

EMOTIONAL IMPACT ON DESIGNER'S COGNITIVE PROCESS IN THE EARLY STAGES OF DESIGN

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ABSTRACT

This paper explores the role of emotional impact on designer's cognitive process in the early stages of design. After a short review of the current research status of designer's cognition and emotion, we propose two-way impact that seems important to understand the emotional impact on designer's cognitive process:

- (1) *Emotional impact in generative way* is to regulate or activate the mental information process.
- (2) *Emotional impact in evaluative way* is an emotional reaction which causes evaluative judgments on the designer's idea or even about himself.

The two-way impact has a strong relation and influences on each other during cognitive process in the early stage of design. Finally this paper will discuss the current methodological and technical issues to assess designer's activity, as well as perspectives for further work.

Keywords: *emotional impact, designer's cognitive process, early stages of design*

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1. INTRODUCTION

In recent years, there has been a growing interest in the analysis of designer's activity that emphasizes the importance of early stages of design [4][7][18][28][33][48]. This interest is oriented to the optimization of design process from early idea generation phase (often referred to as 'conceptual design phase' [21][40]) focusing, for example, in ways of shortening the duration of design process and also well matching consumer's needs and designer's intent. These issues have led toward formalization and digitalization of the early stages of design.

In cognitive science, including recent emergence of behavioral and neuroscience data, the research on cognition and emotion has remarkable emerged. Before, several researches were centered on 'cold' cognitive process, like decision-making to memory process, but nowadays their focus area is the interplay between cognitive and affective processes [38][41].

We have observed interesting findings related to emotional aspect of designers throughout precedent several empirical studies which aim at analyzing designer's cognitive activity. Since then, we found that the study on designer's emotion is crucial and inseparable in order to formalize designer's cognitive process in the early stages of design, which are considered as some of the most cognitively intensive stages in the whole design process.

In this context, our research was structured according to these three phases: (1) Formalization of designer's cognitive process of mental information categorization (2) Identification of emotional impact on designer's cognitive process (3) Development of computational tools.

As a first step of the research on emotional impact on designer's cognitive process, in part 2, we focuses on a wide range of literature review on the cognitive and emotional aspect of designers in the early stages of design, and our empirical examples will be provided. In part 3, we suggest two possible ways of emotional impact on designer's cognitive process: *generative/ evaluative*. In part 4, we argued the limitation of current methods and technique to assess designer's activity. Finally, the paper concludes by suggesting future work and by including some considerations regarding the need for deepening on this study.

2. DESIGNER'S COGNITION AND EMOTION IN THE EARLY STAGES OF DESIGN

2.1. Designer's cognitive process in the early stages of design

In the early stages of design, designers consider all aesthetics, ergonomics, emotions, production and cost related production in question [34]. Design concept design and its context are built up over time by designer employing multiple sources of information from observation and encoded information in external world, and also previous experience and learning in the internal recollection [18]. Therefore, a cognitive aspect of designer has increasingly studied in terms of human information processing in design [6][7][13][15][23].

According to the work done by Bouchard et al.[6], in taking a view of designer's cognitive process as information processing in early stages of design, designer engages in an information cycle. Information cycle includes informative, generative and decision-making

phases (evaluation-selection) whose outcomes are intermediate representations (IRs); and iterates evolutionarily.

In the generative phase, this phase consists of the generation of new ideas and new solutions. It begins by numerous mental images, memorized design brief and other information that comes from any design precedent project [6]. It is recognized as designer's individual process in repeating cognitive activities [28]. During the earliest generative phase, some parts of mental images can be externalized in early sketching. These early sketches are not mature to be shared, interpreted or used by other people. They can be served as an external representation, i.e. external memory in which to leave ideas as visual tokens for later inspection [46][48]. External representations (e.g. early sketches) allow a reflexive conversation between the designer and the product to be created [14][23][33][43][46]. Previous studies have shown that external representations also allow designers to identify errors to generate new ideas (e.g. Akin [1]). Similarly Crilly et al.[14] showed that designers engaged in 'bi-directional conversation' with representation, because intentions were formed and reformed during activities of representation (see also Schön's 'Seeing-drawing-Seeing model'[46]). Both external and internal information evolutionarily interact between each other, and they are categorized and synthesized into design solutions through designer's mental processing [6][30].

In this respect, we focus on the phase which is called 'information categorization process' during early sketching'. More precisely, our goal is to determine what kind of mental information is extracted and how it can be transformed or categorized during early sketching. However, it is still challenging work due to the specificity of designer's activity, such as emotion and nature of design information in the early stages of design.

2.2. Designer's emotional aspect in the early stages of design

In design practice, emotional aspect of designer is hard to appear explicitly; nevertheless, designers recognize that their activity deals with emotional content. According to our survey with 40 professional car designers [8], designers are naturally and intuitively conscious of the emotional impact on the cognitive activities to provide design solution characterized by their semantic expression. It has been recognized that the positive affect could play important role to enhance cognitive process [11][12][27]. Especially positive emotional spike, 'WOW effect' [31] is observed in design practice when an individual is offered an experience by the product that is different from or more than what they expected. However, these studies initially addressed the affective values of product through the semantic attributes, or emotional reaction from users rather than designer himself [8][47].

Emotional reactions with non linguistic expression (e.g. facial expression, body movement and vocal outbursts) can also be found in design activity (See figure1). The emotional facial expression has been widely used without doubt; relatively body movement has received little attention in the study of emotional reaction even though sometimes they are not necessarily basic emotions [3]. In addition, vocal outbursts, such as laughs, cries, sighs, yawns, etc. seems at first to be good examples of expressions, for instance, a funny joke elicits amusement, which produces a laugh; a loss elicits sadness, which produces crying; an uninspired lecture elicits boredom which produces a yawn etc. [45].



Figure 1: Various gestures and facial expression of designer

Considering both linguistic and non-linguistic expressions seems very important in study of emotional reaction. Because emotional reaction cannot be done only lexical data, and also we could gather even subtle reaction. Moreover some coincidental data could promise more reliable results. In part 4, we will argue this issue with presenting current status of measuring methods and techniques.

3. TWO-WAY EMOTIONAL IMPACT ON DESIGNER'S COGNITIVE PROCESS: *GENERATIVE* & *EVALUATIVE*

Based on the reviewing theoretical/experimental studies from psychology science and neuroscience, this part proposes two-way emotional impact on designer's cognitive process: *generative* and *evaluative* (see Table 1).

Table 1: Two-way emotional impact on designer's cognitive process

Generative way		
(G1) Aesthetic dimensions entailed harmony rules	Activating the necessary information crossing the different levels of attributes, such as semantic description, shape and color etc.	[8][30]
(G2) Freshness of the design solutions	Regulating an attention to match demanding task by 'affective feedback'	[2][11] [27][37]
Evaluative way		
(E1) Intrinsic coherency of the solutions	Evaluating the concept by the entailed harmony rules of information	[7][8] [11][12]
(E2) Hedonicity of evaluative decision making	Evaluating the concept by hedonic quality, e.g. designer's satisfaction	[10][23] [27][45]

'Emotional impact in generative way' plays a role to regulate the mental information process: activating the necessary information or changing attention to match a demanding task. In contrast, 'Emotional impact in evaluative way' is called, when designers employ their own emotions for evaluating or judging their ideas or even designers themselves. Both ways have a strong relation and influence on each during cognitive process in the early stage of design.

3.1. Emotional impact in generative way

3.1.1. (G1) Aesthetic dimensions entailed harmony rules

Designer's expertise refers to particular knowledge which is called emotional design in Europe, and more Kansei Engineering in Asia [8]. Design information consists of different levels: high level (semantic, values, style), middle level (sector names, patterns) and low level information (colors, forms textures). These levels of information can be seen as the position of an axis going from abstract (high-level information) to concrete (low-level information). Especially Kansei is a subjective process which enables to link high-level information with low-level information. This way of activating the necessary information crossing these different levels of attributes are strongly demanding emotional impact on the cognitive process, that we called here 'aesthetic dimensions entailed harmony rules (G1)'

That is to say, designers naturally and intuitively recognized the emotional impact on their cognitive activities in: (1) generating high level information such as value, semantic words, for example, 'well-being' or 'serenity' which can reflect secondary emotion, and (2) categorizing information to provide design solution which is characterized by semantic expression following harmony rules crossing the different levels of information, and also between several colours, textures and shapes [8]

3.1.2. (G2) Freshness of the design solutions

Clore and Huntsinger [11] have repeatedly shown that the source of affect would be finding oneself making progress on a task or encountering difficulty rather than induced mood states. This 'affective feedback' would then regulate attention and elicit 'cognitive tuning' to meet task demands. Isen [27] also found that positive affect enables flexible consideration of different aspects of concepts, or alternative cognitive perspectives. This facilitative effect of happy feeling promoted creative or innovative responding and does not extend to routine tasks. Similarly Ochsner et al. [37] emphasized the fact that cognitive change might be used either to generate an emotional response when none was ongoing or to regulate an already triggered response. Furthermore, according to the psychological point of view on language for the emotion perception [2], it is also possible that emotional words themselves could influence or reactive at a certain stage of stimulus categorization, where memory-based knowledge is being brought to bear on an already formed concept and prior experience.

3.2. Emotional impact in evaluative way

3.2.1. (E1) Intrinsic coherency of the solutions

According to Clore and Huntsinger [11][12], in performance situations affect provided compelling information about the personal value of whatever is in mind at time and serves as feedback about progress toward goals (Affect-as-information); however, sometimes maximizing positive effect is itself the goal (Affect-as-goal). In this part the former refers to intrinsic coherency of the solutions, and the latter serves as criteria of evaluation, namely hedonistic way in part 3.2.2. Actually, in many design circumstances, informational and hedonic goals often coincide so that it is hard to be conceived separately.

As we discussed in part 3.1.1, design information consists of different levels of information (High, Middle and low). The coherency takes place between all dimensions: high-level (semantics, sociological values) and low-level dimensions [7][8], and also inside low-level dimensions which are related in different directions among and between forms, colors or textures[8]. For example, we observed that designers made a judgment or evaluation low level information by high level information, for example, “(in watching their sketches), this grip is too classic, it is not so good”, or also made a judgment or evaluation among the same low-level information.

3.2.2. (E2) Hedonicity of evaluative decision making

Hedonicity of evaluative decision making is that maximizing positive affect is the goal itself (Affect-as-goal). That is to say, when designers make an evaluative judgment, they often ask themselves about how they do like their idea/sketches. Sometimes it could appear from aesthetic satisfaction, or also accomplishment of assigned design task [10]. For example, designers verbalized: “*Oh yes, it’s interesting*”, “*Nice, I like this*”, “*Ab Ouais, this concept that I like?*”, “*It’s more fun*”, or “*This form is just bothers me a little, it could be better!*”, “*I am not happy*” etc. In addition, based on the classification of emotional adjectives in linguistic: stative, manifestive and causative interpretation, when we said that something is ‘interesting’, the meaning of ‘interesting’ does not see a simple value on a scale; however, it can be decomposed in a complex structure such as ‘that stimulates in someone an interest’, or ‘that cause in someone a state of being interested’ etc. [24].

Hedonicity, in a sense of positive mode, is useful for making a decision easier and improving quality of these decision [27]; however, it could also mislead the point of view between what designer like and what costumer want in the later process. Nonetheless, hedonic value seems very crucial part for understanding designer’s activity in design practice.

4. LIMITATION OF ASSESSING DESIGNER’S ACTIVITY

Since the study on designer’s cognitive activity rapidly increased as the interdisciplinary topic in recent years, different methods from not only psychological research, but also Kansei engineering and neuroscience have been employed in design research to capture and understand designer’s internal processing. In selecting the main applied methods for capturing and understanding designer’s cognitive activity, figure 2 illustrates some of methods depending on the different disciplines, level of instrument (Heavy-Light) and covering scope of designer’s activity.

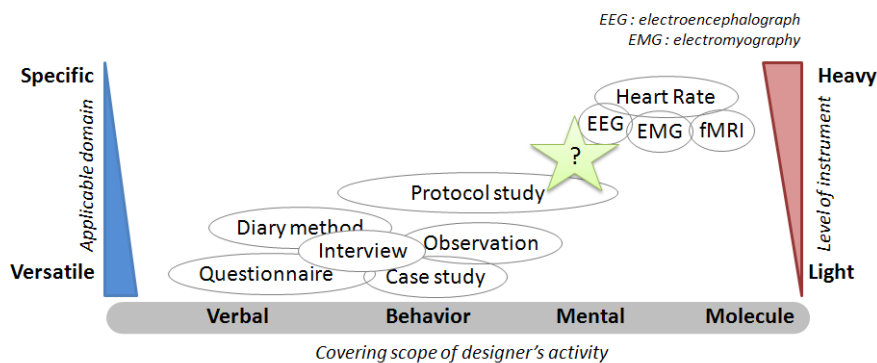


Figure 2: Main applied methods for measuring designer’s activity

The X axis represents the covering scope of the designer's activity from verbal, behavior (Facial mimics, gesture etc.), mental to molecule (physiological) level. The right Y axis represents necessary efforts for handling instrument for experimentation (Light-Heavy), and the left Y axis represents the application area whether if the method is used in specific domain or several. These methods could be applied, depending on the research goal and situated experimental environment, such as feasible time, cost and the expertise.

In Europe, culturally there has been intensive investigation toward identifying cognitive way in using questionnaire, interviews, observation or a protocol study[13][15][34]. On the contrary, Asian approach has much emerged into psycho-physiological measurement by combining the techniques, such as, electromyography (EMG), heart rate and electroencephalography (EEG) etc. in the scope of Kansei study [30][32][34][47][49].

Undoubtedly, combining physiological measurement with cognitive method has some advantages and disadvantages [50]. Unnatural, obstructive and heavy instrument might interfere with designer's natural activity and influence on the results; however, applying physiological measurement under careful consideration could give us promising objective results and deepen understanding of designer's activity. The emerging investigation from Kansei Engineering [47] and HCI community could also be a good source to prompt this approach, for example, the contents at HUMAINE Portal [24].

Accordingly, it is still a challenging work to attempt to the valence of cognitive and physiological method [13][17] and develop economic and feasible new technique[50].

5. CONCLUSIONS

Within this paper, research related designer's cognition and emotion, especially in the early stages of design has been reviewed. Key contribution of the paper is presenting two-way emotional impact on designer's cognitive process: *generative/evaluative*. 'Emotional impact in generative way' plays a role to regulate the mental information process: activating the necessary information (G1: Aesthetic dimensions entailed harmony rules) or changing attention to match a demanding task (G2: Freshness of the design solutions). In contrast, 'emotional impact in evaluative way' is an emotional reaction which causes evaluative judgments on the designer's idea (E1: Intrinsic coherency of the solutions) or even about himself (E2: Hedonicity of evaluative decision-making). The two-way impact has a strong relation and influence on each other during cognitive process in the early stage of design.

Further study is necessary to give more empirical results to support the two-way emotional impact which we hypotheses above. We will conduct a protocol study with product designers in combining physiological measurement. And then, other subjective variable, which could potentially influence on individual emotional reaction, such as cultural difference in emotional vocabulary, individual differences etc., will be considered.

From a long view perspective, we believe that (1) this research could make enrich to modelling designer's cognitive process in the early stages of design; and (2) it will also serve as specification to elaborate new computer aided design tool (CAD) for the earliest phases of the design process.

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