

Confidence and doubt in doctoral research: The temptation of certainty

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Many aspects of doctoral supervision are well known from methods and methodology to research questions, philosophies and epistemologies. A core aspect that is touched upon less frequently yet is central to the lived experience of the researcher (and which is essential for rigour and trust occupying a significant amount of cognitive effort) is confidence and doubt. The use of confidence and doubt to drive research is a daily experience for the researcher yet the practice and challenges are infrequently addressed directly in doctoral environments. Confidence can be essential as a driver when researchers with strong convictions lack complete arguments to justify actions based on experiential, innate or purely intuitive motivations. Doubt can act as a valuable aid to personal critique and can mitigate the excesses of over-confidence. Overconfidence can blind a researcher to critical flaws whereas excessive doubt can destroy promising findings and innovations before they are proven. The authors explore how the initial worries and concerns from novice researchers about reliability and rigour transform into an exchange between confidence and doubt which become central generators balancing critique, risk, experimentation, and honesty. We review a wide range of diverse theories and concepts exploring different perspectives with a view to supporting those building research careers with positions from which to gather insight to strengthen their practices. Particular value can be gained from the decision-making routes that can follow from a better understanding of what underpins the drive for certainty.

Keywords: doctoral supervision; confidence and doubt; design research; certainty

1 The temptation of certainty

“Darwin’s work on barnacles began with the accidental discovery of a small, persistent fact. [...] Darwin’s facts existed before he discovered them. [...] Darwin’s facts emerged because he had a theory that guided him. [...] [He] spends a full six out of fifteen chapters addressing objections he imagines readers might have” (Weinberger, 2011).



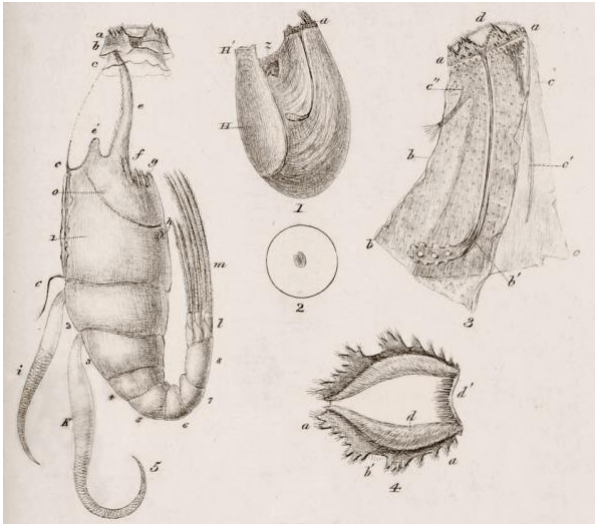


Figure 1. Charles Darwin's study of barnacles (*Cryptophialus minutus*) found an intermediate evolutionary species supporting his evolutionary theory and branching descent. From Vol. II of *A Monograph on the Sub-class Cirripedia* (1854). Illustrated by George Sowerby.

Why do we strive for certainty? In practice as well as in research we usually plan ahead, we may try to follow a particular process and want to feel 'in control'. John Dewey suggests that we seek certainty because we are human (Bauer, 1991), not because we are designers or researchers. For example Science requires uncertainty as a driving force as illustrated by Darwin's pioneering work where great efforts are made exploring potential objections to fieldwork findings guided by theory. As practitioners we trust our expertise while as humans, we wish to avoid feelings of insecurity, uncertainty and ambiguity. While this may apply to all research in general, it might be especially true for doctoral research, where experienced design practitioners explore new terrain by becoming academic researchers. Thus, becoming learners again, in their own field. This learning process can often be characterised by uncertainty, insecurity or anxiety.

At the same time knowledge has its limits. There is value in uncertainty, play, exploration and subjective interpretation in dealing with those limits (Gaver, et.al. 2004). It is here where new insights might emerge. Donald Schon writes about such indeterminate zones of practice in which we encounter uncertainty, situations of confusion and messiness: "The situations of practice are not problems to be solved but problematic situations characterised by uncertainty, disorder, and indeterminacy." (Schon, 1983, p25) in another text he asserts that as a learner:

"You feel vulnerable; you feel you don't know what you're doing; you feel out of control; you feel incompetent; you feel that you've lost confidence." (Schon, 1987, talk at American Educational Research Association).

As practitioners, as learners and researchers we wish to avoid these feelings. Instead, we might seek control, certainty, and confirmation. As design research practitioners we might feel confident, as researchers however, we are learners again, and do not.

Researchers undertaking a practice-based doctorate may be experienced practitioners but are less experienced as researchers—and thus might feel insecure and doubtful. How can we as supervisors help our students to cope with this? We may suggest, quoting David Orr (Orr, 1991) that ignorance

was part of the human condition. "Ignorance is not a solvable problem, but rather an inescapable part of the human condition. The advance of knowledge always carries with it the advance of some form of ignorance" (Orr, 1991, p1). While advancing knowledge = advancing ignorance; some questions are answered, and new questions may be emerging. There will always be some degree of uncertainty or unclarity involved. While we strive for clear insights and certainty, based upon evidence, we must also remain sceptical and doubtful, as we might not see the full picture. We should learn to accept uncertainty and trust that clarifying answers will emerge in the research process. Perhaps we should never be entirely certain about our findings and keep on asking critical questions. Ranulph Glanville mentions in this context that research was thorough once new questions stopped emerging (Glanville, 2014).

Whereas knowledge in the sciences value's reproducibility as knowledge of something that has been observed, in design research we generate knowledge for future transformation so our thinking has a forward evolving transmission requirement. Our methods and methodologies respond through emergence and the stitching together of theory and practice where each design research project is unique and unrepeatably. Due to this, results are never replicable. Designing is not a reproducible science and can never become one.

Linda Candy suggests that reflection might play a key role in the design research process: "By embedding reflection in every thought and action, the reflective practitioner learns to live with uncertainty and face unexpected events and problems as a normal part of practice" (Candy, 2019, p254). But what about PhD researchers moving between planning and exploring, predictability and unpredictability? Candy compares this to a dance: "I think a system that brings opportunities and unpredictability is more interesting for a dancer than a system that allows you only to control as if you would have a remote control" (Candy, 215). Uncertainty and reflective thinking go hand in hand. Emerging researchers can move from unreflected and perhaps defensive certainty to a critical-reflective confidence. They know their material, can explain their process and findings, their insights and the weak points of their theory as they have reflected upon it.

Another research issue involves ignoring facts that consciously or unconsciously contradict preconceived theories, ideas or beliefs, leading to a cognitive dissonance. Such cognitive dissonance is also a factor where a doctoral candidate may avoid the necessity of their beliefs and actions contradicting each other to try and disprove a valued concept, theory or finding. According to Festinger (1957):

"A man with a conviction is a hard man to change. Tell him you disagree and he turns away. Show him facts or figures and he questions your sources. Appeal to logic and he fails to see your point."(Festinger, 1956, p257).

He goes on to explain the underlying process:

"1) The existence of dissonance, being psychologically uncomfortable, will motivate the person to try to reduce the dissonance and achieve consonance. 2) When dissonance is present, in addition to trying to reduce it, the person will actively avoid situations and information which would likely increase the dissonance." (Festinger, 1957, p3).

It is clear that a preference for consonance as opposed to dissonance may be desirable, however when and where to deploy these responses relies on a high level of awareness. Self-awareness and mental modelling in response to the requirements of thorough research is a sophisticated mindset rarely addressed directly during supervision leading to a tendency to 'find what we are looking for' and develop theories and concepts that support our worldview.

Further pursuing this line of thought Maturana and Varela (1992, p17-18) describe 'Christ Crowned with Thorns' (circa 1510), a painting by Hieronymus Bosch that introduces the four forms of estrangement and interior loss. They describe how an assailant drags Jesus to the ground by his robe and in this act conveys an emphatic visual certainty. Maturana and Varela go on to address a deeper set of issues underpinning experiential human drivers for the temptation of certainty that prove that things are as we see them and that no other alternatives are true, thus confirming a common way of being human. Finally, a rationale is constructed linking the phenomenon of cognitive experience and the blindness of certainty. They promote the suspension of certainty and that all cognitive knowing is personal, biological and blind to the cognitive acts of others. Through this Maturana and Varela construct a cognitive argument declining the temptation of certainty flowing from an essential cognitive model for acting and knowing with others. The cognitive argument for avoiding the temptation of certainty is persuasive yet how can we engage such arguments in doctoral research?

Returning to our purpose; what can we do as supervisors? Over time supervisors develop an intuition whether a PhD researcher has made a real breakthrough and has reached a new stage in view of their research aims, or if they have simply reached a satisfactory stage, staying within the self-imposed boundaries of reflecting, skills and control. In our experience there are doctoral researchers that work in an overly structured manner, perhaps afraid of letting go and dealing with unpredictability and uncertainty. These we like to encourage or persuade to leave that safe space behind and trust their intuition and learn to embrace uncertainty, thus inviting novelty, serendipitous insights and observations. This might be somewhat risky, particularly in view of an individual's cognitive dissonance and a defence mechanism that preserves balance and worldview, yet the rewards might be high. It requires a trusting relationship on both sides between supervisor and candidate. Less structured, or wildly unstructured researchers however, we like to encourage working in a more planned, structured and organised way. This will benefit them and their research and tends to happen more regularly while supervising a postgraduate thesis. Here we may find frustration at the limitations of rigorous academic research expectations of disciplinary and institutional requirements.

All students embarking on a qualification bring baggage, assumptions, biases and preferences and design research is no stranger to this. We often find an inheritance of common misunderstandings of what counts for reliability and rigour in research - "Yes, but I want my research to be reliable, scientific'. As if scientific research is a guarantee of an immutable standard while ignoring longer traditions of enquiry and knowledge generation and most crucially the central tenet of scientific research that it's based on doubt.

We also see critique of the artificial separation of design and the sciences via New and Kimbell (2011) and the opposite, what Ghassan (2016) describes as the straw man of science being used as an artificial caricatured opponent of design thinking and design research. Particularly in design research which has struggled to define its ontology and rigour framework, we see a tendency to compare ourselves with the arts and sciences and assert design thinking as a third domain building on C.P. Snow's 'vacant plot'

(Snow, 1959). The simplification of design vs. science or the eradication of borders are both unhelpful and can lead to over-simplified assumptions about the nature of knowledge generation and research. These simplified caricatures not only blind us to useful overlaps and interactions but are unhelpful by justifying design research 'in opposition to' or 'against' rather than focussing on an emerging domain which operates under its own authentic practices.

These mental oppositions are often characterised as the positivist vs. constructivist epistemological positions. In a major contribution to environmental psychology JJ Gibson proposed 'Ask not what's inside your head, but what your head's inside of' (Mace, 1977) contrasting the positivist making a model of the world in one's head for navigating the world versus constructing an understanding of the world as we navigate our way through it. The work derived from Gibson's earlier studies on safety issues for vehicles and aeroplane landings having insufficient theoretical explanations for incidents. Earlier, Popper also made a similar analogy by proposing theories of mind using the analogy of buckets and searchlights proposing buckets an enclosure for collecting insights, versus searchlights as a tool for exploration (1972).

"The principles of scientific progress are very simple. They demand that we give up the ancient idea that we may attain certainty [...] with the propositions and theories of science (an idea which derives from the association of science with magic and of the scientist with the magician): the aim of the scientist is not to discover absolute certainty, but to discover better and better theories [or to invent more and more powerful searchlights] capable of being put to more and more severe tests [and thereby leading us to, and illuminating for us, ever new experiences]." (Popper, 1974, p361)

This can be characterised (Fig. 2) as a searchlight with the mind as an exploration tool where the world is navigated via affordances that create meaning through exploration. Control is external and projection of meaning is inward. The bucket makes a collection of facts as a model for navigating the world where control is internal and projected outward. Doubt exists as to whether people (researchers) are constrained into such simple analogies at all levels of thinking and this may underpin an argument for dancing between confidence and doubt.

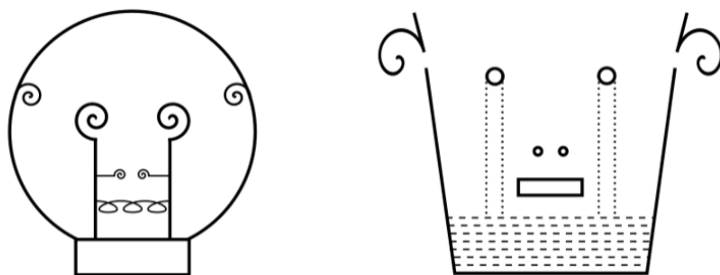


Figure 2. Image based on Popper's bucket and searchlight theory of mind in *Objective Knowledge* 1972 (Kowalewski)

A recent example of confidence and doubt was experienced by one of the authors. A quote from Vladimir Lenin was intended to be used for an academic paper "There are decades when nothing happens; and there are weeks when decades happen". The quote has been used frequently in news articles, especially because of conflict in Eastern Europe and always appears without citation. Sometimes quotes are mis-attributed so the researcher searched for the text citation and page

number. Interestingly there were no direct citations and in fact there was no mention of this quote in either the 19th or 20th centuries in sources consulted. The earliest mention appears to be an interview between Eric Ruder and the British MP George Galloway in 2006 (Ruder 2006). Further research in the Russian language also found no direct quotes, however it may be very loosely based on a phrase from Lenin in 'The Chief Task of Our Day' from 1918 (Daglish, 1956). Remembering another Lenin quote that indicated this irony: 'A lie told often enough becomes the truth' further research was conducted to identify the source of this quote. Again, we find no written evidence of Lenin making this quote and its attribution is in the 21st Century.

An ironic path can be traced between these quotes bringing a surface confidence in quoting a major historical figure with insights that seem profound and timely irrespective of the accuracy of their attribution. Yet the lack of credible authorship undermines the temptation of certainty. Should we ignore and refuse to accept these words due to what appears to be unreliable origins, or should we instead focus on what we may perceive as the value and wisdom gained from these remarks? The researcher moves between confidence and doubt from moments of false confidence into confident doubt maintaining an investigative trajectory that results in an illustration of uncertainty based on a process, or method of doubt. On the one hand the result is unreliable in terms of material confidence yet the process and underlying doubt driven outcome provides confidence. Paradox and serendipity are actors here in the dance between confidence and doubt helping us to 'know what to do when we don't know what to do'. Recognising and capitalising on these moments becomes an essential response that maintains cycles of research avoiding dead ended doubt.

As advisors in the beginning stage of support we need to encourage researchers to muster the courage to question their own assumptions and through the process of prototyping, observing, theorising, modelling and questioning – trust them to home in on 'the truth'. The question is how resilient we are towards ambiguity and doubt, and how long researchers can endure before 'nailing' their emerging 'tentative hypothesis' as a fact to the door of design research. As mentioned above, Glanville alleges that one knew that one had reached a satisfying stage of research, when new questions stopped emerging, and we re-encountered earlier questions. Something he often described as the stopping rule. Having reached this stage, one could move on.

2 Should we trust in methods?

When in the 1960s the design methods movement began, initiated by Christopher Alexander, J. Chris Jones, Bruce Archer among others, they strived for order, structure, reliability and appropriateness in the process of designing, something ('a doctrine') that could be taught and repeated, moving away from the craft based, more intuitive and individualistic approaches of designing of the past. Designing was to become orderly, organised, based upon logical, rational-technical thinking and acting. Langrish (2016) writes about the movement being driven by "a belief in post war optimism and science-based progress". Earlier Buckminster Fuller had called for a 'design science revolution' and Herbert Simon for a 'science of design'. Both perhaps being inspired by the success of operations research and a way of thinking, signified by John von Neumann's quote "All stable processes we shall predict, all unstable processes we shall control' (Dyson, 1984). Such a structured, methodical, logical and rational approach would also give designers a language and allow them to communicate about their design process, their methods and desired designs to clients and consumers. The design process would become

demystified, more logical, rational and clear. The hope was for designing to become a kind of science. However, the same group that advertised such design methods in the early 1960s turned away from prescriptive methods, disillusioned, in the early 1970s. Archer had developed a rather impractical 229 step idealised design checklist (Dubberly, 2016) and Boyd Davis noted Archer's negative re-assessment of his systematic method in a reappraisal of his 1968 doctoral thesis (Boyd Davis and Gristwood, 2016).

Today methods have evolved beyond researching designing and now include designing research giving more structure and reassurance to design researchers. Langrish (2016) argues that they made the design process visible and open for review and revisions. However, we think without rigorous critical reflective practice there is the danger of – uncritically – applying a recipe and blindly following it. There are (at least) two fatal elements in applying a method without doubt, a critical and alert stance here: Blindly –implying uncritically and overly confident– applying a method and following its procedure, can lead to identifying irrelevant details, missing out on relevant observations, perhaps missing the 'bigger picture' and not identifying important connections, thus leading to wrong insights, wrong decisions and theories. Potentially this can lead to inappropriate or mediocre outcomes (theories and designs). While methods may provide some confidence for the methodically opaque and vague aspects of the design research process, how making, reflection, knowledge and insights come together in research, – this sense of reassurance bears the danger of following the wrong path to superficial results and potentially missing a 'real' issue.

2.1 Risks from rigidity and premeditation

Discussions during seminars and doctoral research conferences often revolve around initial expectations of a research degree versus the reality. This is sometimes typified as 'I thought I just had to review theory, identify methods, do the practice then say what happened, but it's not like that, it's not that easy'. The realisation that methods do not adjudicate the result and that the gap between methods, tools, and context always required adjustment and interpretation can be disorienting as the realisation that certainty is elusive emerges. Glanville argues here that design research was not some kind of advanced degree, but:

"The point of a PhD is that it's different: it shows a competence to run research, and that's essentially a lonely process. Hence, we supervise, we don't tutor. It is for the candidate to find out how, and for them to get past the problems. Of course, we offer hints, but we do not give solutions. It is precisely this independence and cussedness that the PhD is all about. So, in principle and in the main, we supervise, we don't tutor and we don't teach." (Glanville, 2005)

Rigidly following a premeditated plan and applying a particular methodology (theoretical framework combined with an application of particular methods) provides structure hence confidence and sometimes over-confidence. To discover new things including methods, theories and insights we have to do things differently and work with a situation, not impose our conception upon it. Where does trust in method end and where does critical thinking and reflectivity enter? We guess that we all have examples of excellent students doing their thesis project by following a plan and applying a particular methodology - then ending up with an overly contrived fictitious project which makes little sense under realistic conditions?

Another insecurity is imposed through striving for scientific 'objectivity'. In design research the knowledge emerges through action and reflection, through error and feedback, not necessarily

through precise measurements and quantitative data. Those are the exceptions. Design research is often more subjective and therefore theories, examples and prototypes are tested and discussed with others, colleagues, and supervisors. Therefore, the step-by-step process of research and how new knowledge emerges has a strong social dimension to it, a dimension that often does not receive the necessary attention and is taking place in the background. It is here where ideas are tested, either to ‘help others see’ and get feedback, or to realise that one’s theory, example etc. might need rethinking. Here we are reminded of Wilkinson’s ‘elevator story’ (Wilkinson, 2006, p103), in which the temptingly ‘obvious’ technical problem of elevators being too slow, is identified through sensitive investigation, observation, interviews and participation in combination with critical reflection, playfulness, empathy, susceptibility and peripatetic musings, as a socio-technical problem. In fact the speed of the elevators is sufficient yet the passengers feel uncomfortable being placed in a confined space in close proximity with strangers and complain about the duration of this experience. Such a subjective approach and a hunch for thinking outside of the box are perhaps the result of extensive experience, embracing, and the courage of learning from errors.

Exploring these concerns (Fig. 3) resulted in a doctoral seminar discussion typifying both the opportunities and issues that a postgraduate researcher will face as they shift between the axes of confidence and doubt and realise or ignore the positive and negative consequences. One might argue that the core skills of a doctoral researcher are founded on how these four quadrants combining confidence, doubt and negative and positive connotations are negotiated with each other.

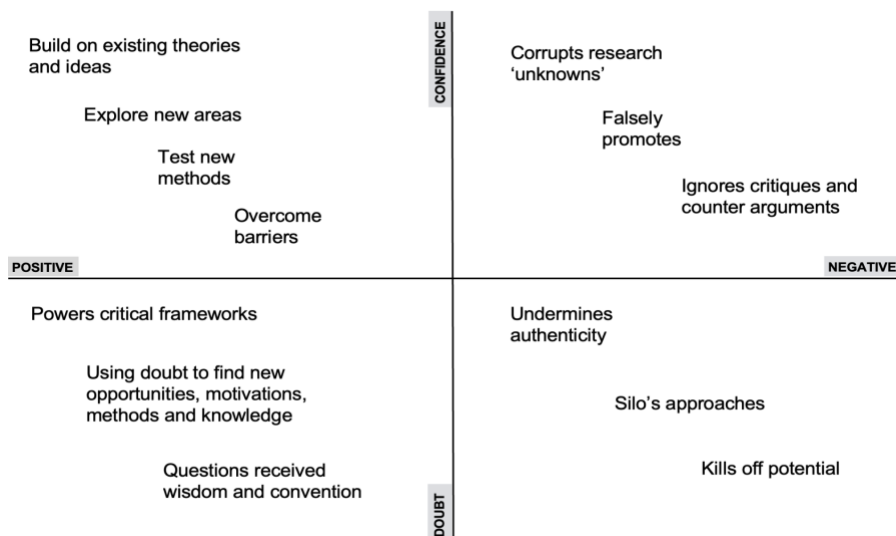


Figure 3. Matrix of confidence & doubt and positive and negative connotations. Core quadrants for a doctoral researcher?

In professional design practice, before design methods, design process models and ‘design thinking’, designers often needed to convince their clients less through evidence and more through their strong convictions, experience and reputation. The ability to convince by being supremely confident and elitist and deploying cognitive dissonance to one’s advantage can actually be really helpful in this context. Designer Rafi Manasian:

“We are selling the future. And because the future does not exist yet we are asking people to have faith in what we believe in. And to do that we have to be convincing.” “You don’t have to

be elitist or narcissistic to be confident, but they tend to correlate with each other. The danger for the designer is that you begin to believe your own lies.” (Maurelio, 2023)

What if such a ‘social engineering’ attitude was learned in professional settings and transferred into academic research? When, what designers lacked in evidence, and a critical, reflected, structured process they learned to convince through an attitude of being convinced, and having little doubt? Maurelio argues:

“[I]t’s hard to measure success. Rather than focusing on things that one can measure, some designers focus on surface level things such as how to dress or how to act. The power of your personality and the way your present ideas can make a big difference. It can be very theatrical and performative. The way you talk about an idea matters.” (Mauriello, 2023)

What if such delusional confidence leads design researchers to believe their own theories? We are not supposed to believe them, we are supposed to test them. Converting from design practice; creating a user and client friendly narrative, ignoring inconveniences and goal orientation converts into process transparency, temporal accuracy, the realisation of emergence and most importantly leaving space for novelty. Without the essential space for novelty we may produce ‘nice’ projects, confirm our cognitive dissonances, feel safe and cosseted on our journey, but are we researching, and are we generating new knowledge?

Blindly trusting in methods reduces the power of criticality, reflectiveness, new perspectives (e.g. own anticipation, expectation (“body vs. space”)), contradictory evidence, honest, problem identification and being open to new insights. Should we develop a traditional, straight forwards methods adoption approach or instead encourage explorative meandering emergent methods? While the research aims and questions will influence this to a certain extent the role of methods as a pivot for confidence and doubt is crucial so that we avoid feeling safe in our process and application of - linear or iterative - methods, in case we entirely miss making crucial observations.

The strictures of a classical thesis chapter structure can enhance the folly of certainty. An evolutionary series of research questions is presented as the only set, the practice that described the need for theory is reversed so that theory precedes practice, the emergent methodological journey realised in the latter stages of the investigation is presented in the early stages as a path to follow. How can we trust research that is temporally rearranged, tidied up then tied up in a neat bow? Glanville describes this as ‘This manner of accounting is post-rationalisation: the tidy explanation after the event of what was, perhaps, a rather different experience’ (Glanville, 1999, p83) arguing against the lazy use of emergence to replace a different research reality. This highlights the thorny issues of formatting, rearranging, argument and narrative building while trying to recall a state of mind for a researcher who may be writing months or years after an event.

3 Leading towards serendipity

In our view good research involves planning and methodical work, yet sensitivity and openness for the unexpected are essential as well. For example, not always being in control and at times ‘poking around in the fog’, while making sense of interview data, for example. This might sound paradoxical, but it distinguishes good research. It is in these often-unexpected moments when serendipity arises and important new directions for the research unfold. These might be small and seemingly banal and

unimportant moments, for example, when something does not go as planned. This can be a simple technical or conceptual error or oversight. Gaver, Krough, Boucher and Chatting (2022) discuss the challenges of wholeheartedly embracing approaches from design's social and engineering minded neighbours and explore a similar vein of thinking describing the crucial role of emergence in design research and how attempts to tame serendipity via mechanisms such as preregistration are a major risk.

However, because as humans we try to avoid such frustrating moments of failure, big & small, we might reflexively and automatically, ad hoc, identify a solution, a workaround or an explanation. This, reflection in action, often happens in a very brief moment, in the blink of an eye, a eureka moment so to speak. Yet it might be exactly here, where something did not go as planned and expected, where our technique or theory was wrong and failed, where new knowledge well worth investigating might be found. Paying attention to such small moments where we feel in our improvisational designerly element by overcoming an obstacle can be learned. Then it is time to pause the flow and inquire what just happened. For example: good research questions need not be overly difficult. Sometimes it is the deceptively small and simple questions that are hard to answer.

Donald Schön describes such a moment while in conversation with a student. He is asking her concrete questions; she answers him with a generalisation. After several attempts before reaching a clear answer, Schön moves to a conversational meta-level and asks her if she had realised the trajectory of their conversation and if she didn't think this was unusual (Schön, 1987). Such moments, of not being in control, having no explanation, and observing with wakefulness, might lead the researcher into new directions and new insights. We think that such a perceptiveness – true listening and critical wakefulness – lies at the heart of a reflective and critical (research) practice where a relaxation of control produces serendipity.

Nelson confirms: "To be *out-of-control*, with no agendas, outcome expectations and similar scripts of logic aimed towards a predetermined end is essential for the emergence of breakthrough insights." and he continues: "The rational side of the mind has to trust the un-controlled intuitive side in a creative partnership. This partnership can be nurtured and enhanced but not controlled." (Nelson, 1994, p8). He indicates that creative aspects of design which we expect to experience in design research require un-controlled behaviour. What we learn here is that out-of-control becomes a desirable state where we can have confidence that we are open to exploring new terrains and that a certain unknowingness is crucial for allowing novelty, the unexpected to emerge. We experience this feeling of being out-of-control that becomes durable and sought after where it eventually replaces false certainty. It becomes a fulcrum point which we stabilise with both feet in confidence and doubt.

4 Navigating room for change

As we have discussed, while we might like to be captivated by tried and tested methods, we quickly realise that work needs to be done between classic descriptions of methods, new contexts, technologies, issues and social developments. Methodology (or more accurately in practice-based research emergent methodology) takes centre stage as various research props are put into place to scaffold progress, providing support and room for change.

Every major step in research might lead to a change in perspective and we see what we did before in a new light, like ascending a ladder. As we ascend in our research process these earlier steps are seen in a new and different light - we learn, we understand - and they might now be viewed as incomplete interim stages. They were crucial in getting us to where we are now but might have lost their purpose and value and it is time to let go of them (theories, hypotheses, methods, ideas). This we might also have to convey to our research students. However, these steps remain essential for our understanding and allow us to think and act in new ways and reach new insights. These earlier, discarded 'truths' corroborate our new insights. Here we can also recognise that researching and learning are not linear processes with a clear beginning and an end, but ongoing processes that influence their surroundings, our understanding, reflecting back upon each other.

Research structures such as questions, tools, methods, methodologies, philosophies and epistemologies become props, aides to navigating confidence and doubt but should never replace them. Replacing the props attempts to dishonestly absolve the researcher from responsibility and risk as a way of side-stepping responsibility and failure.

5 Honesty transformation

Factors that undermine certainty, complexity and gaps in knowledge are inherently uncertain. Uncertainty is part of the human condition and is a neuroevolutionary necessity (Plutchik, 2001). We also know that uncertainty creates doubt and doubt can keep us safe by not trusting things which appear as real or convincing, particularly where simulation, masking, or other obfuscations are detected (e.g. the 'uncanny valley' in robotics) and give rise to survival instincts avoiding these interactions. (See also Gaver, 2003, Ambiguity as a resource for design)

A new understanding can take place leading to a transformation for the researcher. Does the dissolving of certainty and the practice of dancing with confidence and doubt mark the true achievement of doctoral research? Glanville in the documentary *Zero Spaces* (2015) discusses rigour and honesty in research: 'At the heart of doing the type of PhD we are involved in doing [design research]... is the acquisition of the great skill... or quality of rigour'. He goes on to describe the place of methods: 'The purpose of methods is to support rigour and never to replace it'. And concludes by positioning the underpinning value in research as: 'What's behind all our research is honesty and if we can't see that we are completely lost'. Here we can see that if methods support (but do not replace) rigour, and underneath rigour is honesty, then how do we show this honesty as design researchers both to ourselves and others? What stands for honesty in design research? How do the trade-offs between confidence and doubt surface honesty?

Here the ontology and knowledge production self-awareness of design research remains an issue. At another occasion we have written about rigour in research as being thorough, exhaustive, accurate, and systematic as well as critical, reflective and honest (Hohl, 2016). Whereby honesty is not interpreted in the simple sense of not manipulating data or avoiding a confirmation bias, but in a more fundamental sense of imbuing the research process values and mindset.

Honesty can emerge in a number of forms. A statement positioning the researcher's entry point or perspective on the research, an activist or action driven enquiry method as well as honestly including failures alongside traditional forms of confidence hierarchy in terms of peer reviewed sources can be

useful. Ultimately the transparent articulation of the dance between confidence and doubt transmits honesty as we have seen in Darwin's work on barnacles as the start of this piece.

6 Conclusions

Undertaking doctoral research is the least scaffolded and most risky form of education with supervisors who are necessarily standing behind the researcher as they lead. This exposes candidates and supervisors alike, particularly in practice-based research where the same discipline is undertaken in a very different and sometimes contradictory form to that which has been experienced before. Process and outcome are swapped in their priority leading to uncomfortable challenges for the researcher.

We have reviewed a wide range of theories and concepts that we hope provides a landscape of reflective support for postgraduate researchers. These can signpost helpful ideas and approaches to strengthen our self-awareness that support decision making when researching. On this journey we have seen how confidence and doubt can be woven into research practice to strengthen and enhance our practices and convey the honesty that must underpin all research. We agree with the Glanvillian proposition that methods support rigour and should not replace them, and that underneath methods lie the foundation of honesty. Our questioning of the use and understanding of research methods as props rather than promises requires greater responsibility and awareness for the researcher. An awareness of theories of mind, cognitive dissonance, control versus serendipity, honesty and timing become key ingredients.

Confidence and doubt emerge as the core experiential challenge that exposes and tests the mental models for researchers, necessarily stretching them into new and more sophisticated forms. We argue for neither concrete structure nor unbounded experimentation but a refined research practice that balances both of these essential research values. Using structures and props, methods as guides not guarantees, balancing control with serendipity and using structure as a prop for honesty transformation support us in avoiding the temptation of certainty. For as supervisors we must learn how to support others to know what to do when they don't know what to do.

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