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Thinking while drawing and drawing to think: Exploring 'reflective doodling' as a critical reflective practice in design for transitions.

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Citation

Thinking while drawing and drawing to think: Exploring the critical reflective practice of 'reflective doodling'.

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Abstract: This paper attempts to articulate what is typically tacit within the process of 'reflective doodling'. By dissecting different types of artefacts created during reflective doodling, the paper demonstrates how this critical reflective practice creates a synergy between design research and design practice. The nuances of reflective doodling are unpacked and its relevance to complex problems is explored through the emergent practice of 'design for transitions'. Discussion reveals the importance of external inputs into the process and explores how the layers of thinking and action embedded in its processes expand the dynamic interplay between research and practice.

Keywords: design for transitions; reflective practice; reflective doodling; sensemaking

1. Introduction

I think and draw as a form of meditation, as a form of exploration, as a form of creation and as a form of occupation. This thinking-drawing process of reflection is habitual. What happens within it often feels tacit, unknowable or at least unexplainable. Schön (1983) explores the inherence of tacit knowledge in practices such as design and describes how practitioners usually know more than they can articulate. Documenting the typically tacit thinking-drawing process of 'reflective doodling' during my PhD brought a deeper consciousness to my reflective process. That consciousness extends to this paper, which explores the critical reflective practice of reflective doodling in the context of 'design for transitions', an emergent design approach focussed on systemic change encompassing social justice and ecological sustainability (Boehnert, 2018; Escobar, 2018; Fry, 2009, 2017; Irwin et al., 2015; White, 2018; Willis, 2006, 2015). This emergent approach was a core focus of my PhD which examined the designer's role in the complex problem of excess consumption and waste. The PhD documented the transformations needed personally and professionally within design practice in order to address complex structural problems.

Reflective doodling emerged from this research as an active and critical process of drawing and thinking. The process intertwines *thinking while drawing* with *drawing to think*, and from the convergence of these non-linear reflective processes, 'design as sensemaking' (Cross, 2008) emerges. Here the marks made and the actions taken shift from reflective to deliberative, and the practitioner starts to make sense of the work, leading to the creation of knowledge and/or artefacts. Unlike typical exploratory drawing and sketching processes, reflective doodling is reliant on clear contexts and critical inputs, from multi-disciplinary literature and from a range of diverse perspectives.

2. Methodology and Methods

This analytic autoethnographic paper further explores the critical reflective practice undertaken throughout the researcher's PhD (Wallace, 2020). Anderson (2006) describes how analytic autoethnography recognises the researcher in their research but avoids traversing an auto-biographical path by maintaining strong connections back to a theoretical framework. Reflection on previous action research cycles informs a new cycle of reflection and action; one that is more deliberative in its attempt to make sense of the processes undertaken as part of this work. Building on Schön's reflective practitioner (1983), is Forester's deliberative practitioner (Forester, 2009) who reflects in/on action, but also on possible future action, using participatory processes to engage multiple perspectives. Forester describes this as a form of 'critical pragmatism', where a practitioner's potential actions are critically examined as part of an informed process. In this paper, the overarching frame of critical pragmatism is informed by two key perspectives: firstly, by the ontological, plural and participatory approaches from Escobar (2018), and secondly, by the prudent, ecological and relational thinking approaches from Plumwood (2002).

This paper is also informed by an ongoing living lab study, where participants are documenting their practice of reflective doodling over a 12-month period. Initial reflections on data collected through a workshop and interviews with two emerging designers are captured in this paper. Both participants have attended a 3-hour workshop followed by a two-week exploration of the reflective doodling process in their own practice. They each discussed their early experiences with the process through one-on-one semi-structured interviews. Additional interviews will be conducted with these participants throughout 2020 with a view to repeating the study with a larger participant group.

3. Critical reflective practice for uncertain futures

The need for critical thinking in design has never been more urgent. Humanity faces multiple ecological and social crises that present uncertainty and opportunity and require transformative change. This also presents design with opportunities to transform. Critical reflective practices could foster greater synergies between design research and design practice. One such critical practice, reflective doodling, is explored throughout this paper.

The need for criticality in design is evident in design's mediation of consumer culture (Bordieu, 1984; Julier, 2008; Wallace, 2020). Design is used to reinforce a linear economy and promotes a way of being in the world that is unattainable by all, unjust to many, and unsustainable by design (Fry, 2009). Design's historical and current contributions to structural injustices and unsustainability are evident in artefacts and their legacies. Many reinforce a rationalism that is anthropocentric, particularly androcentric, colonial, and unjust in multiple and intersecting ways (Boehnert, 2018; Fry, 2009; Plumwood, 2002). Design also reinforces power structures through its expert performance of acts of differentiation, through its transmittance of persuasive communication, and through its industrial symbiosis with business (Wallace, 2020).

Designers are trained to be expert consumers who mediate and participate in consumer culture (Bordieu, 1984; Julier, 2008; Papanek, 1988; Wallace, 2020) and in commercial practice designers become caught in a complicated tangle of complicity and conditioning. Awareness of the wicked problems humanity faces often fails to translate into practice, and can be eclipsed by designers' commercial context (Boehnert, 2018). The feedback loop between education and industry reinforces this approach, leading to waves of newly-graduated designer-consumers who appear to be incapable of conceiving design outside of commercial contexts (Thorpe, 2008; Wallace, 2019).

In emergent areas of practice and research such as design for transitions (Boehnert, 2018; Escobar, 2018; Fry, 2009, 2017; Irwin et al., 2015; White, 2018; Willis, 2006, 2015) there is an acknowledgement that who we are (designers) and what we do (design) contributes to and is bound by that which is structural and systemic. Design for transitions' intent is to design in ways that enact or facilitate systemic change by approaching design in everyday contexts (Kossoff et al., 2015; Manzini, 2008). As an approach to design it acknowledges the hypocrisy of designing this change whilst being embedded within these systems, however the power dynamics within the system cannot be ignored as part of this attempt at change (Boehnert, 2018; Willis, 2015). Building this understanding in practice expands creative thinking in ways that require greater criticality, reflection and deliberation. Early insights from a study of this process with two emerging designers indicate it may be a generally useful process for a critical thinking and problem articulation. This paper's focus is on its usefulness as a method in 'design for transitions' for approaching complex and wicked problems that are entangled with one another in social systems (Rittel and Webber, 1973).

4. Thinking while drawing

It is not uncommon for practitioners to think while they draw. In reflective doodling, this process can be harnessed as a way of processing new theoretical knowledge and concepts from multi-disciplinary literature. These doodles take a variety of forms, and dissecting this process identifies what each form shares and what is unique amongst them.
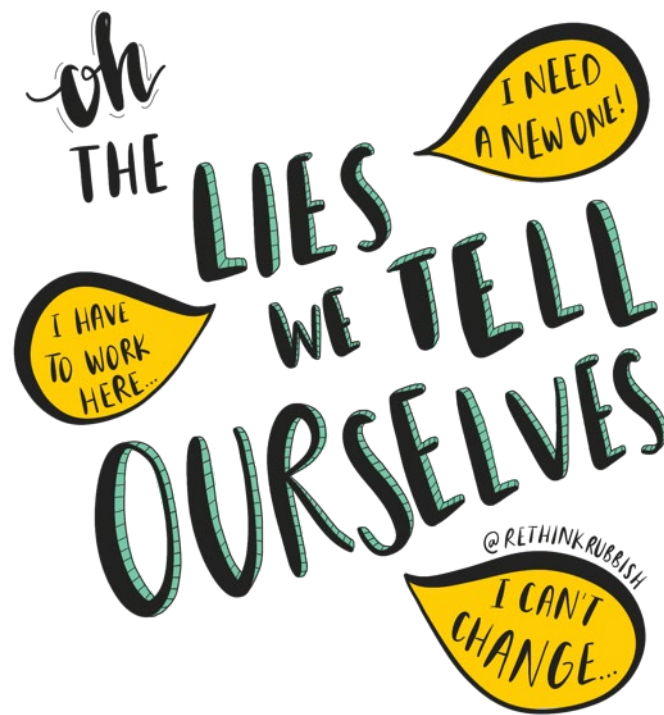
Figure 1   A reflective doodle, used to explore philosophical and socio-economic concepts in PhD research.

Figure 1 presents a doodle that was created during reflection on Sartre's (1993/2012) concept of 'bad faith'. According to Sartre, to live in bad faith is to live incongruously to your true desire or calling. He describes how self-deception is used to justify actions that are disingenuous and how this impacts one's identity (Sartre, 1993/2012). This doodle used illustrated typography to unpack the larger concept. On face value, it is nothing special, it is 'just a doodle'. However, the process of creating it unlocked a larger critical thinking process. Each mark, each stroke, each block of colour was made while thinking. Particularly, about 'bad faith'. And specifically, about 'bad faith's' role in hyper-consumption, a significant contributor to structural unsustainability. What differentiates reflective doodling used in this way from the usual *thinking while drawing* processes used by designers, is the role played by critical thinking, the context and inputs into the thought process—namely the philosophical concept of 'bad faith' and the socio-economic concept of hyper-consumption in the context of design. The process uses drawing to let the mind wander and critical thinking to make the wandering more pointed.

4.1 Embodied reflection and sensemaking

The reflective processes performed by designers through sketching and doodling draw on a combination of tacit designerly skills and knowledge that intersect thinking and doing. In this sense they are often processes of embodied reflection, where the practitioner's lived experience both informs and reveals itself through acts of thinking and doing (Kinsella,

2007). The tacit knowledge embedded in creative processes is also described by Cross (2008) as a designerly way of knowing. Sensemaking converges thinking and drawing and is used for synthesis and communication of what the designer 'knows' but cannot verbalise (Cross, 2008). Further articulation of embodied reflection is provided by Escobar (2018 p. 54) who recognises embodied reflection as a dance between action and reflection, which in turn makes the act of reflection an experience in its own right. This metaphor of movement aligns neatly with Schön's (1983) descriptions of the back and forth exchange that occurs between a practitioner and their sketch during reflective processes. Embodied reflection and sensemaking both play key roles in *thinking while drawing* and in reflective doodling.

4.2 The role of languages in reflection

Schön (1983) frequently makes connections and comparisons between music and design, which both use languages learned through practice. Playing music relies on a comprehension of musical language, and likewise, design is reliant on a fluency in visual language. Neither practice is solely elite or expert and both can be performed with varying degrees of skills and knowledge. However, a practitioner's proficiency in any given language will certainly be evident in their processes and outcomes, be they musical, visual or otherwise.

Brown (2010) presents a visual alphabet consisting of 12 forms that can be combined in any number of ways. Not unlike music which also works from a base of 12 notes to create complex compositions, these 12 visual forms provide Brown with the foundation for building a visual language with shapes/marks. The forms include a point, line, angle, arc, spiral, loop, oval, eye, triangle, rectangle, house and cloud. Each form is a symbol that is pre-coded and then re-coded as they combine to create new forms. Ungerleider and Bell (2011) describe the neurological processing of complex visuals as "combination-coding" (pp. 785-786) where something complex is coded by a breakdown of its simpler parts—much like breaking down longer words into their short-chain syllables when learning to read. In Figure 2, three forms from Brown's (2010) alphabet (angle, loop and line) combine to create an arrow element.

Figure 2   Combining forms from Brown's (2010) visual alphabet to demonstrate "combination coding"

On first glance this might read simply as a decorative arrow, however, reading the "combination coding" reveals more than the suggestion of direction that is pre-coded in our interpretation of what an arrow means. The line indicates movement, and a secondary read

of the quality of the line suggests the motion is fluid rather than formal. The addition of a loop communicates movement along a non-linear path, and the angle placement provides a sense of direction, in this case, downward. Conversely, if this arrow was drawn without the loop form, it would communicate a more linear direction. Likewise, a more formal line would communicate an increased structure to the path taken. The nuances that stem from the way a mark is made and how it is combined with other marks become important communicative tools when drawing. The complexity embedded within a visual language becomes a kind of shorthand that a practitioner can use to move them through their thought process at pace. These nuances are not captured explicitly in Brown's (2010) description of the visual alphabet, but they are certainly evident in a reading of its use. Using visual language as a form of shorthand is particularly helpful during reflective doodling where action can shift between the need for faster and slower paced doodling to capture initial thoughts quickly and then explore them more slowly. Simple marks and their complex combinations can be used by the designer just like notes and chords are used in simple and complex combinations by a musician.

Visual language is often supported by verbal language to aid in communication and in some instances a doodle is reliant on both languages in order to effectively communicate. Schön (1983) uses communicative terms such as 'back-talk' to describe the exchange that occurs between a practitioner and their work. This exchange is coded with years of knowledge and experience, artistic and analytical skills, material understanding, tactile ability and capability. 'Back-talk' is often recorded through notations that combine visual and verbal cues. One participant described their experience of 'back talk' in reflective doodling as an interactive process that felt like a conversation between their mind and the page. To think and draw in this way is to speak a visual language that does more than communicate ideas, it visualises the process of reflective thinking and can contribute to the creation of new knowledge. Responding to 'back-talk' aptly demonstrates embodied reflection and a mastery of the languages of reflection.

4.3 Drawing as part of reflection

Drawing is a commonly used process for ideation and reflection in creative practices. Reflective doodling is a designerly reflection and sensemaking process that blends drawing processes and reflective practice with theoretical knowledge and insights gained through the distinct and recognisable set of thinking and doing practices from design. Not unlike the descriptions above, its exchanges are coded. Each additional input expands upon the typical designerly skills/material knowledge to include a more explicit focus on theoretical knowledge and diverse perspectives. Figures 3, 4, and 5 show a progression of thinking that occurred through the reflective doodling process that began during (and continued after) a 2018 workshop with Tony Fry based on his paper, *Design After Design* (Fry, 2017). The paper and workshop both provide a critique of the 'defuturing' role design plays in contemporary settings. The workshop explored Escobar's (2018) autonomous design approach as a response to the growing social and ecological crises being faced by humanity. Autonomous

design has roots in the Autonomía movement from the Global South. It is participatory, decolonial and disconnected from design's usual neo-liberal contexts. Instead of promoting an unsustainable status quo filled with technocratic responses to our current crises, the autonomous designer partners with communities and movements to explore convivial and communal ways of being in the world (Escobar, 2018; Fry, 2018).

Figure 3 displays page six of a ten-page documentation of Fry's workshop. On first glance these notes appear to be a clean documentation of information, but upon reflection I recognise multiple embodied reflections in the notes. Prior to reengaging with this 'first pass' of information, I assumed it to be a relatively 'pure' documentation of the workshop content. Discovering embodied reflections within my notes was unexpected, despite this kind of cognitive processing being common in high quality notetaking (Jansen et al., 2017). In previous discussions of the reflective doodling process I have failed to recognise this aspect of notetaking as reflection in action. In documenting and responding to new knowledge, and by adding fragments of old knowledge to it, the notes form part of an active exchange. It was noted by one participant that reflective doodling was "more involved, mentally" than normal note taking. Much like 'mind-page conversation' noted by the other workshop participant, these notes start to reveal the embodied nature of this interactive process.
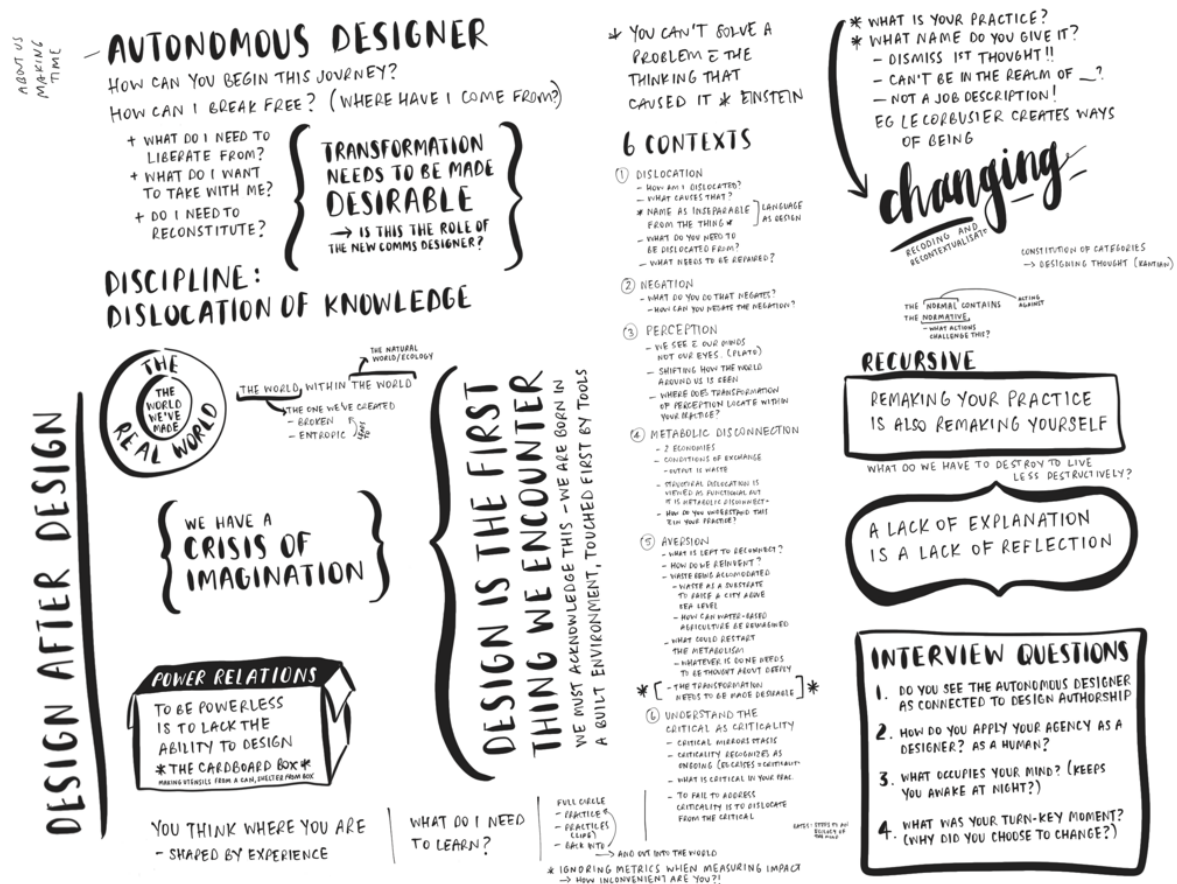

Figure 3   Initial notetaking and reflection in action during a workshop (page six of ten).

Figure 4 shows a mid-point of reflective doodling, one that uses the process of doodling in order to think. As key themes and insights are transcribed into visual notations their concepts are considered more deeply and another cycle of reflection begins. As each cycle passes, the process shifts to sensemaking, (see Figure 5) where the concepts of others are connected more directly into my own work and into the literature I am currently engaging with, and provocations are made into the larger context of design and the designed world.

Figure 4   A mid-point: here reflective doodling is used as a form of visual notation where notes become more illustrative. The time taken to arrange them, connect them and make them more visual is also used to think and reflect upon their content and meaning.

Both workshop participants initially found it challenging to describe what occurred during their own notetaking and doodling processes. Two weeks later in their post-workshop reflections, they each described their initial experiences with the process. One described the ways the flow state evoked by reflective doodling unlocked knowledge buried in their sub-conscious or helped them make new connections in their work. The other described how it helped them to digest and recall new concepts. The visual explorations in reflective doodling appealed to both participants as visual learners. One described how "I feel like I'm writing down what my brain is producing *while* it's producing, and I think there's great value in that". For this same participant, there was also value in the tactility of drawing as an explorative

process, which they felt created a stronger connection between their research and their practice as a designer. They believed it provided both creative nourishment and clarity of thought which they felt improved the connections being made through their writing. Both participants will continue to use reflective doodling and will be interviewed again in six months as part of the ongoing study.

Figure 5   *Here reflective doodling is being used as a form of sensemaking. A smaller notation system connects concepts to my own work and that of other authors and theorists to integrate this new knowledge. These notes were later dissected again as part of a slide deck where they were carved into sections and visually simplified.*

In the examples above and others yet to be explored in this paper, the focus of the reflective doodles is on the integration of new theories or concepts that are particular to the intersection of sustainability transitions and design. The doodles presented in this paper were drawn at different times during a three-year period using a tablet and stylus with custom brush settings for both visual mark-making and written documentation. Each process occurred iteratively and built knowledge cumulatively, often occurring in discrete yet overlapping phases of 'doodling to understand', 'doodling to explore', and 'doodling to communicate'. The digital environment these doodles were created within facilitated a layered approach, and iterations were captured on separate layers in a single file. In the

context of thinking while drawing, reflective doodling is an informed, multi-layered multi-stage process, structurally and conceptually. It draws continually on the practitioner's skills, knowledge, experiences and contexts, and in doing so it demonstrates a form of embodied reflection. During interviews, discussions explored how the 'unfinished' doodles aided the practitioners' thought process, while the 'finished' reflective doodles created a simple visual entry point for an audience to engage with complex concepts. The potential for reflective doodles to improve complex communication for an audience was noted. This aspect will continue to be explored through the study, in addition to the usefulness of the process as a form of embodied critical reflection for practitioners.

5. Drawing to think

While sketching is an accepted form of communication, particularly for visuospatial ideas used in architectural drawing (Tversky, 2002), it appears to be less easily recognised as a process of thinking and is easily subjugated when described as a form of doodling. This is captured in the contrast between Brown's (2010) description of doodling as "thinking, albeit in disguise" and in Ammon's (2019) critique of the glorification of the 'paper napkin sketch'—a type of intuitive sketch that is commonly held up as proof of an a-ha moment of creative genius. As Ammon argues, celebrating an isolated sketch as 'genius' ignores the presence of multi-layered systematic drawing processes that are typically shaped by different actors, contexts, tools, cultural settings and epistemologies (Ammon, 2019). Ammon is careful not to erase or devalue inspiration and insights within creative processes, instead arguing for greater recognition of what underlies these a-ha moments. She describes how the spontaneous napkin sketch is not a perfect render of a mind's eye image, rather, there is much informing the spontaneity. Through processes of analysis a practitioner might recognise traces or breadcrumbs of it in their knowledge bank, or in their earlier sketches, notes and doodles. This critique of oft-glorified napkin sketches also offers insights into drawing as an integral part of the creative thinking process, and as part of the hard work that is performed by creatives. This is further evident in Ammon's (2019) analysis of practitioners' drawing practices, where their comments reveal further insights into the practitioners' experiences: "I can't get very far just thinking about it without drawing something", "when I sit down to work, it's hard", and "the process of thinking only unfolds as she draws" (Ammon, 2019 pp. 598-599). Each comment tells a story about how some practitioners will innately draw (or doodle) in order to think, and how both thinking and drawing present challenges that must be faced as part of the process—it is hard work. Yet if we return to Schön, (1983) practitioners' failure to articulate what they know and how they know it, gives the napkin sketch phenomenon an unfortunate credence.

Schön's (1983) music analogy helps recognise the value provided by skills, knowledge, experiences and context underpinning creative processes like the impromptu napkin sketch. When musicians improvise (or 'jam') they are performing a set of very specialised skills and enacting specialist knowledge. A musician's ability to listen and respond accordingly is no more spontaneous or genius than a designer's napkin sketch. This aural read-and-respond

process is informed by years of practice of their craft, knowledge of the instrument(s) being played and heard, of musical scales, of timing and tempo, all aided by tacit knowledge of what will work in the context of the jam. The context plays a crucial role; a feedback-induced hard rock riff is unlikely to work in a freeform jazz exploration, even if both are being played in the same tempo and key. Musicians tacitly know what feels right in the context of a jam.

A reliance on skills, knowledge, experiences and context is also inherent within reflective doodling which has a meditative, iterative and deliberative nature wherein these multi-layered processes become visible. This physical and metaphysical layering was demonstrated in Figures 3 to 5 and will be discussed again in the upcoming presentation of Figures 6 and 7. Reflective doodling is a temporal process that leaves breadcrumbs of itself in the work; a line here, a thought there. Each remains part of the doodling artefact as it undergoes continual processes of refinement. Engaging with these breadcrumbs is a non-linear process. Newly defined marks often become new jump off points for enquiry, creating a web-like exploration not unlike reflective practice as described by Schön (1983). A web is also evident in the way reflective doodles speak to one another both as a part of cumulative cognitive processes and as a series of artefacts.

To observe someone *drawing to think* is to witness their thought process unfolding, but not all that is embedded within a drawing, sketch or doodle is readable to others. The uniqueness of a practitioner's visual coding operates like shorthand to its creator, (as seen in Brown's (2010) visual alphabet) imbuing a sketch with meaning that may be unknown to those outside the process—though this is not always the case. In my own notes there are shorthand codes drawn from a variety of sources, from visual sketches to stenographer's marks. Some of these are readable, while some are less likely to be understood by others. Workshop participants also used visual cues that acted as a shorthand, whilst this was less readable to others, it captured their thinking in ways that allowed further engagement either through more drawing or through a writing process.

Some shorthand visual devices—and the ways they are used—are pre-coded; to draw on an earlier example, the arrow seen in Figure 2 is pre-coded as a symbol for direction and so becomes a device that automatically reads in a particular way. Reading its nuances expands our interpretation. A triangle shares this directional coding but can also represent other things, such as nature elements (fire and water), change (in shorthand), power (or hierarchy), gender, religious and spiritual trinities, and even warning messages. The triangle is pre-coded and then re-coded by its given context and relationships with connected or surrounding marks. It is through this process of reconfiguring and re-coding marks that the practitioner is led to new interpretations, new meaning and new knowledge. This responsive process was noted as highly valuable by workshop participants. By following breadcrumbs and responding to them, the practitioner converses with their drawing (Schön, 1983). When engaging in this way, the practitioner's thinking and the resultant work both shape and shift one another in new directions. The practitioner is neither thinking nor drawing as independent processes, rather one is used to enhance the performance of the other and in doing so enhances the performance of both. In this sense, thinking and drawing become blended and somewhat

inseparable in certain contexts. Developing this inseparable blend takes time, however both participants felt an immediate value from their early engagement. During the workshop, participants demonstrated their understanding through shared discussion of their doodles. In their interviews, one stated that "the entire process spoke to me" and the other suggested that "if people are taught this earlier on they'll be able to express their ideas better and in more concise ways." Both agreed that they needed more time with the process to fully master it, particularly in relation to *drawing to think*.

Drawing to think uses the entangled thinking-drawing process to build new knowledge in ways that *thinking while drawing* cannot. To offer a visual example of this process in action, Figure 6 presents a series of snapshots from another reflective doodling process. On the far left is Geels' (2002) visualisation of a multi-level perspective (MLP) in socio-technical transitions theory. By way of a brief overview, the MLP is a theory that describes three levels in socio-technical systems (landscape, regime and niche), how activities in these levels evolve and how they interact in periods of systemic change. The MLP was a catalysing theory in my PhD. My investigations into designing systemic change engaged closely with the MLP, its constraints and its applications within design. Using reflective doodling to examine the current socio-technical conditions of the wicked problem of consumption and waste, led to an operationalisation of this theory in design contexts: communicating an understanding of the conditions of this wicked problem, that could be used deliberatively to identify points of system intervention.
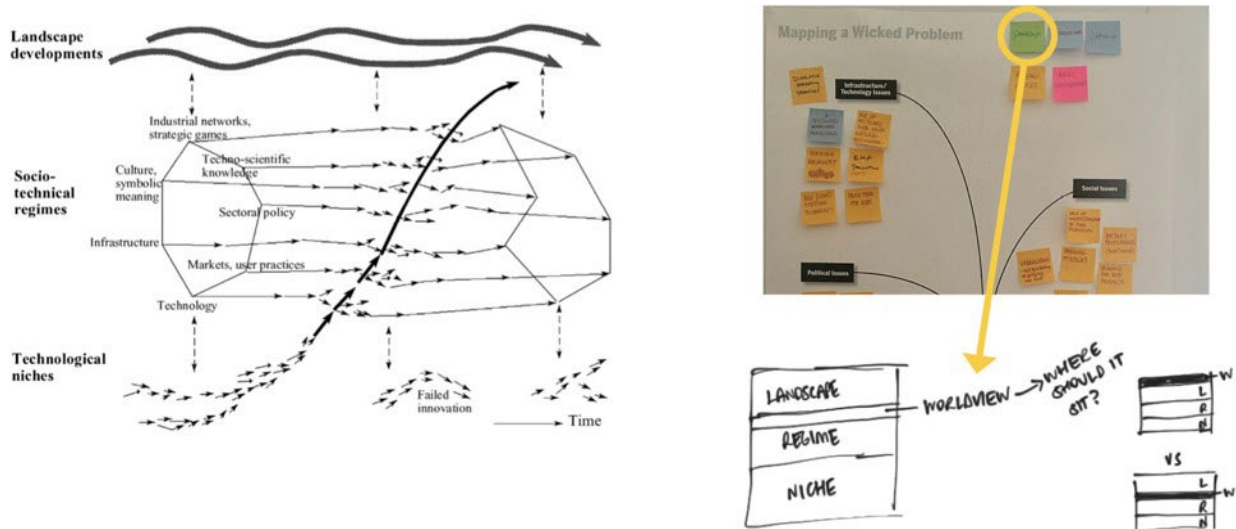

Figure 6   *A start point: reflecting on how to operationalise Geels' (2002) MLP theory through reflective doodling.*

As seen in the far-right image in Figure 6, the reflective process began with recognition of side notes that highlighted the dominant paradigm in a system. The paradigm was important yet obscured in the MLP, and the thought process that followed is contained in a doodle,

exploring where the paradigm could be positioned in a reimagined MLP. A handwritten note accompanies this sketch, it says 'worldview—where should it sit?'. This seemingly simple question sparked a year-long process of reflective doodling to explore how the MLP changed as a result of adding this fourth level, and what the implications were for MLP theory and design for transitions. In Figures 7 and 8, multiple snapshots of this process are presented to show how this investigation took place both within the MLP map and through a notation system that overlaid it. At the bottom of Figure 8, a new draft of the MLP map includes a fifth band to represent ecology as the context in which the MLP situates. The addition of these bands further advances the MLP by operationalising it for design.
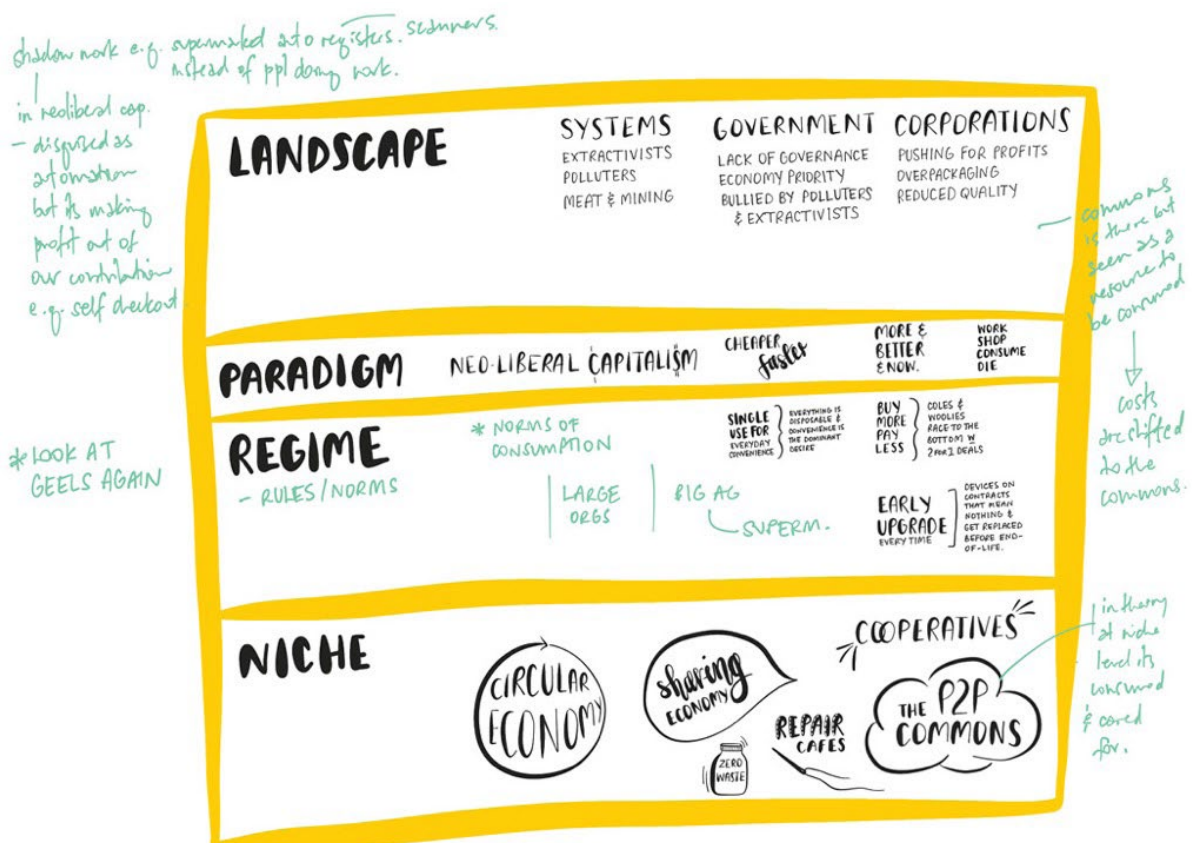

Figure 7   A snapshot of the reimagined MLP in an early draft format. The concept is still being digested and notes in an additional layer suggest changes to consider for the next iteration, including the suggestion to return to the original source material.
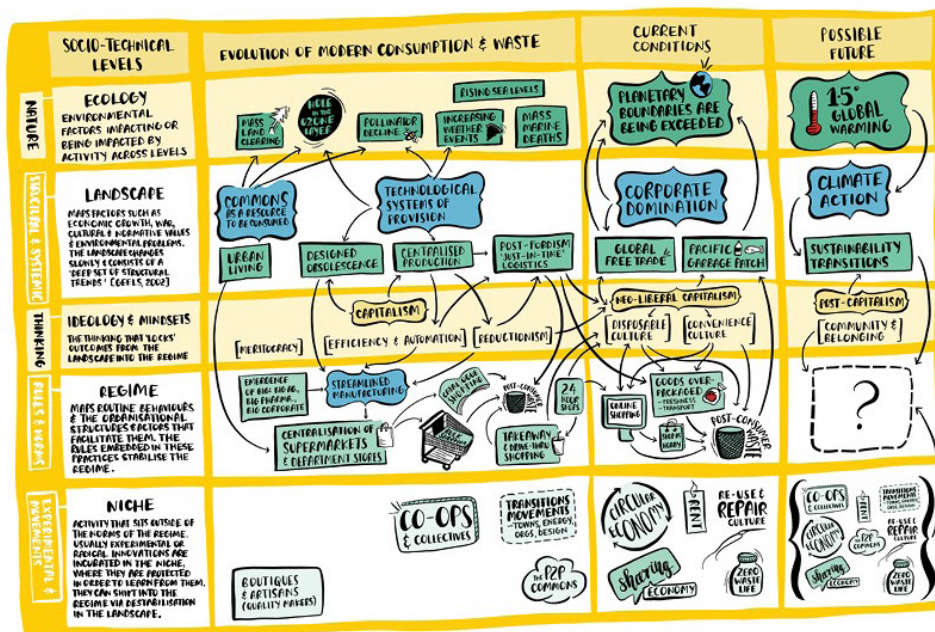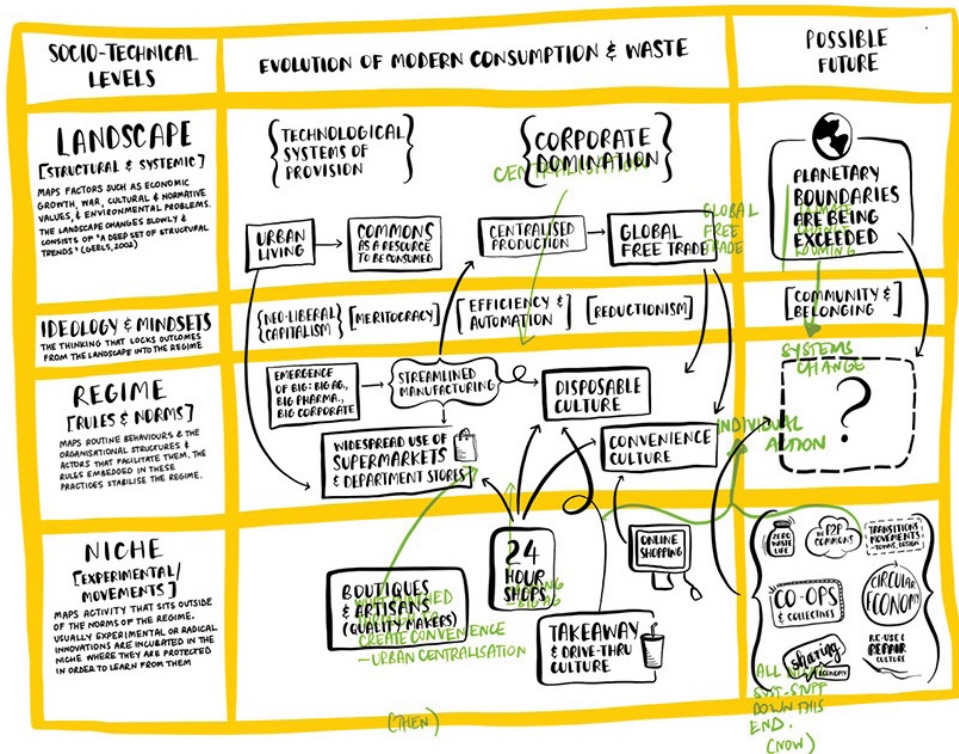
Figure 8   Top: A mid-point of reflective doodling displaying the conceptual shift to add columns and sub-levels with reflective notes made in a layer of the sketch. Bottom: A finished sketch mapping the problem of consumption and waste using a reimagined MLP that operationalises Geels' (2002) MLP theory.

Communicating this theory using a past-present-possible future model also extends how this theory could be used in design for transitions for problem articulation and intervention identification. These advancements led to another reimagining of the MLP as an organic holarchy, where each level is nested and the overall communication shifts from one that feels hierarchical, to one that more effectively communicates the web of interactions that occur between levels and across systems (see Figure 9). This created a much-needed shift in communicating how intervening in a wicked problem could impact the system and/or the larger context in which the system is located. By making modes of thinking and their larger ecological context more explicit, the MLP becomes a tool that designers can use not only to map a problem, but to identify points of intervention, to explore how these might impact the system and its context and to communicate these findings to others.
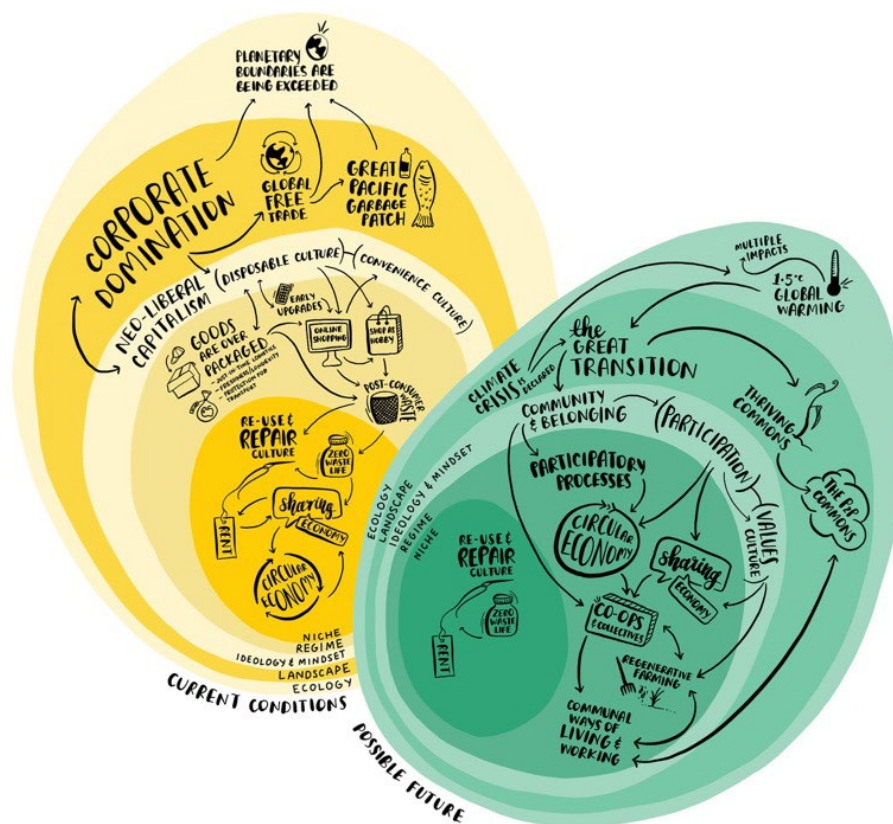

Figure 9   The MLP reimagined as an organic holarchy where the system mapping has a simpler narrative and the visual shape has a less hierarchical feel.

Drawing to think facilitated this process of exploration and embedded within these figures is evidence of a multi-staged approach. At the top of Figure 6 it is clear that I am still deciphering the theory—I am doodling in order to understand it. In the central and bottom sketches in Figure 7, I am doodling to explore. This is demonstrated by the nuancing of terms used, the shuffling of cultural frames between levels, by the evolution in elements/activities mapped, and by the addition of columns to show stages, from historical emergence,

to current conditions and into a possible future. It is not until Figure 8 that doodling to communicate begins. Evidenced by the simplified content, use of organic forms to mitigate the hierarchy of rows and columns and instead present a truer representation of the socio-technical system as a holarchy. The usefulness of these revised MLP tools for other practitioners exploring wicked problems is currently being tested.

Whilst there is a breadcrumb of my initial a-ha moment traceable in the process presented in these figures, there is certainly no spontaneous genius aspect to any of it. Rather, early and repeated engagement with the literature along with a continual process of reflective doodling led me toward this particular end-point. It was hard work. Enjoyable, but hard. As I continue to engage with these and other tools that were developed using reflective doodling, my understanding and appreciation for the process continues to develop. Without *drawing to think* I do not believe these tools would have advanced in this particular way. But reflective doodling provided more than a process for thinking—its meditative nature provided an albeit strange way of relaxing whilst continuing to think. In many ways, reflective doodling served as an exercise in mindfulness, allowing me to switch off (relax) in order to switch on (create). In fact, many significant advancements in this work occurred at night while I was 'relaxing'. The sometimes-repetitive act of doodling also appeared to increase my well-being and engaging with these creative processes often brought enjoyment to what was otherwise hard work. This side effect was unexpected but welcome. Recognising this and reflecting on it during my PhD provided much clarity around the role that creativity and in particular, the practice of drawing, plays in my satisfaction of needs.

5.1 Drawing to think in the context of wicked problems

As the problems that designers reflect upon become increasingly complex and wicked by nature, our reflection must also become increasingly informed; by theory, by experiences (our own and others'), by criticality and by processes (known and as yet unknown). This kind of reflection is a learned practice. It relies on reflection in and on action, reflection in and on time, and in addition to this, a deliberative approach that considers what might come and what might be. Reading and responding; listening and responding; acting and responding; these can be slow processes and they warrant frequent reflection. This way of working is a dance, a movement, a shift to, from, and between one thing and another (and another and another and so on). Plurality and movement are key in addressing wicked problems, which are typically found in complex adaptive systems. The diversity in a system calls for diversity in our responses to it (Ashby, 1957). The adaptive nature of a system requires continual responses to the surrounding conditions and continually adapting actions that shift them again. These processes are as fluid as they are innately reflective. This calls for designers to make adequate time for reflection, to find comfort amongst the chaos, and to be agile thinkers who are willing to change themselves in the process of changing the systems they are embedded within.

Context is a necessary aspect of understanding and responding to the current conditions of a system, but these contexts can be partially obscured if the capacity for reflection is limited.

Making the ecological context for design activity more explicit in the MLP was done in an attempt to avoid any obscuring of this context during reflective doodling. One's capacity for critical reflection can be further nudged through tools such as the MLP canvas, but the capacity for reflection using such a tool is strengthened through the practice of reflecting with the tool itself. This is amplified through a constant nurturing of the mind performing the reflection, by ensuring that knowledge is continually built, dismantled and rebuilt, and that multiple and decolonial perspectives are sought. This is an important note for reflection on wicked problems such as climate change, where truths and contexts are plural and continually shifting, and where the knowledge needed exceeds that which most designers hold.

6. Some final thoughts on what reflective doodling is and does

Throughout this paper my understanding of what reflective doodling is and does has been shifting, and as the study of this process continues in the living lab, this understanding will likely continue to evolve. I hope here, as this paper concludes, to provide more clarity by redefining its processes as they are currently understood. In *thinking while drawing*, the process of making marks is used to make sense of something. Reflective doodling as part of this process can take a number of forms, not only as a method for documenting thinking, such as in ideation, but also as a method of information processing, demonstrated in this paper through doodling to process concepts, and through doodling as part of notetaking. The reflection conducted for this paper revealed how reflective doodling attempts to construct new knowledge on-the-fly, as a form of reflection in action during notetaking and by using drawing as a more deliberate and visual way of thinking through something. In *drawing to think*, reflective doodling is used as a way of opening neural pathways to understanding new theoretical knowledge, as an approach to unpack the complexity of wicked problems, and in the examples shown, as a thinking process to identify leverage points in everchanging systems. In these contexts it is reliant on a number of inputs including (but not limited to) theoretical concepts, knowledge from other disciplines, and diverse perspectives. Each input serves to increase practitioner capabilities through cumulative knowledge building that broadens thinking and reduces biases and assumptions.

Reflective doodling is more complex than its simple name suggests. It is a critical reflective practice underpinned by a range of inputs that inform its processes. Highly developed critical thinking is necessary not only for those engaged in design for transitions, but also for any researcher or practitioner who is focussed on complex or wicked problems. Through the layered processes of reflective doodling, designers might find new and unexpected synergies between research and practice.

7. References

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