

UNCONSCIOUS INTERACTION BETWEEN HUMAN COGNITION AND BEHAVIOUR IN EVERYDAY PRODUCT: A STUDY OF PRODUCT FORM ENTITIES THROUGH FREEHAND SKETCHING USING DESIGN SYNTACTIC ANALYSIS

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ABSTRACT

The development, advancement and critical study of design thinking challenges designers to explore every possible factor in high value innovative design concepts. Designers must expand their thinking parameters and seek values in design activities by analyzing all related factors in human behaviour. Moreover, the need for more communicable and stringent design development strategies of the product's conceptual ideation is increasing. Based on prior studies of human behaviour factors, the theory of unconscious interaction and cognition in human behaviour has shown its value as a guide for designers to create an innovative product design concept during sketching activities. In this paper, selected conceptual sketches generated from an understanding of the theory of unconscious interaction and cognition in human behaviour will be analyzed. This study aims is to analyze form elements and entities implemented by designers using design syntactic analysis as the main methodology. The ultimate goal is to identify which elements visualized (1) the superior gestalt consisting of form entities and form elements of the highest hierarchical (global) level of the product form; (2) the characteristic shapes which indicates the purpose and function of form aesthetics and (3) a signifying curve as a form ingredient which indicates the functional component of product form. The final section will discuss the result and the significance derived from the outcomes of the study. This includes the functional identifications and analysis of form aesthetics, the consistencies and uncertainty elements, and product concept reasoning.

Keywords: Design syntactic analysis, interaction in design, methodology, product design, unconscious human behaviour.

1 INTRODUCTION

In the psychology perspective, unconscious interaction of human cognition and behaviour in everyday life can be explained as an automatic process of being effortless, unconscious and involuntary [1]. Meanwhile, in the design perspective, it can be defined as the subtle and amusing ways that humans react to tangible things and the environment around them [2]. This fits the descriptions of "goodness of fit" and the idea of unselfconscious design as introduced by Alexander [3]. According to Alexander, people unconsciously make a good fit from a misfit as soon as the misfit is recognized. The embodied interaction was triggered by incremental engagements that lead to subjective and possibly unknown improvements in relationships among everyday products, environment and users [3]. The integration of varying and disparate literature regarding this theory has shown extraordinary potential to contribute to product design development (see e.g., [2], [4], [5], [6], [7], and [8]). However, the applicability and the usefulness of understanding the theory may be questioned, specifically in this matter, since the empirical evidence in relation to designers' reflective practice is still considered limited. In this study, the ultimate aim is to understand on how a designer responds to affordance and how the element in design ideation is generated based on affordance, how it is determined. Hence, this study requires an extensive observation methodology as means to extending the knowledge about designers' design activity.

1.1 The attributes of unconscious in everyday behaviour

Norman [9] concedes that there are three levels of emotion interactivity, namely: (1) visceral; (2) behavioural; and (3) reflective. In this study, the attributes of unconscious in everyday behaviour were derived and adapted from Norman’s idea of behavioural interactivity. Through a cautious and repeated process of analysis, design cases and psychology literatures regarding unconscious behaviours, Sohn, Nam, and Lee [6] determined four attributes of unconscious in everyday human behaviour, namely: (1) adapting; (2) reacting; (3) signalling; and (4) conform to others (see Figure 1).

The existence of 'initial intention', 'individual and 'social' are the key factors to distinguish between these four attributes. Some automatic interactivities do not require any willful initiation and operate quite independently of conscious control and many of the behavioural interaction we do every day are things of which we are perfectly aware [10]. However, we no longer need to think about the act after we have consciously launched it because we have done the act so often. These behaviour interactions are often acquired skills, actions that become automatic only after significant repetition. Therefore, the attributes can be instigated by stimuli of which we are not yet conscious, or by stimuli of which we were recently conscious but are no longer.

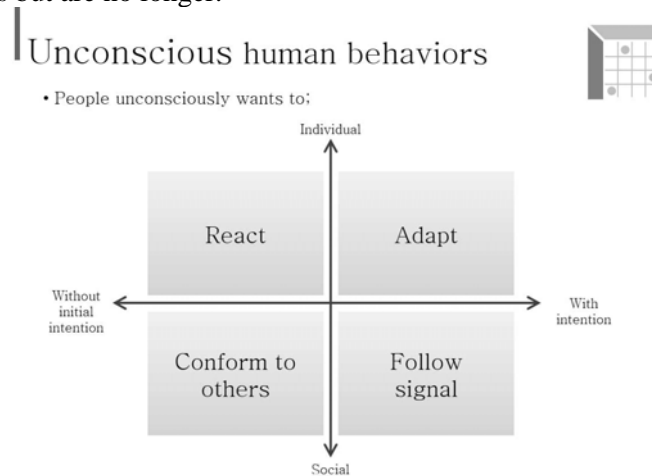


Figure 1. Four attributes of the unconscious in everyday human behaviour, adapted from Sohn, Nam and Lee [6]

1.2 Design syntactic analysis

Design syntactic analysis is a methodology to analyze form [11] entity relations that reveals a consistent treatment of a visual composition, functionality and design format (see Figure 2). There are three form entity levels in describing an evidence of aesthetic organ structure, communicative functions and characteristics of form elements. Referring to Warell [12], those three levels can be identified through: (1) The superior gestalt level: consisting of form entities and form elements of the highest hierarchical (global) level of the product form (outer shape); (2) The intermediate level (form features): consisting of significant characterized shapes and form elements (features) of product form (inner shape); and (3) The lower level (product component): a signifying curve (form ingredient) is distributed across the product form. Understanding these from entity levels is claimed contribute to identifying design syntactic (structure establishment) reasoning implemented in designers’ conceptual sketches.

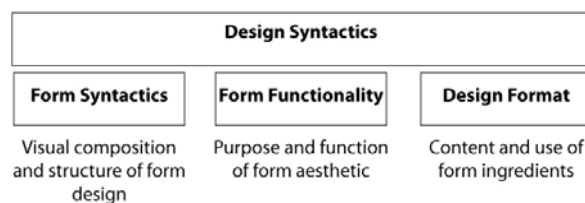


Figure 2. The theoretical framework of Design Syntactic, adapted from Warell [12]

2 RESEARCH OBJECTIVE

The study concerning theory of unconscious interaction of human cognition and behaviour in everyday product has been explored by integrating a variety of disparate literature. However, there

was no study found which tries to understand the designers' sketching process based on affordance using the theoretical basis of reflective practice and design syntactic analysis. Moreover, numerous studies on the designers' sketching process has contributed to the formulation of the objective of this research: to use design syntactic analysis to understand designers' sketching process in relation to the theory of unconscious interaction of human cognition and behaviour in everyday product.

The overall research question guided the investigation regarding how designers' conceptual ideation devoted to the theory can be understood. Based on findings reported from previous studies, there were three sub questions developed as follows:

RQ1. An analysis of form entities reveals a consistent treatment of a design format and an evident aesthetic organ structure. Thus, which part in designers' ideation sketches were generated in relation to the theory has a consistent treatment of a design format?





RQ2. It is argued that uncertainty is the primary factor triggering change in sketching structure and drives invention in design. Thus, are there any uncertainty elements of form entities existing in designers' sketches in relation to the theory?

RQ3. Form entities in design carry aesthetically determined functionality. Thus, what are the functionality elements embedded in designers' ideation devoted by their reflections on the theory of unconscious interaction of human cognition and behaviour in everyday product?

3 METHODOLOGY

In this research, we explore how designers generate conceptual sketches based on their understanding, analysis and reflection on the theory of unconscious interaction and cognition in human behaviour. We also study the characteristics of these conceptual sketches in order to determine and describe the ingredients of the visual form composition such as the shapes and their arrangement, in an objective manner. Therefore, we explore the designers' sketching activity by understanding their reflective practice [13] and critically analyze them using design syntactic analysis [12]. The investigation was based on two studies:

Table 1. The polar images

Image A: adapting	Image B: signalling	Image C: reacting	Image D: conforming to others
			

In study 1, a total of 30 practicing product designers, product design students, and educators were selected to participate in Verbal Protocol Analysis (VPA). During the VPA, they were given four polar images (coloured) that depict the subtle and creative ways in which people interact with a product. The polar images were categorized into Sohn's four attributes of unconscious in everyday human behaviour [6] as in Table 1. They were asked to generate conceptual ideation sketches based on their understanding, analysis and reflection on each polar image. Hence, each designer participated in four episodes of VPA in connection with these four attributes.

In study 2, there were a total of 10 respondents; master's degree level design students were asked to analyze four conceptual sketches which were generated from study 1. As a reference, four polar images (grayscale) the same as Table 1 were given as well. The respondents were asked to identify design syntactic (structure establishment) reasoning implemented using a coloured pen on each sketch (printed on A3 paper sheets) through: (1) the superior form level (outer shape); (2) the intermediate form level (form features); and (3) the lower form level (product component) [12]. Finally, the material produced in study 2 was critically analyzed by the authors with respect to: (1) the consistencies of structure establishment analysis by respondents; (2) the uncertainties elements of structure establishment existed in designers' sketches compared to the polar base images; and (3) the functional identifications and analysis of form aesthetics in designers' sketches.

4 FINDINGS

At the end of Study 1, four conceptual sketches from each episode were generated by 30 designers which make a total of 120 conceptual sketches generated during study 1. Out of 120 sketches, four conceptual sketches were selected by the authors based on a heuristic quality review. Results from Study 2 are illustrated in Figures 3. In Figure 3, the frequency of consistency elements in three levels of form entity as indicated by respondents are illustrated in the set of four sketches. Moreover, the uncertainty elements of three levels of form entity, and direct functional identifications were also illustrated as well.

Based on the result, the author found that the ability of the designer to realize intent made performance results vary considerably between designers and between the assignments given. According to VPA data, the result shows that designers are able to understand the context of the main theoretical basis. In general, they are capable of extracting their perceptions in relation to Sohn's attributes [6]. Moreover, we found that designers are proficient enough to construct a critical analysis to determine the 'misfit' in given polar images and reflect on how the embodied interaction portrayed could contribute as valuable factors in enhancing products values.

Reflective practice and thinking, as described by Schön [14] will lead to new interpretations and present opportunities for new solutions in the process of sketching as performed by the designer. As reflected in this study, designers produced a conceptual ideation that solved the 'misfit' as follows: (1) mobile charger with automatic roller in its body in order to solve the messy cable management; (2) a parking meter with a digital screen indicator for signalling purpose when the product is malfunctioning; (3) a pen with chewable cap, purposely to provide comfort of biting reaction; and (4) sunglasses with hanging cable and built in mp3 speaker (see Figure 3).

5 DISCUSSION

Our discussion of this research focuses on the characteristics of designers' conceptual sketches in relation to the theory of unconscious interaction of human cognition and behaviour in everyday products. The sketching process has been investigated based on the proposed research questions with respect to three characteristics: (1) consistency: describing the establishment and reliability of structure establishment reasoning as indicated by respondents; (2) uncertainty: denoting the triggering factor of change in design which drives the product invention; and (3) functionality: describing product functionality embedded in designers' ideation devoted by their reflections on the theory and polar images. Figure 3 exhibits the analysis of design syntactic in designers' ideation sketches, which was generated in relation to the theory of unconscious interaction of human cognition and behaviour in everyday products. The analysis underscores which elements represent the structural establishment of form entities in each of the conceptual sketches.

In order to address the first research question, the structure establishment of form entities were identified on the notion of consistency as indicated by respondents (similarities elements existed between the sets of design syntactic analysis indicated by respondents). In Figure 3, the frequency of consistency element indicate the consistent treatment of a design format implemented in each level of form entities. As analyzed and indicated by respondents, the elements of structure establishment in each level of form entities were determined by a high level of consistency (most indicated elements between sets of analysis by respondents).

In response to second research question, Figure 3 illustrates the result of uncertainty elements of form entities existed in the conceptual sketches. In this research, the uncertainty elements were identified on the notion of which elements were partially transformed or changed throughout the stages of the sketching process, compared to the polar images. The term uncertainty is used to refer to a change in design through recognition and promoting reasoning about the depicted ideation. By comparing each level of form entities with the polar images, the author identified the changes which led to aesthetic value and innovation. These changes are the triggering factors in design that drives product invention.

Finally, with respect to the third research question, the result of form functionality analysis is indicated in Figure 3. The main purpose of analyzing the functionality of the constituent form elements is to identify the underlying design intent. According to Warell [12], the analysis covers all functional aspects of the product under study, including internal functions (i.e. structural, transforming, and additional functions) and interactive functions (ergonomic, syntactic, and semantic functions). In this research, the approach was based on direct functional identification supported by triangulation

analysis of VPA data. During functional identification, the sketches under study is scrutinized with the objective of identifying functions which belong to different classes by direct observation.

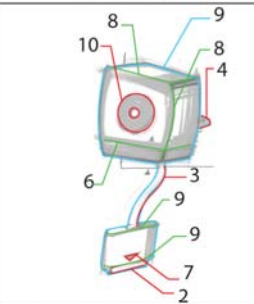
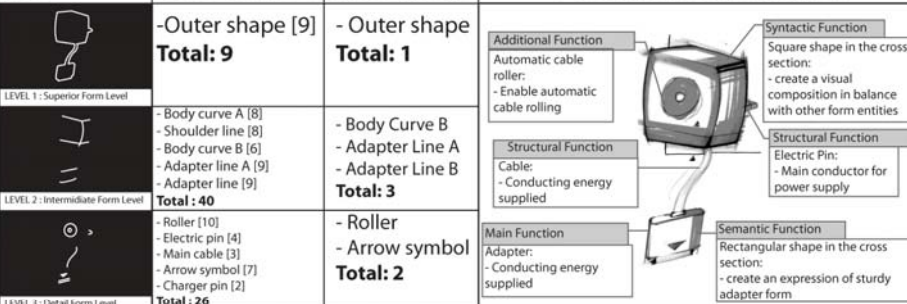
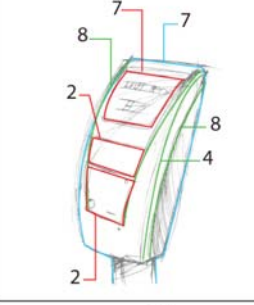
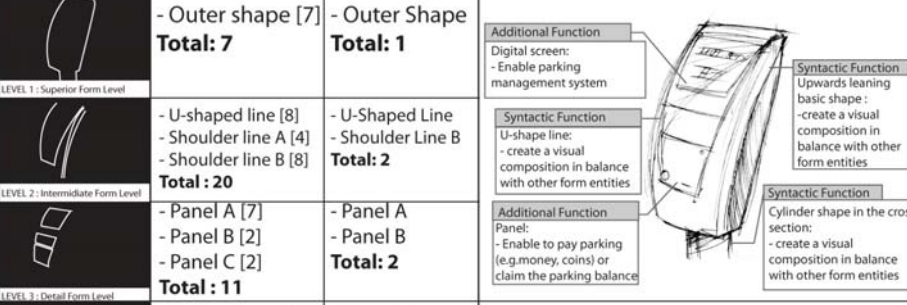
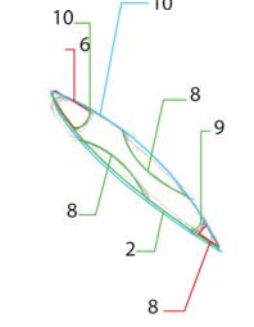
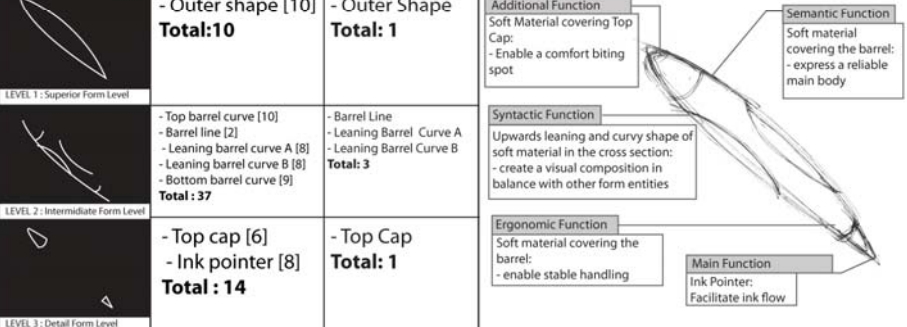
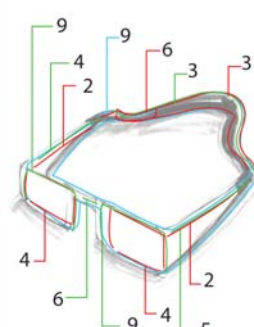
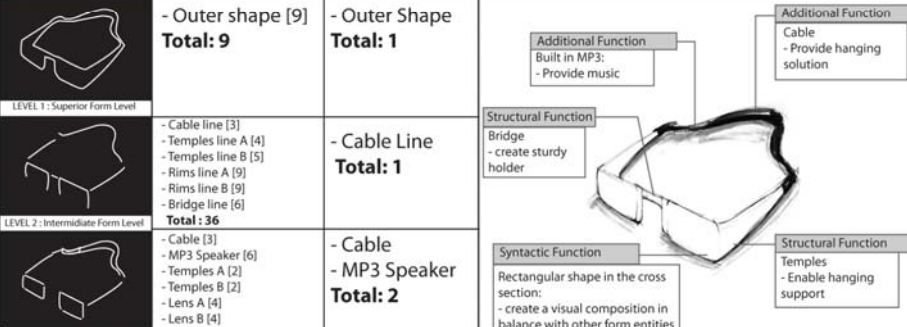
Form Entity Analysis	Consistencies	Uncertainty	Form Functional Analysis
	<p>LEVEL 1 : Superior Form Level</p> <ul style="list-style-type: none"> - Outer shape [9] <p>Total : 9</p> <p>LEVEL 2 : Intermediate Form Level</p> <ul style="list-style-type: none"> - Body curve A [8] - Shoulder line [8] - Body curve B [6] - Adapter line A [9] - Adapter line B [9] <p>Total : 40</p> <p>LEVEL 3 : Detail Form Level</p> <ul style="list-style-type: none"> - Roller [10] - Electric pin [4] - Main cable [3] - Arrow symbol [7] - Charger pin [2] <p>Total : 26</p>	<p>- Outer shape</p> <p>Total: 1</p> <p>- Body Curve B</p> <p>- Adapter Line A</p> <p>- Adapter Line B</p> <p>Total: 3</p> <p>- Roller</p> <p>- Arrow symbol</p> <p>Total: 2</p>	 <p>Additional Function</p> <p>Automatic cable roller:</p> <ul style="list-style-type: none"> - Enable automatic cable rolling <p>Structural Function</p> <p>Cable:</p> <ul style="list-style-type: none"> - Conducting energy supplied <p>Main Function</p> <p>Adapter:</p> <ul style="list-style-type: none"> - Conducting energy supplied <p>Syntactic Function</p> <p>Square shape in the cross section:</p> <ul style="list-style-type: none"> - create a visual composition in balance with other form entities <p>Structural Function</p> <p>Electric Pin:</p> <ul style="list-style-type: none"> - Main conductor for power supply <p>Semantic Function</p> <p>Rectangular shape in the cross section:</p> <ul style="list-style-type: none"> - create an expression of sturdy adapter form
	<p>LEVEL 1 : Superior Form Level</p> <ul style="list-style-type: none"> - Outer shape [7] <p>Total : 7</p> <p>LEVEL 2 : Intermediate Form Level</p> <ul style="list-style-type: none"> - U-shaped line [8] - Shoulder line A [4] - Shoulder line B [8] <p>Total : 20</p> <p>LEVEL 3 : Detail Form Level</p> <ul style="list-style-type: none"> - Panel A [7] - Panel B [2] - Panel C [2] <p>Total : 11</p>	<p>- Outer Shape</p> <p>Total: 1</p> <p>- U-Shaped Line</p> <p>- Shoulder Line B</p> <p>Total: 2</p> <p>- Panel A</p> <p>- Panel B</p> <p>Total: 2</p>	 <p>Additional Function</p> <p>Digital screen:</p> <ul style="list-style-type: none"> - Enable parking management system <p>Syntactic Function</p> <p>U-shape line:</p> <ul style="list-style-type: none"> - create a visual composition in balance with other form entities <p>Additional Function</p> <p>Panel:</p> <ul style="list-style-type: none"> - Enable to pay parking (e.g. money, coins) or claim the parking balance <p>Syntactic Function</p> <p>Upwards leaning basic shape :</p> <ul style="list-style-type: none"> - create a visual composition in balance with other form entities <p>Syntactic Function</p> <p>Cylinder shape in the cross section:</p> <ul style="list-style-type: none"> - create a visual composition in balance with other form entities
	<p>LEVEL 1 : Superior Form Level</p> <ul style="list-style-type: none"> - Outer shape [10] <p>Total:10</p> <p>LEVEL 2 : Intermediate Form Level</p> <ul style="list-style-type: none"> - Top barrel curve [10] - Barrel line [2] - Leaning barrel curve A [8] - Leaning barrel curve B [8] - Bottom barrel curve [9] <p>Total : 37</p> <p>LEVEL 3 : Detail Form Level</p> <ul style="list-style-type: none"> - Top cap [6] - Ink pointer [8] <p>Total : 14</p>	<p>- Outer Shape</p> <p>Total: 1</p> <p>- Barrel Line</p> <p>- Leaning Barrel Curve A</p> <p>- Leaning Barrel Curve B</p> <p>Total: 3</p> <p>- Top Cap</p> <p>Total: 1</p>	 <p>Additional Function</p> <p>Soft Material covering Top Cap:</p> <ul style="list-style-type: none"> - Enable a comfort biting spot <p>Syntactic Function</p> <p>Upwards leaning and curvy shape of soft material in the cross section:</p> <ul style="list-style-type: none"> - create a visual composition in balance with other form entities <p>Ergonomic Function</p> <p>Soft material covering the barrel:</p> <ul style="list-style-type: none"> - enable stable handling <p>Semantic Function</p> <p>Soft material covering the barrel:</p> <ul style="list-style-type: none"> - express a reliable main body <p>Main Function</p> <p>Ink Pointer:</p> <ul style="list-style-type: none"> - Facilitate ink flow
	<p>LEVEL 1 : Superior Form Level</p> <ul style="list-style-type: none"> - Outer shape [9] <p>Total : 9</p> <p>LEVEL 2 : Intermediate Form Level</p> <ul style="list-style-type: none"> - Cable line [3] - Temples line A [4] - Temples line B [5] - Rims line A [9] - Rims line B [9] - Bridge line [6] <p>Total : 36</p> <p>LEVEL 3 : Detail Form Level</p> <ul style="list-style-type: none"> - Cable [3] - MP3 Speaker [6] - Temples A [2] - Temples B [2] - Lens A [4] - Lens B [4] <p>Total : 21</p>	<p>- Outer Shape</p> <p>Total: 1</p> <p>- Cable Line</p> <p>Total: 1</p> <p>- Cable</p> <p>- MP3 Speaker</p> <p>Total: 2</p>	 <p>Additional Function</p> <p>Built in MP3:</p> <ul style="list-style-type: none"> - Provide music <p>Structural Function</p> <p>Bridge</p> <ul style="list-style-type: none"> - create sturdy holder <p>Syntactic Function</p> <p>Rectangular shape in the cross section:</p> <ul style="list-style-type: none"> - create a visual composition in balance with other form entities <p>Additional Function</p> <p>Cable</p> <ul style="list-style-type: none"> - Provide hanging solution <p>Structural Function</p> <p>Temples</p> <ul style="list-style-type: none"> - Enable hanging support

Figure 3. The result of Study 2

6 CONCLUSION

6.1 Advantages of understanding the theory of unconscious interaction of human cognition and behaviour in everyday product

This study expands the design continuum of artefacts used in our everyday life, defined as everyday products in relation with the theory of unconscious interaction of human cognition and behaviour. In this paper, our hope is to provide a better understanding about the possibilities of looking at the realms of unconsciousness and embodied human interaction for product innovation. In finding a fit between human values, designers should start to understand critically and looking at every tiny factor existing in human interaction and behaviour, including the realms of unconscious. This does not involve the

mere replacement of a term; rather, the role of unconscious interaction of human cognition and behaviour in everyday products must be considered broadly. Through the content analysis of literature and scientific evidence from empirical study, we argue that the theory of unconscious interaction of human cognition and behaviour in everyday products provides significant value as a new thinking parameter in design. A collection of cases depicted an embodied interaction, the subtle and creative ways in which people interact with the product have inspired designers to consider actual contexts and people's responses to those contexts.

6.2 Advantages of Design Syntactic Analysis as a Methodology in Design Education

Based on the empirical evidence, using design syntactic as an analysis methodology provides ways of approaching aspects of structure establishment and form entities, innovation elements in design and functional identification of the designed product in relation to the theory. Since the form design development is a crucial part in the designers' design process, the higher institution or design school should consider implementing design syntactic analysis methodology as part of a special curriculum in the education. The curriculum should emphasize giving understanding about design syntactic analysis as a systematic approach that synthesizes the form elements in order to better understand the visual composition and structure of form design, functionality of form aesthetics and format of form ingredients. By doing that, students' reasoning ability on form structure establishment in conceptual ideation may be increased.

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