Abstraction: Investigating the Phenomena to Facilitate Form Generation in Design.

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Abstract: The discipline of Design is essentially multi-dimensional and inter-disciplinary. On one hand where it deals with artificial intelligence and the cognitive behavior, on the other it derives its roots deeper in the theorized philosophy of the mind. Abstraction is one such phenomena that is seen to be contributing to the design field and human cognition in the most natural and under-toned manner. This paper aims to outline on philosophical grounds this phenomenon as a wholesome, intuitive and intelligent process that can dub itself as a key process in Form generation. To demonstrate this process, we have used a case-study where the process of abstraction is explored with the Form Generation process.

The explanation of abstraction is done in a very field-specific manner in different domains. A study of the philosophy can help understand the phenomena better by getting a working idea of the process and levels involved. This paper shall throw light on the evidence of levels, basic properties, and role of perception in abstraction. Abstraction may provide a very fundamental and useful understanding of the framework of mind, while in process of concept-building. There remains a gap in understanding the ever-expanding and syncretic behavior of the abstraction process in context of generation of Form.
Further research shall seek how the process of abstraction can be used for building methodologies and strategies based on this dynamic phenomenon for design and further our knowledge of the creative process in Form generation

Key words: Abstraction, Form, Form Generation

1. Introduction

The notion of abstraction is followed by vivid explanations in linguistics, art, mathematics and the sciences. Artificial intelligence regards this phenomenon not only significant; but one of the complex functions of the mind [1] While investigating the role in designing communities and social interaction; the process is defined as removing specific details to find simple rules that underline the phenomena [2]. In the field of neuroscience it is considered an organizational mechanism that structures the perceptions gathered from various experiences, helps problem solving and bring past experiences to the foreground when needed [8]. Art creates inexplicable forms and visuals with the help of abstraction that have impeccably surprising outcomes. The result is also innovative

techniques in the journey to seize the abstract. As one of the design processes this phenomena is yet to attract attention. The terminology and the intricacies of this phenomenon are yet to be defined on the Design grounds. This paper forms the part of a larger whole that aims to build information on role of abstraction pertaining to Form generation and perception in design.

In this paper we aim to define the term and outline the inherent process/es on philosophical grounds with showcasing a case-study. First the process and meanings are looked at, that various philosophers have outlined; and then a generic idea of the term is built. Later the evidences of inherent level systems are sought looking at various domains, and the contemporary theories to qualify the subject are compared with. The understanding is further elaborated upon with the phenomenon of Perception that is not only crucial in this aspect but entwines itself with the abstraction process; and plays an important role in designing. Perception also establishes itself as the resultant of abstraction [19]. The process of Form generation is discussed afterwards, that signifies role of the phenomena in the design process. The discussion part concludes how this information can be useful as applicable to design, and what are the implications.

The central thought is establishment of Abstraction as an inherent intelligent process that can be consciously put to use for form generation. Also weather knowing levels and exploring associations of abstraction and perception can help prove fruitful for developing methodologies that can further the enhancement of Form generation methods in the design domain.

2. The need for a review

As stated, various domains richly derive from abstraction as an intuitive process and intelligent phenomena of developing understanding of the matter [1]. This phenomenon is though passively seen working submerged in forming the design idea and form generation, and is an underlying factor to aesthetics, symbolism, art and perception, its relevance to design education with context to Form need more exploration.

There is a need to surface coherent processes that abstraction contributes to; that are most relevant to design, like form generation, design process building, user experience and concept-building. Not only is there a need to contextualize this phenomena as it is understood from various sources, it also needs to be structured and categorized to appreciate its relevance and importance in the design realm.

3. Scope

This paper provides a literature review on the abstraction process, and how this mechanism creates the support structure to the Form building and perception.

Abstraction is a vast domain in itself. Our humble endeavor is to find relevance in the field of design with:

o   A cohesive information base on Abstraction and the abstraction process from various domains.

o   Presenting a generic framework based on presented ideologies so that the subject is better understood.

o   Contextualizing the term and process in the design context and demonstrating dynamic connection of the abstraction process with form generation.

4. Central Philosophical Concepts for abstraction as a process

One of the earliest, Plato [16] asserts the existence of a field of ideas that exist, in spite of it being imagined or

not imagined by humans. A 'supra-abstracted idea' that can be unique to each human being. These are the genuine knowledge of: say, truth or beauty etc. These are termed as Platonic Forms. Where ordinary objects or concepts can change, these Forms are unchangeable, permanent and reliable, certain forever. This stood as the abstractness for that time. The other classic thinkers like Locke, explained abstraction as a procedure of the mind [3]. Descartes too explains the phenomena of Abstraction and exclusion as mental operations; where in the former the focus is on one idea: which may be a part of the larger whole, but in exclusion; both –the part and the whole is compared in order to refute one or the other [20]. In Locke's view "ideas taken from particular beings become general representations of all of the same kind" [15].   According to him, simple qualities assigned to objects like taste, color, smell, tones directly reach the mind in the most raw manner, and are remembered very explicitly while recreation. Though there was much criticism faced on abstract ideas, and Berkeley specifically counter argued Locke on this aspect that one individual quality of an object cannot be separated from other qualities [3]. He argued it is impossible to imagine the motion of an object minus its shape, color, and/or direction.

Berkeley treats abstraction process with a 'shift in attention' as leading to it [17]. This can be understood by moving the focus on to only the selective qualities. Though selection might not be an intuitive result, focus can be developed formally. An abstract concept can be associatively generated with sequential cognitive processes. Linnell furthers Aaron's thoughts [13], while explaining Locke's theory of abstract ideas identifies three strands of arguments, here these are put forward as the strands, formally not giving us parallel perspective, but as each a step ahead of the other, forming levels.

-The first, identified being "a particular idea which represents many other   particulars". The mind generalizes a particular idea.

-The second that, the abstract idea is framed by negating the constituents. It is resultant of a certain process of elimination, moving from complexity to simplicity. (An idea also supported by Barsalou [1] in human cognition.)
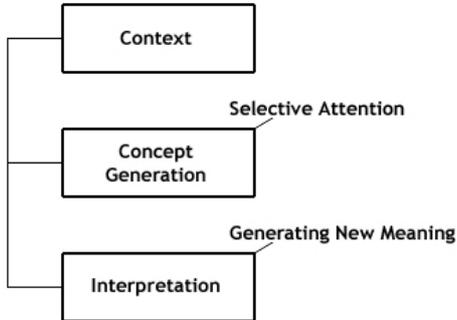
-The third, "neither a particular idea nor a part of the particular idea…it's the meaning…the essence.

(Ref. 01 and 02)
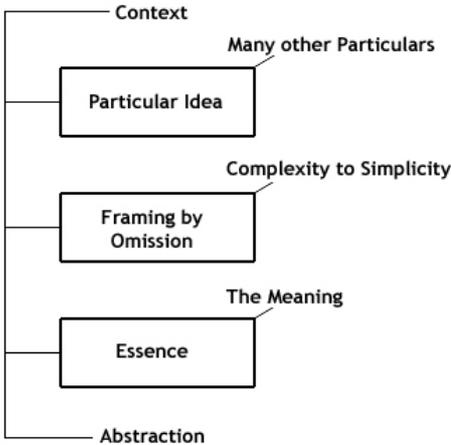
Locke's Theory of Abstract Ideas: The Three Starnds as a Process

Berekely's selective focus abstraction as a Process

Fig 01   Fig 02

The process as understood from Berkeley's view [14] can be:

–   A Context of an entity

– A selective attention concept. (Extracting features that are individualistically relevant.)

– Interpretative mode, generating new meaning.

Now while comparing we can clearly visualize that there is a difference of vocabulary in the arguments, but the processes are very much aligned to a central theme: that from the initial conception, the selection procedure of the mind works as an abstraction process, unique to each person, and the result is a new concept, devoid of its parentage.

As we move to the contemporaries, for Susanne Langer abstraction is the process by which one forms an understanding of any condition, object, or phenomenon. "Abstraction of formal elements for other intellectual purposes is a natural and even an irrepressible human activity" [11]. She also emphasizes abstraction as an absolute natural phenomenon that forms the human cognition and asserts: "Abstraction is the recognition of a relational structure or form" [11]. Abstraction at its very basic for her would mean, approaching a class or phenomena of ideas and concepts without relation to a larger or more integrated whole. Here abstraction can be seen as generalization of thought; this idea is shared by many philosophers like Locke, Berkeley, and Langer.

According To Susanne Langer, in the process of abstraction: After the concrete knowledge is gained of the subject, the first step is to make the object unimportant in appearance. The second step is to disintegrate it from its connections and as a complete stand alone entity, and thus the construction pattern can now be conceived. Associative detailing is observed, by discarding the physical status. [10] (Ref. Fig 03)
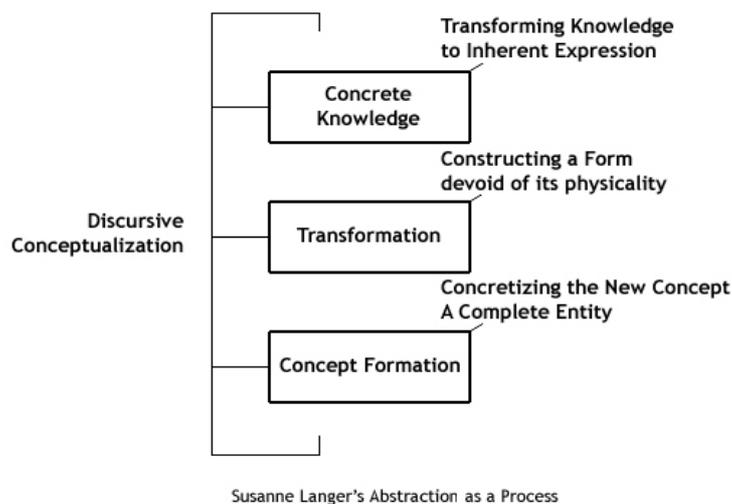

Susanne Langer's Abstraction as a Process

Fig 03

A process of abstraction can be discursive reasoning and would lead to recognition of pure form. Philosophers agree that abstraction involves the elimination of relatively specific information; we need see how this information can be used to address the significance of representational aspects of abstraction for the visual fields. Scientists as well as philosophers have agreed that the process of abstraction involves a much more rigorous method than mere cloning. Mind does not make an identical picture of the seen, but creates an intelligent interpretation in bits and pieces, which are complete in themselves as smaller wholesome concepts. [1]

We thus summarize our understanding that:

o Several schools of thought agree on the grounds of eliminating relative information specifically early in the process.

o We also gather that, an abstracted form becomes a complete end in itself, can withhold multi-component

information. It can be fabrication of many variations of simpler and selective forms or ideas. It can prove to be crucial understanding to form generation process in design that is discussed later in the paper.

o A process to 'selective attention' is an important juncture, as it is important to human cognitive understanding.

o Qualities of the subject can be highlighted or hidden under contextual subjectivity.

o Transformation of context into personal experience has not been given much prominence by Locke and Berkeley, but considered significantly important by Susanne Langer

o Once abstracted, an entity can be subjected to further abstraction as it is an independent complete whole in itself.

5. Coming to an understanding of the term abstraction

Abstraction is therefore understood as a mechanism that simplifies the information by not using the former concrete details. It is a selective combination of relevant data to form a conceptual understanding of something. Though from AI; the definition given by Guinchiglia is most representative and significant of the phenomena: "Abstraction is the mapping from one representation of a problem to another which preserves certain desirable properties and which reduces complexity." [6]

Thus an understanding can be developed that by conscious or subconscious efforts certain decisions are made that develop our understanding of things. There is only useful information kept to build conceptual and contextual understanding. (Though even the unuseful information also remains in our perception in some abstracted way as the rejection criteria). All our senses play a part in this mental developmental and dynamic mechanism.

6. Properties of Abstraction

Properties of abstraction have been discussed in a reserved manner by theorists. But the cognitive scientists [8] and the artificial intelligence theorists [1] have excellently outlined properties so that they can form the basis to understanding the basics of abstraction.

Barsalou furthers the categories of abstraction as categorized by the senses, and divides the central form as [1]:

o Abstraction as categorical knowledge: where a specific category is abstracted out of the enormous experiences.

o Abstraction as the behavioral ability to generalize across instances: where the properties of one or more categories can be summarized behaviorally.

o As summary representation: A concise summary of the selected concept.

o Abstraction as a schematic representation: These describe categories in memory: Properties can be distorted in various ways to make a caricaturist representation. This Increases distinguishability from other categories very clearly.

o Abstraction as Flexible representation; and,

o Abstraction as abstract concepts

He names the three central properties as; *Interpretation*, *Structured Representation* and *Dynamic Realization*.

Here indeed forming the concept is expressed in a very simple way but indicates that there might be a method to solving the puzzles of chaos and keeping them in the mind's niches. This concept also gets a strong support in

Susanne Langer's [10] opinion too that abstraction is most natural to human mind and there is an innate human need to put chaos into order. Several factors can impact forming of a concept. These factors can be socio-cultural, personal, educational, etc. There are cultural systems of meanings, but it is also important to notice that abstraction may not be separated from individual beliefs or individual thought processes.

7. Evidence of Levels

A distinction is made by Witkin as the two levels of typification and Individuation: being low level and high levels respectively [19] and the emergence of a new phenomena (can be new form) is stated to be depending upon the conception of the level of the abstraction [4]. The levels in the process of abstraction are also stated to be based on the principals of categorization. There is a human tendency to categorize an idea, estimation or abstraction of probable typicality in a category [18] and the basic level of categorization are considered as the most abstract and the most inclusive.

When we talk about levels of abstraction, several philosophers talk about certain levels which take place within the cognitive mind resultant of many faceted dynamic activity of forming concepts. We have discussed and tried to visualize thought processes of abstraction by Locke, Berkeley and Langer in fig-01, 02, 03, and move forward with Emiko Ohnuki, who forms Perception – conception – Symbolization as the schema in forming levels of abstraction [5].

These three stages appear to be working in forming the abstractions in the human mind. Though we need to see how and where can we assimilate and create information that happens for the design and art in order to not only know the phenomena but also use it effectively to create concrete information on creating abstraction of form.

Though all of the stated levels create a new concept of existing phenomena, we need to venture into the level 3, (If we treat it hierarchically) where externalization happens for a designer; to generate applicability of the process. Externalization is where generation of a form comes into being. At level 3, concretization of the malleable floating concept can happen, which can now further be put in four levels.

a. Physical   (direct appearance, shape, size, orientation)

b. Behavioral   (Can be action or Movement)

c. Emotional or Expressive (Attributes and other qualities. These can be considered super-imposed levels)

Expressive or Spiritual (Emotion, Expression, Spiritual.) (Ref. Fig 04)
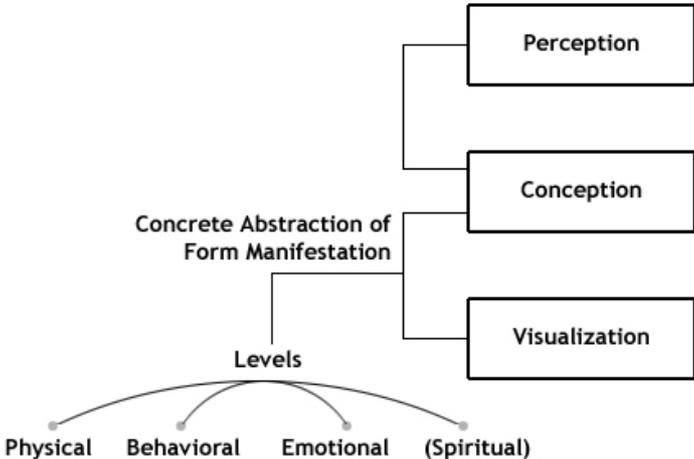

Fig 04: Abstraction levels: The Perceived structures happen to exist on a co-relational basis taking on a step further from Emiko Ohnuki [5].

These levels though ideally form a successive order, but any of the three could happen first or last. The form that may emerge hereafter can relate with any of the above levels. The implication in applicability of these stages in generating new forms is to also develop along with, an assessment base of how and why one stage can be treated above the other or even be treated as parallels. We see the solution lying in the dynamics of the application procedures and material used. This is an area of future research also where active application-oriented tasks can be build to materialize concrete form in initial process of the form generation in product Form ideation.

8. The Phenomena and Form Generation

The question before us stands that, in the design background how do we use the depth of this mechanism, and see its role for the expansion of understanding and generating form? Form generation in the design context is mostly related and considered a part of idea generation. Experiments in the third dimension have been reported for aesthetic development along with computational patterns to develop visual language [22]. The experiments with form has also been done to see aesthetical reasoning with a combination of organic objects with geometric computational structures, that are very significant in form study [9] or imagination enhancing creative mechanisms are talked about for creative form, as 'reconstruction of shape elements'[21]. In the presented work, we are trying to approach a theoretical framework of abstraction; and how this process can be approached to understand its applicability in the form generation process to support the field of design.

While trying to understand the form generation process as aided by abstraction, we discuss one of the experiments, where active form generation is led stage by stage. It was noticed that levels progressed with the thought process, as the form evolved. The stimulus selected by the sculptor is the form of a dragonfly. The initial stage was to know, develop the perception of it by various means like images, reading about its nature, habitat, etc. (It is to be noticed that prior to this exposure, we have a tactile, and sensual (primarily visual) perception of the stimulus. We also might have a faint remainder of trying to catch it in open space.) The knowledge is further developed by probing use of it as motif in civilizations, and myths or interpretations attached with it.

At stage I; the stimulus in its abstraction is captured in various ways in soft material, to experiment with its form.

At stage II; the play with form itself has led to several selection and rejection stages, as the stimulus is moved closer to being '*becoming from its material'*

At stage III; the transformation of the abstract form can be noted in a more or less final stage solution; where the finesse of the physical form is visually decisive of itself.

At stage IV; all we can see is only the material remains from previous stages, a complete new form is seen devoid of even its physical semblance of the stimulus. (Ref. Fig 05 and 06)
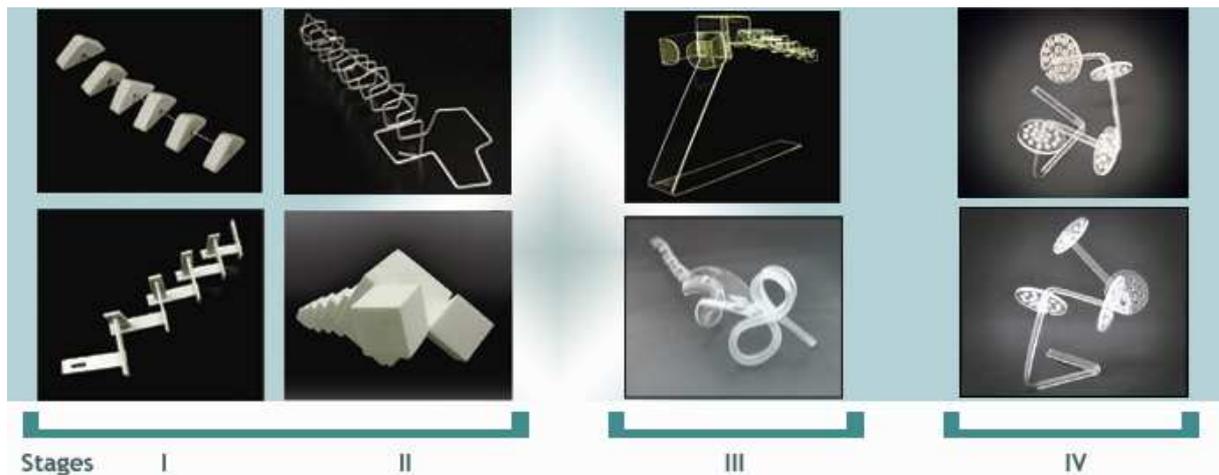

Fig 05: The chosen stimulus

Fig: 06. The Stages

We can see at Fig 06; at stage IV that though visually the stimulus was led to its form in a finalized way, what could have been dwelling on the designer's mind that led to such a complete transformation at the stage IV? While in the abstraction process journey a former selection and rejection of the material was happening, it stopped at the acrylic medium, as finally it was seen to be favoring the transparent quality and delicacy of the stimulus.

It was the form at stages I and II in the mind that led to selection of the final material. But as soon as its job was done, the form also got rejected and a complete new form emerged. It could be the designer's search to yet concretize the unseen, beyond physicality (level 1 to2) of the perceived stimulus to higher levels (level 3-4). Though we use the term higher, for the levels, none of the previous creations can be considered lesser, as they are a complete representative entity of their own. Though the experimenter is taken over primarily by its structural orientation at I and II; he is able to seek variation in shifting between the materials and at III and IV not only focuses his ideas, but also enhances his 'selective attention' detailing towards progression with the progressive levels in abstraction.

It can be noticed how in the first two stages (I, II) the solidness of the form is there; and later the sheer volume is rejected (III, IV) as it pose an obstacle to the delicacy and transparency that is evident as a chosen criteria when the material is finalized. It can be noticed how effectively the need to reach at a different level in abstraction has triggered not only experimentation but also growth in the thought process that elevates the structural levels from I, II to IV. At IV the concept can be seen completely dissociative of initial physical context.   It is the essence of the subject's abstracted concept -of the creature's movement and static sound zones of the whizzing wings while accompanied with the rapid movement that has taken to be the final form.

We witnessed in this study, that the underlying process of abstraction were seen taking concrete stages as it surfaced its evolution. Actively being involved in the process, transforms the process in a personalized manner to enrich perception that not only relives older notions, but create newer concepts to be stored in order to make the perceptions richer. Abstraction here has been done tentatively and visually, by gradually and progressively concealing and revealing forms drawn from the nature. We can create symbolic elements that have no representational origins to experiment with the form.

The process highlights, what attributes were selected and what was eliminated for this subject in order to still hold on to the essence of creation. The Medium to express here also became an opportunity.

Though the process is led in semi-planned manner, play with free form led serendipity help enrich the abstraction process. Such tactics if used can rejuvenate the designer out of his/her usual techniques to form generation, at the very beginning of creating a product form. Experimenting with form generation at early stages can potentially prove as richer mechanism for form generation. Form play stays at multi-level, and multi-layers. The formal relationship of the physical form vanishes to give way to the expression or emotion devoid of its physicality. Perception changes with each stage of abstraction. Each level paves way for the next level to happen gradually as the process develops. The abstraction and perception at a level result in the abstraction and perception of the next level and the ladder of concept-making develops. The purpose of the active hands-on experimentation is to create emotive qualities of the stimulus, to surface the essence of the visual element. The aim can be to reach at a stage; where there is *no clue* left of the physical Form. The abstraction along with the perception of the creator can create evolutionary levels that help in creating surprising and out of the box form ideas.

9. Discussion and Future Research

Abstraction and Perception: A Creator's Journey: These are two entwined processes of human mind that lead on to concept building. Abstraction shapes perception by selection and rejection. Though selection and rejection both hold subject reality of each individual as criteria of acceptance or rejection; there can be universal canons of shared local or universal perceptions. For example cultural rituals and motifs, local modes of communication, language gestures and ideologies, over time with abstracted data an individual's perception shapes up; and guides as comparison or reference to further making selections and rejections.

There is also an understanding that we develop, that realization of an object is not is not singular to the object. The perceptual understanding is enriched with abstraction specific to the form. An object is capable of being abstracted by as many individuals in as many ways. Each has the capability of highlighting a particular aspect above the rest that it possesses in a particular environment or attitude that it is viewed in.

We know objects as we see them. An object presents itself at the first level only as an abstract entity. The Form represents itself as the object it brings into vision. The form interprets the function, abilities, qualities and the essence altogether, to be viewed as a concept. The point is that each object is bound to be seen as an abstract notion of itself. Each object is made universally, but is meant to be taken in (understood) personally. Each object manifests and imbibes at the basic, two processes of its understanding. One while in its creation, the other, while it being viewed, appraised.

A thought Process while concept-creation always remains abstract, only the result can be seen or a further abstraction of it-as an interpretation can be seen. But in the design process of the thought the gradual progression from a mere idea to many ideas and changing form, can be concretized via sketching, initial 3D modeling with software etc; but offering to build a form hands on, can reach further. It will not only make the stages and the levels seen as in the experiment stated, but also trigger the thought itself. And if studied, it has the potential of becoming to some extent an applied methodology in Design education.

An object of view transforms in a multitude of variations and is seen accordingly with many variant ways. Working concretely with form with the abstraction process facilitates the experimenter of looking and feeling a thing, beyond its one perceived meaning. Its feel and its journey with senses keeps creating new meanings to make a richer perception rather than a single kept meaning of it. This point can prove a key to designer's journey in form generation.

Acknowledgement

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