Transferability: Exploring ontological properties for design knowing

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Abstract
The nature of design ontology continues to be explored as a crucial step in building closer relationships between the domains of the sciences, arts & humanities, and design. We focus thinking by design researchers including the co-authors to question the true nature of design ontology and its relationship to time, core design practices, reliability, and collaboration across domains. We examine how temporal relationships can drive a new definition of core domain level practices via an examination of Archer's wroughting and wrighting as core practices for design. Our exploration identifies transferability as being the ontological essence of design. However, this raises serious problems in terms of rigour and reliability. We propose an ontological mirror that explains the diverse nature of design while addressing serious rigour issues. This formally positions design as knowledge for future transformation.

Author keywords
Design Ontology; Design Epistemology; Transferability; Design Futures.

Introduction

As the impacts of climate change draws larger numbers of researchers from increasingly diverse backgrounds into inter-and-trans disciplinary collaborations some central questions for knowledge production between the different domains of thinking remain unanswered. Design research has struggled to define a clear ontology being influenced by both the sciences and arts and humanities which sit either side. The sciences value reproducibility and generalisability while the arts and humanities value rich depth and qualitative practices providing both with a framework for rigour. One of the key attributes for design thinking appears to be its relationship with the future. Arguably a unique quality of designing is its capacity to abductively transform what comes next. Both design research and design practice appear more concerned with changing the 'world to be' rather than understanding 'the world as it is'. The relationship between design and time is worth exploring. While this is promising it raises key questions related to reliability; How can a domain of thinking claim rigour and reliability for a future focussed practice?

Time

When we speak of positioning domains of thinking Simon (1969), Chris Jones (1992) and Glanville (2005) have all positioned design in relation to what the authors have called a future prospective design (Galdon and Hall, 2019) or abductive mode of thinking (Douven, 2011) with time-based analogies for different forms of knowledge production. Simon proposes the beginnings of a temporal relationship between design and the sciences where he describes the future speculative potential of design as:

> "Design, on the other hand, is concerned with how things ought to be, with devising artefacts to attain goals. We might question whether the forms of reasoning that are appropriate to natural science are suitable also for design." (Simon 1969, p.115)

Simon also distinguished between a pre-set goal versus ‘Designing without final goals’ (Simon 1969, p.162) as a way of addressing complex, dynamic, emerging wicked problems (Rittel & Webber, 1973). This begins to open up a difference of reasoning between the natural sciences (and social and formal sciences) and what at the time was an emerging awareness of design thinking alongside a loosening of design as a problem-solution based linear activity. Previously a notable opportunity opened via CP Snow’s ‘two cultures’ Rede lecture with the proposal of a ‘vacant plot’ for a future third culture coming into being (Snow, 1959). This was filled by Bruce Archer who proposed the term ‘design thinking’ in Time for a Revolution in Art and Design Education (1978). John Chris Jones further developed the idea and deepened the future orientated nature of design asking the question "Is designing an art, a science or a form of mathematics?" and answered:

> “The main point of difference is that of timing. Both artists and scientists operate on the physical world as it exists in the present (whether it is real or symbolic), while mathematicians operate on abstract relationships that are independent of historical time. Designers, on the other hand, are forever bound to treat as real that which exists only in an imagined future and have to specify ways in which the foreseen thing can be made to exist.” (Chris Jones, 1992, p.10)

Separating the points of difference between operating on the physical world as it exists at present verses being ‘forever bound to treat that which exists only in an imagined future’ ties design to a practice for tomorrows, and at the same time requires the need to specify ways for which these unforeseen things can be created. As we shall see later this provides a powerful opportunity to explore new trajectories for the epistemology-ontology of design while at the same time creating a significant problem when compared to repeatability or generalisability as the rigour qualities that constitute knowledge generation in the sciences. Glanville goes further when discussing time and proposes a ‘forever ahead’ type of new knowledge production which here is proposed for architecture but which he later claimed applied to all of design.

> “Design science and history, the approaches that have dominated design research until relatively recently, are based in an approach that generates knowledge of... I propose that research in design (architecture) should forge a new type of knowledge, knowledge for, intended to help us act (better), to (more successfully) perform our activity as designers. This is one way of shaping our research so that it is based in design, sensitive to design, and designerly.” (Glanville, 2005, p.112).

While acknowledging Cross’s ‘ways of knowing’ (2001) he goes further to hint at the conversion of knowledge of, into knowledge for:

> “Some will argue that there is a third kind of knowledge that converts knowledge of into knowledge for. I agree. It is commonly called technology, and I refer to it as transfer knowledge (or translation knowledge).” (Glanville, 2005, p.112).

Through his publications Glanville expanded on the implications of knowledge for what he called future transformation and how this created important features of design knowledge as being always partial, incomplete, and subject to change, while at the same time having a capacity to be good enough for now. He separated Knowledge of (the sciences) from Knowledge for (design) while recognising the critical relationship one had to the other. Glanville’s future transformation contrasts with Buckminster Fuller’s (1992 (1927)) call for an anticipatory design science (which never fully materialised) in that it understands the future-critical nature of design. Fuller saw the future as a planned for activity where projections could be made and solutions at the ready, whereas for Simon, Chris Jones and Glanville these temporal reasonings point towards an ‘always to be’ that requires asking fundamentally challenging questions about knowledge being built in the present or retrieved from the past. What has emerged is a series of issues, one of which is serious and crucial to how we understand designing and design research. In addressing this issue, we explore the core practices of thinking domains and how this leads to a propositional ontological position for design thinking.

Wroughting and Wrighting Practices

In Time for a Revolution in Art and Design Education (1978), Bruce Archer proposed a convincing model for the core practices of the aforementioned three domains as: Arts and Humanities - Reading and writing, The Sciences - Reckoning and figuring, Design - Wroughting and wrighting.

Reading and writing captures the place of arts and humanities practices situated in the continuing now, whether they reference historical or future times. This ties both practices and time-space to a present backwards or present forward trajectory. Reckoning and figuring in the sciences encapsulates the essential role of exploring and investigating the world as it was or is, even if this allows projections for future events or activities from the now. Knowledge is built on a past observation irrespective of when it is intended to be used. For design wroughting and wrighting captures Simon's 'how things out to be', Chris Jones's 'forever bound to treat as real that which exists only in an imagined future' and Glanville's knowledge for (future transformation)' as a continuous and never-ending practice. This wroughts initial forms (for products, systems, or experiences) assembled into sets of forms wrighted through adjustments and corrections that steer towards what Simon called 'what out to be'. In many ways this contrasts with contemporary design practices as projects and products in linear formats.

Another useful comparison we can make is through the three thinking domains motivations for experimentation: Arts and Humanities - Experimenting to fail, The Sciences - Experimenting to test theories, Design - Experimenting when the route forwards is unclear.

In the arts and humanities debate, conjecture, argumentation, provocation, and reflection create a contemporary fluid subjective knowledgescape whereas in the sciences repeatability becomes an essential objective quality of trust and rigour. Reproducibility concretises knowledge and builds arboreal networks of knowledge that can be traversed.

Conversely, design is concerned with 'how things ought to be' (Simon), is 'forever bound to treat that which exists only in an imagined future' (Jones) and is focused on knowledge for future transformation (Glanville) as a way of addressing complex, dynamic, emerging wicked problems (Rittel & Webber, 1973). Consequently, it could be said that design researchers have little interest in repeatability and few examples exist in design research where a research project or findings are reproduced in order to test their validity. Common practice is to extend the research into a new space, develop, adapt, hybridise and combine the methods and approaches. Hence the nature of design knowledge construction relies more on the ability to move or more accurately perhaps extend knowledge to other spaces and contexts rather that repeating a result. There are also practical limitations for viable reproducibility in a domain situated in socio-cultural contexts where capabilities continually shift indicating that reproducibility becomes impractical if not impossible. Participants cannot unknow a previous experience and particularly in complex scenarios may elicit alternative results on a different date or location.

Design Knowing

Previous work on design knowing contains thinking which connects in a number of different ways to explore the ontological properties of design research as transferability. In the context of HCI Zimmerman, Forlizzi and Evenson (2007) have also challenged the repeatability paradox "There can be no expectation that two designers given the same problem, or even the same problem framing, will produce identical or even similar artifacts" (Zimmerman, Forlizzi & Evenson, 2007, p7). Instead, they propose process, relevance, and extensibility. Through process Zimmerman et al brings the notion of rigour, however, they bring it from a disciplinarian perspective more aligned with the scientific method. Instead, we extend the notion of rigour into the capacity to effectively transfer and scale. In terms of relevance Zimmerman state that; "from what is true (the focus of behavioural scientists) to what is real (the focus of anthropologists)". We speculate this perspective and propose that design should focus on what is valuable for the purposes of transformation (the ontological focus of designers).

Binder and Redström (2006) review the three traditions of design research; design theory, design studies and sciences of the artificial taking the latter's (Herbert Simon's) call to change existing states into preferred states. They note that all three threads of knowledge production are

incompatible yet contain an observer role akin to the 'knowledge for future transformation' that we derive from Glanville's second order cybernetic perspective. The future focus on what should be coincides with the future focus of transferability. It also highlights the gap between Simon's 'what should be' and how and when this is achieved.

Durrant et al (2015) in proposing a dialogical platform for disseminating research though design in a first-hand account of organising the experimental RTD conferences format provides a compelling example of a context for transferability and the unique position of design research.

These tally with some of our questions on the basis for rigour while the dialogical platform can encourage transferable dissemination of research in the context of the interactions between people and things. The authors also call for more diverse dissemination platforms that could enhance the reach of a transferable design ontology and call for more consensus:

> "However, questioning around the relationship between the epistemology of design and science remains open and much debated. This is perhaps due to a lack of consensus on the epistemological and methodological frameworks that designers are using." (Durrant et al, 2015, p.9)

Through constructive design research Krogh and Koskinen (2020) propose 'drifting by intention' as part of the experiential approach and how knowledge can be understood through four belief systems. Drifting is explored though several PhD case studies and aims to begin closing the gap between Frayling's research through design (1993) and how it leads to knowledge production. It describes how drifting is viewed as an 'illegitimate practice or black art' by the methodic epistemic tradition that how it is viewed as needing regiment or elimination. Decision points or gates are identified as intervals to revaluate progress and trajectory. From a temporal point of view the emphasis is placed on drifting in the now, and how looseness in design research can facilitate new opportunities and highlight inconsistencies as creative opportunities or new routes to explore. They state that: 'Knowledge has to be robust to survive in conversation, but the aim is not to create knowledge claims that would survive years or even centuries.' and 'Design ideas have to survive in dialogue…' (Krogh & Koskinen, 2020, p.43). This highlights a useful property of transferability in having conversational robustness.

Building on this and in the context of arguing against the intention binding approach of the preregistration movement Gaver et al (2022) discuss practice-based design in the context of HCI identifying the tension between intention and emergence characterising practice-based design research as emergent concurring with Archer's wroughting and wrighting. Earlier work by Gaver (2012) agrees that design is generative and design theory unfalsifiable in opposition to the Popperian scientific tradition. There are other similarities, and a parallel in a discussion of Suchman's influence from ethnomethodology (Garfinkel, 1984; Suchman, 2007) in the way that agents produce and maintain ongoing activity rather than conforming to an underlying law. The ethnomethodological view aligns with an ongoing 'in action' exploration but misses the temporal relationships and futures concern.

Dixon concurs with Gaver, Krough & Koskinen, and Zimmermen in highlight the need to advance beyond the traditional criteria of reliability, validity, and objectivity '…with the potentially special approach to knowledge claiming in design, there is also the possibility that the evolution might take on a different form here too.' (2023, p.127)

An Ontological Mirror

Based on the need for flexibility and adaptability we propose transferability as the primary ontological quality of design thinking as the basis for an epistemological landscape that is fluid and dynamic. We extend the Glanvillian concept of translational knowledge applied to knowledge of into knowledge for (Glanville, 2005) via core practices of wroughting and wrighting (Archer, 1978). Transferability operates in new contexts and practices via wroughting and wrighting between knowledge of and knowledge for in a series of intertwined circular relationships (Fig. 1a). The diagram in Fig.1b captures both the transferability interface between knowledge of and knowledge for. From this perspective, the authors have positioned design as a future prospective domain of thinking in the context of abductive reasoning (Galdon and Hall,

2019). We exchange a degree of accuracy for access to future contexts that are partial. Therefore, our output is probabilistic, and research is always preliminary in its nature.

We also recognise earlier work by Lincoln & Guba (1985) seeking to substantiate qualitative research through in-depth evidence gathering and the generation of trustworthiness criteria of credibility, transferability, dependability, and conformability. Nowell et al (2017) state that the researcher cannot know all the sites their work may transfer into and that only recipients can judge this aspect. The context of this emergence of transferability as a criterion of trustworthiness emerges in naturalistic inquiry via anthropology and social sciences providing a useful framework to enhance trust, however it addresses questions related to knowledge of now, rather than knowledge for future transformation explored through design practices for tomorrows.

At this point we can ask some challenging questions. How can a form of knowledge which is always 'for' have the same confidence as traditionally constructed knowledge built on reproduced experiments? With this in mind, is transferable designerly knowledge created in a different form to that which we conventionally accept? Do the same rules apply to knowledge of as to apply to knowledge for? The proposition we put forwards indicates this is so and that there is scope to consider knowledge for future transformation as having different criteria as knowledge of. In this case how do we proceed? If we take Glanville's 'good enough is better than best' (2013), how do we know that transferable knowledge is good enough and how do we separate transferability from fantasy or speculation? What gives us the confidence to invest in a mode of thinking that we can support tackling complex future global issues? The answer potentially lies in the reciprocal nature of wroughting and wrighting and its circular ability to sense weak signals that feed back into continually amending the project at hand. In other words, prototyping. Design is always in a beta state.

If we accept this proposal that generates partial and subject to change knowledge, what reasoning can account for the potential reliability issues of transferability? Here we propose an ontological mirror (Fig. 1b) whose purpose is to position design as a reflection of the scientific domain. In this series of mirrored relationships, we see the collection of properties and their attributes. For example, 'Time: What ought to be' reasons 'Validation: a posteriori' and dependent on contextuality, determines 'transferability' as the mechanism while 'experimentation to reduce ambiguity and uncertainty' confirms futures trajectory.

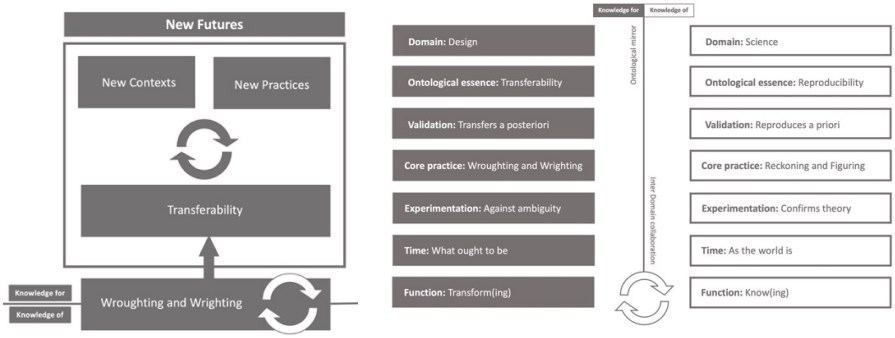

Figure 1a. *How core design practices lead to transferability.* ***1b*** *Ontological mirror comparing the design and science domains of thinking.*

We offer the idea that continued transference is a sign of reliability akin to, but at the same time opposite to continuing to successfully reproduce an experiment. Therefore, as noted earlier, flexibility and adaptability are essential properties of design. Deploying transferred design research becomes knowledge confirmation rather than the retesting of results. One of the key properties of transferability is its ability to be transmitted and scale. This is essential for a mode of thinking that considers what ought to be in the future and builds the capacities, networks and information flows necessary to arrive at preferred futures as depicted in the futures cone (Hancock & Bezold, 1992).

Rigour

Rigour as understood in the sciences means discipline, where discipline guarantees the faithful repeatability of an experiment. However, in design this notion can strangle a practice that is fundamentally constructive and demands the possibility of emergence (Gaver et al, 2022). The emergence of a method, technology, or system that can account for the new conditions of a context that is fluid, dynamic, ambiguous and uncertain, one which is never in balance, nor stable. While this condition remains in perpetual change, rigour transforms into the capacity to effectively transfer and scale. It creates a new form of reliability that supports abductive thinking and knowledge for future transformation.

As design knowledge (for) is determined by its impact which is conditional on levels of exchange a posteriori, we can only define rigour in the context of design as shown through: identification of impact on the recipient combined with a posteriori, flexibility within the design process and an understanding of the ability to translate knowledge into applications and systems in order to deliver impact.

Discussion

In beginning to answer our questions above ‘How can a form of knowledge which is always ‘for’ have the same confidence as traditionally constructed knowledge built on reproduced experiments?’ We reason that if continued reproducibility confirms a theory, then we can propose that continued transferability confirms bringing into being Simon’s ‘what ought to be’. The function of design is to transform; therefore, the only constant is change. In this context adaptability and flexibility leading to transferability becomes key. In this way we use the ontological mirror to reflect reproducibility as transferability.

Our second question ‘Fundamentally with this in mind - is this knowledge at all and if so - is this transferable designerly knowledge in a different form to that that we conventionally accept? This challenges the traditional concept of in situ knowledge as reason (the Greek tradition), observation (the Lockian scientific tradition), or more contemporary phenomenological notions (the Husserlian or Heideggerian tradition) revolving around subjective experience or recursiveness as a regressive view of rigour. Instead, it positions transformation as future confirmation. Here we integrate transferability into a collective unity giving design a trajectory by integrating time. This approach to rigour via a recontextualization of knowledge as guiding and probabilistic in nature enhances the move from subjective to abductive reasoning.

In answering our third question ‘Do the same rules apply to knowledge of as apply to knowledge for? We consider the nature and applicability of rules from one domain and invite the idea that they may instead be considered as oppositional pairs as described in the ontological mirror.

Finally, extensibility brings the notion of documentation; "Extensibility means that the design research has been described and documented in a way that the community can leverage the knowledge derived from the work" (Zimmerman, 2007, p8). The handover from extensibility becomes transferability, which is concerned with flexibility for adaptability.

Conclusions

We have explored a temporal narrative that brings to life design ontology as a future focussed mode of thinking continually delivering into designed futures. This has allowed the identification of transferability as the essence of a domain level practice. The critical role of recognising core design practices as wroughting and wrighting negotiates the dual role of interfaces and exchanges between design and the sciences and how design practices and contexts can be driven by transferability. By integrating complexity, uncertainty, ambiguity, and contextuality - which are indivisible in design practice - the potentials of transferability are established.

Our proposal of an ontological mirror has several purposes in answering the rigour issue where repeatability is irrelevant. Crucially the ontological mirror shows how rigour via repeatability takes on an inverse yet equal form in design practice for transferability in design as repeatability in the sciences. This leads us to propose knowledge into future transformation as the domain level epistemological activity and knowledge generation foundation for design thinking.

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