or test their initial ideas. The use of consumer collages help designer to identify emotions and experiences of participants. This statement was supported by Mckay (2006) who

pointed out that the use of collage help to elicit requirements. Collage when used as a tool support potential end-users expression of impression, understanding, and emotions regarding a product which otherwise have been inaccessible to a designer. Collages can overcome the verbal communication issues of articulation and verbosity, but also limit the problems of disclosure reluctance in order to increase trustworthiness of the empirical finding and idea analysis (Saunders, 2009).

4.3 Prototypes

A Prototype is an early sample or model built to generate design ideas. Brown (2009) stated that prototyping is always inspirational because it inspires new ideas. Prototyping intends to find the manifestation in its most economic form, and will filter the qualities in which the designer is interested without distorting the understanding of the whole. The rapid visualization of multiple ideas through low-fidelity prototyping allows designers to reframe failure as an opportunity for generating and improving (Gerber, 2012). Most research regarding prototypes have centered on evaluation functions rather than support of design ideas exploration (Pniewska & etl, 2013)---the generative role in enabling designers to reflect on their design activities in exploring ideas. However, by way of working with prototypes, designers can identify design opportunities, and explore other design alternatives, that is, “learning by doing” and actively searching and experimenting any possible solutions.

4.4 Storyboard

Storyboard is another popular visualized technique for designers to generate design implications and verify design ideas. Combining aspects of imaging, graphics and scientific visualization, as well as information technology, the designer is faced to solve real-world problems and make these comprehensible for human perception with the help of storyboard. Storyboards not only help designers to explain the research and demonstrate the design ideas (Quesenbery & Brooks, 2008), but are also used to create compelling experiences that build human connections. Additionally, as indicated by Robert and Jock, storyboards are important to generate design ideas in many collaborative scenarios such as when working as a design team. Moreover, storyboards offer a way for designers to really understand the audience that they are creating it for, therefore they are able to get more specific design ideas. Storyboards allow for the most complex of ideas to be effectively conveyed inside the design team or to a variety of people. This designed product can then offer meaning and emotion for its users.

4.5 Other kinds of stimuli

The results showed that the designers seem to give an exaggerated importance to a restricted number of stimuli, such as the visual stimuli mentioned above, when they could alternatively take advantage of other available resources. There is also research indicating the positive influence of using text stimuli (Goldschmidt & Sever, 2010), object stimuli (Gonçalves and etl, 2014), and verbal or conversational stimuli (Salter & Gann, 2003) during design idea generation. In a word, through the review of the various external stimuli, it is believed that designers could potentially benefit from exposure to external stimuli which would provide a starting point or trigger and make the idea generation more efficient. Most researchers have examined when and what type of stimuli designers might be using to support design idea generation (Gonçalves & etl, 2014). Nevertheless, it is still not clear about how the different types of stimuli are retrieved and transformed during idea generation phases. The knowledge transformation between designers preferred stimuli and design idea generation need to be clarified so that designers know how to make use of stimuli to generate innovative design ideas more effectively. It is significant to consider the value of widening the search for different stimuli typologies and representation modalities as cues to creative problem solving.

5 Compare the situation between student and professional designers

The external stimuli frequently used by the designers do not only rely on their individual culture, but also on their professional backgrounds. Expert and novice designers tend to categorize information in different ways: novice designers organize information according to more superficial characteristics, whereas experienced designers are able to analyze information on the basis of many cases of solution principles they have stored in the past (Gonçalves, 2014). It is imperative for novice designers to take the time to learn from professional designers and develop their own methods and codify them into reproducible processes and artifacts (Shedroff, 2003). Further effort would be made to have a comprehensive and holistic understanding about how different designers utilize specific stimuli to generate design ideas, which include the student and professional designers in my case, as it offer a wide variety of resources that help designers, especially student designers, reach beyond the constraints of their individual world-view and into a new world of choice and diversity (Ireland, 2003).

As one of the great designers of product development methodology and practice, Pugh's concern was that the academic teaching of design was aloof from industrial practice, while industrial practice suffered from the lack of reflective structuring and refining theories that can be achieved in the university (Daniel, 2002; Pugh & Clausing, 1996). Previous research conducted in different disciplines compared what stimuli was choose in regard to ideation between student and professional designers,

but so far less studies have explicitly addressed how such stimuli are used during ideation (Gonçalves, & etl., 2014). In addition, most education programs stop short by focusing on the development of specific knowledge and skills without addressing the concurrent transformation and design thinking during the idea generation process (Dall'Alba, 2009). As a result, it is therefore essential to investigate how the professional and student designers use stimuli to generate design ideas in practice in comparison with what are the professors opinions in academic area. The results try to help professional designers get more scientific structure, give student designers more practical guidance in stimuli supporting the design idea generation aspect, which also helping design education refine design idea generation methods and improve resulting techniques to discover a dynamic balance among theory and practice.

6 Research questions

Therefore, it is my research topic to study how different designers preferred stimuli are selected and how they may contribute to generating design ideas and enhancing designers' creativity. The research questions are as follows:

- How do designers conduct an appropriate selection of functionally useful stimuli, amongst the overwhelming diversity of available sources?
- How different types of stimuli are transformed during design idea generation from empirical findings?
- What might be the difference between student and professional designers on their way to utilize specific stimuli during design idea generation phases?

Ultimately, through my research, I want to create an environment that helps the varying designers discover and reflect upon their own design knowledge. Knowing more about how different designers, especially professional designers, to retrieve and transform their preferred stimuli into ideas, and the design thinking involved in the process, is a significant step towards investigating the influence of stimuli during idea generation. Moreover, understanding the different approaches of student and professional designers on this matter can potentially help to investigate what novice and student designers need to learn from effectively utilizing different stimuli. In turn, this would also create effective knowledge transformation from stimuli which would support the innovative design idea generation. In summation, I intend to build a general mechanism for designers to conduct an appropriate and balanced selection of functionally useful stimuli, to transfer empirical findings to one kind of knowledge to inform design.

7 Methodology

7.1 Sampling

Essentially, all respondents should be predominantly comprised of students and professional designers, which include employee, freelancer designers and design professors. Most student designers are IF concept awarded designers. The most important evaluation criteria in IF concept design is the creative concept behind a submitted product, which usually sources from good design ideas (Goldschmidt & Tasta, 2005).

Additionally, some other professional designers are also included in my research such as outstanding designer employees and freelancers, and design school professors. The number of respondents has initially been set to 20, who come from different countries with different industrial design focus areas. At the beginning of the research, 'convenience sampling' is applied to choose the interviewee which means the participants are firstly selected on the basis of accessibility, in order to 'identify the scope, major components, and trajectory of the overall process' (Mose, 2007). This initial analysis of interviews would indicate 'how participants themselves partition the emerging phenomena'. Accordingly, the method of 'purposeful sampling' is then applied. This method is intended to choose the interviewee according to the way this scheme sorts the phenomenon. During the interview, I will try to explore these designers' principles of generating design ideas based on their perspectives while also investigating additional materials such as their awarded work, practical projects, visual dialog and so on.

7.2 Instrument

In order to investigate research questions, I will conduct an intensive qualitative interview to learn about student and professional designers' knowledge on how they select stimuli and transform it into design ideas. The qualitative interview has the common features of grounded theory: open-ended yet directed, shaped yet emergent, paced yet flexible (Charmaz, 2006). It was Charmaz who proposed that the combination of how the researcher constructs the questions and conducts the interview shapes how a balanced open-ended interview that focuses on significant statements can be achieved. My interview would be semi-structured which combines the structure of a set of core questions together with the freedom to follow up points as necessary (Zina, 2010). The advantage of a semi-structured interview with open-ended, non-judgmental questions is being able to come away with all the intended data but also interesting and unexpected statements and stories that emerge (Charmaz: 2006). Charmaz also stated that the combination of flexibility and control inherent in in-depth interviewing techniques fits grounded theory strategies for increasing the analytic incisiveness of the resultant analysis. The interview would ultimately be

conducted in terms of one-on-one face to face or online interviews (Skype, FaceTime, iChat and other audio tools) depending on the availability and accessibility of interview respondents. Furthermore, the interview would be audio recorded. The use of a tape recorder will allow me to give full attention to my research participants with steady eye contact while also providing detailed data when reviewing the recordings at a later time. Second time interview with Delphi method characteristics (Linstone & etl, 2002) would also be used, not only to elicit their design methods or techniques, but also to make better use of different expert opinions and let opinions react with each other when needed.

7.3 Data analysis

The audio data from interviews would be completely transcribed, thematically coded and analyzed. Firstly, Charmaz (2006) pointed out that transcribed audio or tape-recorded interviews make it easy to see when your questions do not work or forces the data, and studying the data prompts the researcher to learn nuances of his research participants' language and meaning. Subsequently, it is much easier for the researcher to define the directions where the data can take him, and learn about the participants' meanings rather than make assumptions about what they meant. Secondly, coding the data is the first step in moving beyond concrete statements to making analytical interpretations, which means "categorizing segments of data with a short name that simultaneously summarizes and accounts for each piece of data" (ibid: 2006). This way of coding show how the researcher selects, separates and sorts data to begin an analytic accounting of them. Therefore, my interview question data would be analyzed with a matrix structure. All designers would be put in a line and interview questions would be put in a column. The data could be displayed in a way of one designer to each questions, but also with formation of all designers to one question. A conceptual framework developed from prior literature provided initial classification of types of design implications and their information sources and so on. This would be further revised and refined as new codes emerged to capture specific types of implications, and additional sources and methods of generation, especially the visualization techniques. This information would then be compared with the perspectives of student and professional designers in practice along with professors in academia, and the profound causes that lead to specific phenomenon.

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