Design Thinking: Phenomenology of early stages of creativity, ideation, affect, communication, design decisions and actions

Abstract

This paper focuses on exploration of the phenomenological aspects of human internal design activities that precede, or transition into, conscious thought, creative ideas, decisions, feelings, words, body states and movements, and actions that are the foundation of Design Thinking. These early stages in Design Thinking are important because they are gatekeepers of what is envisaged and created by a designer, and also provide the foundation of communication, decisions and actions. Study of these early stage and prior foundational phenomena of Design Thinking provide improved foundations for theories about Design Thinking. The relative lack of attention to these phenomena in previous Design Thinking literature is at least in part because such exploration requires the designer undertaking significant additional training to acquire the necessary phenomenological skills of self-perception specific to these phenomena. The paper reports the basis of exploratory research into these phenomenological foundations of Design Thinking undertaken by the author over a 4-year period. The paper includes a detailed description of the research method and four findings that add to the theoretical foundations of Design Thinking.

Introduction

Recently, there has been a focus of the idea of Design Thinking as a specific process to be undertaken by organisations and design teams that emphasises thinking about the user, and their needs and experiences using a designed product or service. This is the 'Design Thinking' model originating in and taught at the Plattner d.school at Stanford and popularised by IDEO and others (for example, Cohen, 2014; Dell'Era, Magistretti, Cautela, Verganti, & Zurlo, 2020; Higgins, 2020; Lee, 2021; R. Liu & Mannhardt, 2019; Lockwood, 2010; McKendrick, 2020; Müller-Roterberg, 2018; Plattner, n.a.; H. Plattner, C. Meinel, & L. Leifer, 2012b; Plattner, Meinel, & Leifer, 2011; Rodgers & Winton, 2010)

Some of the earliest approaches to research about Design Thinking had an epistemological and ontological focus on the internal activities of designers and understanding the ways that designers think when creating designs (see, for example, *4th international design thinking research symposium: design representation*, 1999; Ambrose & Harris, 2010; Balaram, 2011; Bastick, 2003; Beaumont, 2011; Blossom, 2011; Buchanan, 1990; Buchanan, 1992; Chiasson, 2001; Cross, 1990, 1992; Cross, 2011; N. Cross, A. Cross, & S. Glynn, 1986; N. Cross, A. C. Cross, & S. Glynn, 1986; N. Cross, K. Dorst, & N. Roozenburg, 1992; N. E. Cross, K. E. Dorst, & N. E. Roozenburg, 1992; *Current design thinking : a symposium organised by the Midlands Branch of the Institution of Chemical Engineers at Aston University, September 12-14, 1979*, 1980; *Design thinking research*, 2011; Dingli, 1994; Fuller, 1965; Galle & Kovács, 1996; Gordon, Poze, & Synectics inc., 1968; Kamran, 2017; Bryan Lawson, 1980; Y.-T. Liu, 1996; Love, 2009; Murray, 1986; Neeley & Leifer, 2007; Rowe, 1987; Sato, 2010; Wallace, 1992; Whiting, 1958)Bastick, 2003; Cross, 1990; Cross, 2011; N. Cross, A. Cross, & S. Glynn, 1986; N. Cross,

A. C. Cross, & S. Glynn, 1986; N. Cross et al., 1992; Bryan Lawson, 1980; Y.-T. Liu, 1996; Love, 2009; Neeley & Leifer, 2007. Much of the research in design thinking referenced in these documents was grounded in observation of designers and designers' self-reports on their activities and experiences whilst designing. Kamran (2017) regarded this kind of research into Design Thinking as research into a ' designer's own observing' and claimed it is the foundation of theorising about Design Thinking.

This paper similarly focuses on designers' subjective experience of their internal activities whilst designing. Specifically, this paper is concerned with the foundations of Design Thinking, being the related thoughts, actions and affects at the very start of the human process by which a design comes into mind. That is, it focuses on the phenomena prior to, and in the transition into, a creative idea coming into an individual designer's consciousness. The research has a more general benefit. It also contributes to better understanding of the phenomena before and during the emergence of thoughts, feelings, decisions, actions, and changes in body state or behaviours for any human behaviour, not just Design Thinking.

Epistemologically, since the middle of the 20th Century, designing has been regarded as a creative human activity that is substantially rational (Akin, 1979; Alexander, 1984; Archer, 1965, 1968, 1979; Austin & Steele, 2001; Bazjanac, 1974; Beer, 1974; Bird, 2000; G. Broadbent, 1973; G Broadbent, 1984; Buchanan, 1992; R. Coyne, Snodgrass, & Martin, 1992; R. D. Coyne & Snodgrass, 1991; Cross, 2000b; Cross, 2011; Cross, Christiaans, & Dorst, 1996; Cross & Dorst, 2001; Daley, 1982; Dilnot, 1982; Dixon, 1989; K. Dorst, 2007; K Dorst & Cross, 2000; Eastman, 1968; K. Friedman, 1999; K Friedman, 2000; Fry, 2008; Glegg, 1969, 1971; Goldschmidt & Porter, 2004; Gregory, 2000; S A Gregory, 1966; S. A. Gregory, 1966; Hay , P, & McKilligan, 2020; Jevnaker, 2000; Jonas, 2000; Jones, 1966; Bryan Lawson, 1980; B Lawson, 1990; Levin, 1966; Margolin & Buchanan, 1995; McDonagh, Hekkert, van Erp, & Gyi, 2004; Middendorf, 1969; Overbeeke & Hekkert, 1999; Pye, 1964; Roe, Soulis, & Handa, 1966; Spillers, 1974; Thomas & Carroll, 1979; Valkenburg & Dorst, 1998; von Thienen, Weinstein, & Meinel, 2023; Wallace, 1992; Whitney, 1990; Wiggins, McTighe, & ebrary Inc., 2005; Yoshikawa, 1985). It has been generally assumed that designs for products, systems, services and the like are thoughtfully identified as solutions to problems and needs (Buchanan, 1992).

Any discussion about Design Thinking is founded on two questions: 'What is a design and what is the activity of designing?' This paper assumes the following:

- *A 'design' is a set of information about how to make or do something.*
- *Designing is the activity of creating a design.*

Assuming the above, core ontological and epistemological questions in this research exploration into the earliest stages of Design Thinking include:

1. What happens inside a person when they are designing?
2. How does a designer perceive and experience what happens inside them when they are designing?
3. What are designers' perceptions and experiences of how new thoughts and ideas come to their mind, or how new ideas emerge from drawing?
4. How can those internal human perceptions and experiences of the activity of designing contribute to a designer's professional development?
5. How can those internal human perceptions and experiences of the activity of designing contribute to a designer's individual personal development?

6. How can a designer's perceptions and experiences of how new thoughts and ideas come to mind, or how new ideas emerge from drawing be facilitated so a designer can learn from directly from their creative designerly activities?
7. How can a designer use their perceptions and experiences of how new thoughts and ideas come to mind and how new ideas emerge from drawing to improve their decision making whilst designing?
8. Are there additional benefits for designers and others form designers exploring how they perceive and experience the ways that new thoughts and ideas come to mind and emerge from drawing or other activities?

This paper focuses on the first three of the above questions. The remainder are addressed in a separate paper.

The paper takes a phenomenological approach to understanding the foundations of Design Thinking addressing an aspect that has been typically overlooked in the current literature in which the self-reflection of designers whilst designing has been addressed relatively superficially (Kamran, 2017).

Epistemologically and ontologically, the explorations reported in this paper are grounded on the theories of Edmund Husserl (see, for example, Beyer, 2022; Husserl, 1983) and Maurice Merleau-Ponty (see, for example, Toadvine, 2023).

To a large extent the conceptualisation of the phenomenological issues of Design Thinking expressed and explored here use the conceptualisations of Husserl in ways that follow the four themes of Merleau-Ponty that build on Husserl's work. These are:

- Privilege description over scientific explanation and idealist reconstruction.
- Phenomenological reduction (Husserl's 'bracketing' or suspending judgement and bias)
- Eidetic reduction (Husserl's essences of mental objects)
- Intentionality (seen also as conscious agency)

The paper comprises five sections. This introduction is followed by a section providing a brief overview of the Design Thinking literature as it relates to the issues addressed in the research. Section three reviews the phenomenological issues. Section four describes the research method. Section five outlines four findings from the research. The implications of the research are discussed in the concluding section.

Design Thinking

Design thinking has a long history since the late 1950s, with the term 'design thinking' becoming established in design-related literature from the late 1960s (Ambrose & Harris, 2010; Brown, 2008; Buchanan, 1990, 1992; N. Cross et al., 1992; *Current design thinking : a symposium organised by the Midlands Branch of the Institution of Chemical Engineers at Aston University, September 12-14, 1979*, 1980; *Design thinking*, 1954; *Design thinking research symposia*, 2004; Galle & Kovács, 1996; Gerber, 2018; Kamran, 2017; Y.-T. Liu, 1996; Lockwood, 2010; Loewe, 2019; Love, 2009; Meinel, Leifer, & SpringerLink (Online service), 2010; Plattner, n.a.; H. Plattner, C. Meinel, & L. J. Leifer, 2012c; Plattner, Meinel, & Weinberg, 2009; Rowe, 1987; Sachse, Specker, & Lauche, 1999; Wallace, 1992).

Early approaches to categorising a particular modality of design activity as 'design thinking' focused primarily on problem solving and differences between engineering designer's ways of solving problems and those of designers in the Art and Design traditions. Engineering designers were seen as

problem focused, with solutions emerging from the constraints of the problem (Hay et al., 2020). In contrast, designers trained in Art and Design traditions were seen as solution-focused, generating many solutions, and identifying which best satisfied the problem. Both can be seen as alternative ways of working with solution space. The focus of engineering designers being to first identify regions in solution space where solutions are located. In contrast, a primary strategy of designers from Art and Design is create solutions anywhere within solution space, and then identify which solutions best addressed the problem.

Unpacking the concept of design thinking in epistemological terms, since the 1950s, design thinking has been conceptualised in terms of a human process of finding appropriate solutions to design problems. Although the term 'design thinking' refers to the thinking of designers, in fact, the focus of early research into designers' thinking has been primarily on processes by which potential solutions can be identified from characteristics of a design problem. Later, design thinking research in the 1980s and 1990s emphasised the application of cognitive science to designerly thinking (e.g., Chan, 2008; Cross, 2000a; Finke, Ward, & Smith, 1992; Harpaz, 1994; Hay et al., 2020; Love, 2000, 2002; Aaron Sloman, 2001; A. Sloman, 2010; von Thienen et al., 2023). This cognitive science approach modelled designers thinking via computer and informatic theories of cognitive processing, primarily with the aim of creating automated systems to create designs. This path of automation of design activity proceeded somewhat covertly from the 1980s in design software where increasingly aspects of design activity were automated using AI whilst at the same time obscuring this automation from view. An example is the automation of font metrics in Adobe products such as Photoshop, Illustrator and InDesign. Designers appreciated the ease and reduction in time that such automated software offered whilst providing the illusion that all decisions were undertaken by the designers' themselves. Another example, from the early 1970s, Swanson Analysis Systems (later AnSYS and more recently as part of AutoDesk software) provided AI-based optimised generative product design software. Automated design thinking for document layout appeared in the early 1980s via STML, later transformed into HTML and implemented via various hypertext software such as ZOG, KMS and Enquire. Currently, automation of design thinking is now publicly available via multiple providers for a wide variety of design tasks including image selection, modification, design solution identification, document layout.

More recently, the term 'Design Thinking' has become widely promoted by Stanford University d.school and the design business IDEO as the title for a five stage process for business innovation that emphasised the role of users of designed products and services and empathy with their needs and experiences (Greene, 2010; Kelley & Littman, 2005; Plattner, n.a.; H. Plattner, C. Meinel, & L. Leifer, 2012a; Plattner et al., 2011; Plattner et al., 2009). In many cases, e.g. via the design thinking process of Stanford, designers themselves provide that information by acting as if they were users. This Design Thinking process taught at Stanford d. school and popularised by IDEO became for 2 decades one of the most fashionable approaches to management innovation and decision-making. FastCompany argued recently, however, this period of 'Design Thinking' appears to be ending as indicated by IDEO laying off large numbers of its staff (Wilson, 2023).

Design, particularly in the Art and Design fields, has a well-established literature and research program in reflective and reflexive practice, developed in architecture by Donald Schon and others (see, for example, Buchiarelli, 1984; Love, 2002; D. A. Schon, 1987; D A Schon, 1992; Valkenburg & Dorst, 1998). An extensive suite of tools and practices has been developed for reflective practice in design including journals, collaborative review, feedback assessments, and reflective design checklists. Reflexive practice in design uses design methods to design new and better design methods and processes, what Glegg (1971)called 'the design of design'. In essence this is a positive

feedback loop. Reflexive practice in design research is more controversial because it uses design methods to design how research is undertaken. This potentially ignores the conventional restraints on research that provides the objectivity and generalisability expected of it.

These reflective and reflexive approaches to theorising about design thinking are intrinsically meta-cognitive (von Thienen et al., 2023). That is, they exist as a process to review cognitively based activities involved in designing, commonly categorised in terms of psychological or informatic concepts and cognitive activities of thinking, feeling, ideation, memory retrieval, intuition, communication, habituation, body-mind integrated actions etc as revealed by designers' reflections on their design thinking (see, for example, Buchanan, 1990; Cohen, 2014; Cross, 2000a; Cross, McFadzean, & Johnson, 1999; Dell'Era et al., 2020; Garner & Evans, 2012; Gerber, 2018; Hay et al., 2020; Loewe, 2019; Love, 2000; Müller-Roterberg, 2018; Plattner et al., 2012b; Sargent, n.d.; Aaron Sloman, 2001; Stickdorn & Schneider, 2011).

This paper goes significantly beyond the above metacognitive approaches to explore those aspects of design thinking prior to creative thought that in fact determine what creative thoughts, and hence design thinking, is actually possible for a designer. The paper described explorations into the activities prior to and in transition into the conventional realm of design thinking. That is, the paper explores the phenomenology of the designers' perceptions, thoughts and actions as ideas, decisions, feelings, intuitions etc., as and before they first emerge into conscious perception in the designer.

Multiple tacit activities occur prior to the activities described in the design thinking and design cognition literatures. For example, how does a designer perceive an idea coming into mind? Initially, at the outset a designer's conscious mind has no perception of the new idea they will soon have that might be made into a design. Then, a very short time later, the designer has that new idea in their mind. What happens during that short, potentially almost instantaneous transition from 'no relevant idea in mind' to 'idea in mind that might be a solution'? This issue is foundational to any Theory of Design Thinking and raises multiple foundational questions:

- How does an idea or thought come into existence from the situation just prior to that where the designer has no idea of that future thought in their conscious thinking?
- Where does the idea come from?
- If the process is subconscious by which an idea comes into conscious mind, how does that occur? What triggers that specific idea to come into conscious thought, rather any of the billions of others that could have done so?
- What exists unconsciously within the designer prior to the idea coming into their conscious mind?
- How was hat idea selected without consciousness from all the possible ideas that might have come into the designer's mind?
- Does that transition occurring outside the designer's consciousness between the state of not having an idea and having an idea result from a designer's agency – in spite of it being outside consciousness and awareness?

The two pathways to addressing and answering the above questions are via phenomenology, i.e. the designers self-perceptions, and via biological explanation of cognitive theories (see, for example, Chan, 2008; John S. Gero, 2000; J S Gero & Maher, 1993; John S. Gero & Tang, 2001; Purcell & Gero, 1996). However, the literature on the biological explanation of the stages prior to an idea coming into conscious thought are limited (Lazar, 2018) and research into improving such quality of theories of design cognition has stagnated (Hay et al., 2020)

This research, therefore, focuses on the phenomenological turn in which the designer undertakes a detailed subjective phenomenological analysis of what occurs in themself in the time immediately prior to an idea coming into conscious thought. This, however, requires improving the sensitivity and quality of phenomenological self-report of these initial and transitional stages of emergence of thought, emotion, decision, agency and action.

Phenomenology of Activities prior to Design Thinking

The underpinning epistemological and ontological foundation of the research outlined in this paper aligns directly with that of Edmund Husserl (Beyer, 2022; 1983; Marosan, 2022) and his concepts of eidetic and phenomenological reduction and, indirectly, the method of eidetic variation to identify the essential elements of the phenomena (Schmitt, 1959; Q. Smith, 1979; Tassone, 2017; Theodorou, 2015). The research, and the findings, also align with the neurocognitive research findings reported by Damasio, Barile and others relating to consciousness, creative thought, aesthetics and actions (for example, Barile, 2023; Damasio, 1994, 1999; Habibi, 2014; Shafir, 2016).

This design research exploration into design is based on practical fine-grained observational skills. In design education such observational skills are typically taught for visual review of designed and manufactured artefacts, behaviours of users and alignment of designed solutions with problem brief.

In this research, the phenomenological study requires the designer researcher to exactly observe inside themselves the actuality of an idea coming into their consciousness. This requires the fine-grained observation skills to be refined, made more sensitive and to be relearned in order to redirect them to apply internally to the phenomenological perception and analysis of the cognitive and internal activities happening within the designer/design researcher at that moment just before conscious awareness of an idea, decision or action.

A simple, exact and identical physical parallel of the above activity, is watching the immediate, almost instantaneous and simultaneous internal cognitive, affective and physical activities that lead to spontaneous hand movements and facial gestures whilst talking. Another example is watching the almost simultaneous internal cognitive, affective and physical processes underpinning words spoken spontaneously. At its simplest, the phenomenon of interest can be seen in spontaneous informal conversation. When talking without forethought, the phenomenological research is the investigation by self-perception of the selection and emergence of the next words, novel and unknown to the speaker, that are spoken without prior conscious thinking. A musical example is for a musician, to watch the immediately almost instantaneous prior cognitive, affective and physical activities in improvisation just prior to the decision to play a specific note. For comedians to watch the originating factors prior and in the moment of improv. Another slightly different example is the firing action of target rifle shooters and archers who often claim that they aim at the target and the gun or bow fires itself surprising them. This ‘not knowing’ and surprise is intentional because the activities of deliberately firing the gun or bow leads to inaccuracy. In this case, the research focus is on watching the internal processes from which that tacit firing action happens.

In each of these, and similar, creative activities in which a thought , feeling, movement or even words emerge it appears, at least superficially, that they do so spontaneously. Biologically, how does that happen? What are the prior stages upon which this phenomenon is based? What exactly happens during the moment prior to, and after which, there is a new thought, feeling, word, action etc., when before that moment there was no perception of what new thought or action was about to emerge?

To recap, the focus in this paper is phenomenological subjective investigation or exploration of these prior stages to the thought, feeling, intuition, actions etc coming into obvious consciousness. Such an

exploration depends on improving the designer's ability to perceive those internal subjective prior processes of consciousness from a first person point of view (D. W. Smith, 2018). Philosophically, this places such an exploration at the ontological heart of phenomenology and as a foundational element of Design Thinking, design cognition, theories about ideation, creativity and design, and design education.

The subtlety of the events in this phenomenological research requires a higher level of perception by the designer or design researcher than that needed for the more conventional design cognition research methods such as think aloud protocols. It also improved quality of reporting of the detail of these self-perceptions of internal processes. In addition, and adding further complexity, it also requires the designer undertaking the perception and recording of these 'prior' processes to, at the same time, have awareness of themselves doing this perception and reporting along with sufficient self-reflection to observe when they have gone off track and to monitor the quality of both their perceptions of prior processes and self-reports.

In short, there is an expectation that additional cognitive and perceptive skills are necessary to be acquired by those designers or design researchers reporting on their self-perceptions. The competent learning of these additional skills is an essential part of the research method for this phenomenological research into the elicitation of prior and transitional individual human processes from which new thoughts, feelings and actions instantaneously emerge.

Learning these additional skills is an essential part of the research method and requires the designer or design researcher to undertake training and testing in these additional cognitive skills of self-perception in the following areas:

- Increased sensitivity and perception of thoughts and thought processes.
- Increased sensitivity and perception of internal body states and changes to those states including emotional states, feelings, muscle tone and tension/relaxation, temperature, pulse, body position and changes to it, habituated movements.
- Skills in persistence of focus of attention
- Skills in managing direction of attention.
- Skills in creating, maintaining and manipulating multiple separate streams of attention, perception, emotion and analytical thinking.
- Ability to mentally remember sequences and patterns from each of the separate streams of attention, perception, emotion and analytical thinking.
- Skills in identifying which thought and actions are the result of conditioning and habituation.
- Skills in reflective awareness of consistency and quality of all the above activities to be able to identify when they are off track.

The training methods are described in the following section.

Research Methodology

The processes on which emergence of design ideas come into consciousness is typically given a broad-brush categorisation of 'divergent' and or 'associative' 'thinking' (e.g., Baror & Bar, 2022;

Beaty, Silvia, Nusbaum, Jauk, & Benedek, 2014; Casakin, 2011; Teng, Wang, Lu, Quiao, & Hao, 2021; Thakral, Yang, Addis, & Schacter, 2021; Xie, 2023). However, the issue of how divergent/associative thinking occurs, and how it functions and originates, and its precursors are not made explicit not is their relation to phenomenological experience.

This lack of critical and phenomenological attention as to the foundations of idea generation has in general resulted from the limitations of the design research methods used for analysing design processes, for example, think aloud methods and protocol analysis (see, for example, Cross, 2000a; K Dorst, 1995; Ennis, 1991; Ericsson, 1984; Galle & Kovács, 1996; John S. Gero & McNeill, 1998; John S. Gero & Tang, 2001; Rhoads & Shogren, 1991). These design research methods in the main address design thinking only after ideas and thoughts emerge into designers' conscious thoughts. The limitations and choice of such methods are in part the result of not addressing the perception skill limitations of designers, who are the central and essential element of data collection in such design research methods.

All research methods comprise three core elements:

1. Collection of the raw signals about the phenomena of interest in an impartial unbiased manner free from judgement
2. Processing those raw signals into data suitable for analysis
3. Developing predictive theories based on a combination of the processed data and existing well verified theoretical findings.

The quality of the processed data and subsequent theoretical developments in any research in design thinking, including the exploratory research described in this paper, depends crucially on the sensitivity of the instruments and their provision of reliable accurate data. . In this phenomenological research into designers' cognitive, affective, intuitive, physical and agency-related activities of creative design ideation, it is the designer that is the data collection instrument, collecting by self-perception the signals about the phenomena of interest (i.e. the ability to collect signals at the smallest level of detail necessary for analysis), and on the quality of that signal collection. That is, it requires of designers both the ability to collect self-perception signals at the smallest level of detail and of the phenomena of interest, and that the quality of reporting of those signals is reliable and accurately represents the behaviour of the phenomena of interest.

To date, in the literature on creative ideation in design thinking research, it has been assumed designers are naturally and fully able to reliably and accurately report back on their thoughts, emotion and actions whilst designing. For example, in think aloud protocols it is assumed the designers naturally have the ability to report reliably and accurately and with sufficient sensitivity and quality on their internal processes, without any additional training. Well established research from a variety of fields indicates that such an assumption about the sensitivity and quality of the perception and reporting by individuals is typically inaccurate and deeply flawed when reporting about their perceptions, cognition , emotions, feelings, intuitions, decision-making and actions. Examples include findings of research into bias (Frechette, Bitzas, Aubry, kilpaqtrick, & Lavoie-Tremblay, 2020; Mahtani, Spencer, Brassey, & Heneghan, 2018; Tassone, 2017). . In short, previous phenomenological design thinking research has been limited by lack of training in the necessary perceptual and reporting skills of the designers and design researchers acting as data collection instruments.

Hence, the first stage in developing an appropriate research method for this research program was to identify appropriate methods to train the designer(s) gathering the data to be able to increase

designers' skills in awareness and perception in relation to internal thoughts, feelings and body states and external behaviours and actions, along with their abilities to manage multiple streams of cognition associated with attention, perception and memory.

Additionally, as a key part of developing the following skills, it is important for the designer participant to acquire the skills of *phenomenological reduction* or *bracketing* which requires refraining from or suspending judgement and bias which enables them to immerse into the experience, which can also be seen as acquiring humility such that the designer participant does not impose their views onto the perception and representation of the phenomena (Schmitt, 1959; Q. Smith, 1979; Theodorou, 2015).

There are several well-established training methods for achieving such increases in perception skills and their management. These include training in the following sequence in which expertise in each skill set is fully developed before progressing to the next. The following lists and sequences are based on experiences of practicing and assessing these methods in design research by the author over a four-year period at the University of Western Australia. They comprise, in order:

- Practice watching an external object with minimum external stimulus.
- Practicing watching semi-external body processes with minimum external stimulus (e.g. breathing)
- Practicing watching internal physical body processes with minimum external stimulus (e.g. progressive scanning of muscular tension and the effect of breathing)
- Practicing watching the flow of thoughts in mind.
- Practicing watching one's flow of emotions without distraction.
- Practicing perceiving the details of the states in between individual thoughts and between different sensations of feelings and emotions.
- Observing the detail of one's internal motivations to change one's body position.

It appears important to practice these basic perception and awareness skills to the point where the activities can be maintained continuously regardless of distractions.

After the above is achieved, it becomes possible to undertake tasks to begin training involving multiple streams of perception and awareness; management of these streams and the necessary parallel memory processes; and developing the ability to accurately report on the phenomena under exploration. For training in developing and using multiple streams of perception, the most appropriate exercises that build on the foregoing seem to be:

- Practicing counting each successive breath with full attention and without other thought; and restarting whenever the count is lost (count to 10 or 20).
- Practicing watching the moment one goes to sleep, and the experience of the transition process in that moment from being awake and conscious to becoming asleep.
- With eyes closed, practicing watching oneself watching one's thoughts and bodily feelings (i.e. this is two layers of watching and awareness)

- Practicing carefully watching one's thoughts and feelings whilst one's eyes are open perceiving external events. This requires managing internal and external streams of perception.
- Undertaking arithmetic problems whilst watching one's personal thoughts and emotions as well as the thoughts associated with doing the arithmetic.
- Practicing watching one's personal thoughts whilst simultaneously watching oneself mentally humming a tune whilst reading a book.

The last two of these exercises are more difficult for some people.

The next stage in training is of management of attention and perception and avoidance of emotional or conditioned and, following the above, consists of:

- Practicing the above exercises whilst simultaneously watching the internal separate activity of identifying when one goes go off task and returns to the perception task.
- Directing one's attention flexibly and under control to internal activities and external activities and perceptions (i.e. controlling and maintaining one's awareness inside and outside).
- Observing when one's choice of direction of attention or interpretation is shaped by habits.
- Observing when one's choice of direction of attention or interpretation is shaped by prior conditioning (i.e. shaped by cultural or social factors, prior education etc.).
- Watching internal and external activities passively without engagement

The final suite of practices focuses on adding memory skills to perception skills by remembering sequences of multiple separate streams of attention, thinking, feeling and action.

- Practicing watching multiple persons involved in different conversations at the same location and then describing their physical behaviours and mannerisms as well as conversations.
- Practicing listening to different sources of noises in busy environment, and describing the types, sequence and causes of different sounds.
- Practicing simultaneously watching one's internal thoughts, feelings. muscle tone, body positions and tendencies to change position, and later describing them and the sequence in detail.
- Practicing watching one's separate streams of thoughts, feelings and internal body sensations and the nature of the gaps between events, remembering them and describing them later .
- Practice watching the underlying patterns and sequences relating to thoughts and feelings, remembering them and describing them later.

From experience, acquiring the above abilities may take a year or more of self-training. When the designer, preparing themselves to act as research tool, has acquired the above abilities, it is then possible for them to phenomenologically explore the internal processes that are the basis for investigating:

- The emergence of a new design idea into their consciousness

- The subtle decision-making involved in comparing two or more potential partly formed design ideas to decide which is more promising.
- The foundational processes leading to aesthetically based choices.

In practical terms, the above abilities that provide the basis to more reliably collect perceptions about the prior dynamics of human abilities for ideas to emerge in consciousness can then begin to be used as the legitimate formal foundation for data collecting of a research method that includes appropriate analysis to derive more generalisable findings about Design Thinking and creativity in design more generally.

The simplest format of Design Thinking to explore phenomenologically using the above perception skills comprises:

- A problem for which a novel idea for a solution can be mentally envisaged without external input.
- Communication of the problem to the designer acting as research instrument
- The designer undertaking the following tasks using the abilities described in the above training.
    - Watching the activity of bringing the problem into mind
    - Watching the internal thought and bodily processes whilst the designer reviews the problem.
    - Watching the internal thought and bodily processes by which potential solutions emerge into consciousness in the designer.
    - Watching the internal thought and bodily processes whilst the designer reviews and chooses different aspects of possible solutions.
    - The designer identifies the characteristics of the processes by which the design emerges (Where does the design come from? Where do the thoughts shaping decisions about designs come from?) In other words, from where and how does that Design Thinking emerge in an individual?
    - Reporting in detail about the different processes and sequences and parallel activities of cognition, emotion, bodily perceptions independent of the actual problem and design for a solution (neither the specific problem nor the designs of solutions are relevant or part of the phenomenological exploration of design thinking itself).
- The above data from the designers is formally analysed into an appropriately structured report on the research data and implications.

Such a process can be undertaken on the same project by multiple designers who have completed the training in the necessary skills described earlier. This provides in the research method a check for repeatability and whether there is consistency across individuals in the perceived phenomena of processes prior to the emergence of design ideas and spontaneous comparisons and choices about design features. Alternatively, such a test may identify alternative characteristics or archetypal ways in which occur the phenomena of processes prior to the emergence of design ideas and spontaneous comparisons and choices about design features. This latter would align with the phenomenographic

work of Marton and the Göteborg Group (Hajar, 2021; F. Marton, 1976; F. Marton, Hounsell, & Entwistle, 1997).

Findings

The research method described above comprising the training and phenomenological analysis was undertaken by the author as part of doctoral research into the integrated inclusion of social, environmental, ethical and technical factors in design activities during the period 1992-1998. It comprised a particular research pathway that for brevity was not included in the PhD thesis itself, but left to be reported later (Love, 1998).

The research resulted in several findings, some of which apply to Design Thinking, some to the epistemological and ontological issues relating to theorising about human creativity and agency, some specific to understanding how humans relate aesthetically, some relating to intuition, and some, ethologically about what it is to be human. The following findings apply to Design Thinking.

Finding 1: The exploratory research method (described above) was found to be an effective research approach that reveals in more detail than conventional think aloud and similar research approaches the foundational elements of the phenomena of Design Thinking, design creativity, ideation, the prior activities to ideation, embodied thinking, relationships between thinking, feeling, decision making, agency, body position and movements, body internal states (muscle tone distribution, pulse, relaxation, transient neurocognitive effects etc), mental content and prior situations.

Finding 2: Using this research method, consequent causality is easily observed. This is of the eidetic and deictic form that 'this' later item naturally follows and is obviously consequent on 'that' earlier item. This can be perceived in a highly layered manner, crossing modalities of thought, emotion and body behaviours.

Finding 3: Application of the research method to multiple situations consistently revealed a boundary that cannot be directly observed beyond using conscious observation. The actions of the processes beyond that boundary can however be observed via memory. In cognitive terms, this boundary appears to be a physical limit to perception of content of cognitive processes . It is deictically clear that actual cognitive and related processes occur beyond the cognitive phenomena that can be consciously observed. New ideas, concepts, intuitions and decisions, particularly relating to closure phenomena, emerge into consciousness from the other side of this boundary to conscious self-perception. A similar boundary appears to occur for emotions, feelings, agency, body states and spontaneous movements.

Finding 4: The origin of individual human agency and related acts in design thinking together with the originating foundations of the sense of individuality of the designer exist on the other side of the above boundary to conscious observation of cognitive, affective, embodied and physical behaviours and actions. That is, whilst it is clear the subsequent actions of these processes can be observed, the origin of individual designer's sense of self from which Design Thinking and all other human actions, thoughts and feelings are perceived and undertaken, is outside that which can be observed, decided or acted upon directly.

Conclusion

This paper describes design research and a design research method and training for designers and design researchers that expands the phenomenological study of Design Thinking into those activities prior to and in transition to an idea or design coming into conscious awareness. The approach aligns with that of Husserl's phenomenology including phenomenological reduction or bracketing and eidetic reduction focused on the individual experiencing in detail the phenomena prior to and during the processes from which perceptions of ideas, designs, intuitions and similar creative actions come and come into an individual's consciousness.

Perception and recording of the multiple mental, affective and physical activities of this phenomenal trajectory of action requires the development of specific skills in the same way but different to how sensitivity to visual shapes, culture, forms require significant personal education and training in visual sensitisation Art and Design schools The paper describes in detail a suite of training exercises along with their purposes in developing an individual's abilities to perceive subtle cognitive, affective and physiological processes and actions, and the expected time from experience needed to acquire them.

The paper concludes with four preliminary findings that provide new aspects of the phenomenological, ontological and epistemological foundation for Design Thinking, design theory, design cognition, design education, creativity theories and aesthetic analysis across creative and analytical disciplines. They do this in a way that suggests it is epistemologically more foundational than is typical in the literatures in these areas. Additionally, these findings point to the development of new research approaches and new methods in these areas.

This design research program and findings potentially has roles more broadly to the phenomenological foundations of all human thinking, feelings, intuitions, perception, awareness, decision making, creativity, attention direction and management, conscious and unconscious movements and bodily states and human agency. Looking further abroad, this research exploration also offers potential phenomenologically based insights into human mental, emotional and physical malfunction including diseases such as ADHD, problems with proprioception, memory issues, emotional disorders: in fact, anything where phenomenological insight into the processes prior and during an emerging event of interest might be beneficial.

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