Beyond Application

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Upshot: I reinforce the idea of broad connections between cybernetics, design and science that become apparent when the messy processes implicit in each are reflected on more explicitly. In so doing, I treat design not as a field in which cybernetic ideas are to be applied, but one in which they are reflected on and pursued.

1. I wish to thank all the commentators for their stimulating contributions, which cover a range of ground that indicates the wide potential of the relation between cybernetics and design research to inform both fields. It is significant that many of the aspects raised by commenters are focused on core topics of cybernetic research: computing technology (**Mateus van Stralen; Christiane Herr**); cognition (**Andrea Jelić**); and, broadly, the relationship between research/theory and action/practice, which is a focus of **Herr** and **Michael Hohl**, and underlies the concerns of **Jose Cabral, Dai Griffiths** and **Tom Scholte**. As Karl Müller (2010) has noted, there is a need to focus on core topics in order to reinforce the coherence of radical constructivism (RC) and second-order cybernetics (SOC) as a research field. Müller's remarks could be taken as a call for a turn away from topics such as design that have been prominent in recent cybernetics. These commentaries, and the research to which they point, suggest that design may instead offer a focus in which a number of such core issues can be explored.

2. In this context, **Scholte's** introduction to the work of Ann and Lawrence Halprin may be valuable even beyond the project of connecting cybernetics-inspired discussions in design and theatre studies (see also **Scholte**'s target article in this issue). Building connections such as this would seem to be a way to help broaden the relationship of cybernetics with both design and theatre beyond one of application, releasing their potential to explore central cybernetic concerns through practice (cf. Müller 2010: 36f).

3. Of the commentaries, those of **Griffiths** and **Cabral** put forward the most explicit questions, and I therefore concentrate on these below. In line with my approach in the target article, I have attempted to remain focused primarily on how issues raised in design can contribute to questions in cybernetics.

Ill-defined problems

4. **Griffiths** (§8) suggests that the account of design that I have given applies to a particular subset of design, whereas at least some other areas of design deal with well-defined problems. Some design tasks or components of design tasks are, indeed, characterised by more constrained problems than others. Yet even apparently clear and familiar design tasks regularly involve incomplete criteria or contestable premises, and a clearly-defined goal is no guarantee of a well-defined problem (cf. **Griffiths** §6). This is because design is always concerned with the new (target article §8), which is the case

even when designers are not attempting to be especially innovative (that is, when we design a building, we are concerned with creating something new even when we stick to an established typology). This can be seen within the scope of the definition that **Griffiths** (§5) cites: the process of preparing a plan for constructing something is not solely a matter of setting out production information (the working drawings and specifications that will guide manufacture) but of devising what is proposed in these. This process involves forms of reflective, conversational activity whenever such a plan is considered in more than arbitrary terms (that is to say, when it is designed).

5. Take, for instance, some of the questions posed in the design of a new motorway (an example within the compass of engineering, and one to which Horst Rittel and Melvin Webber refer, Rittel & Webber 1973: 163). Different configurations of road junctions will be both better and worse according to different terms of reference. Even considering only the efficiency of traffic flow, there will be trade offs between congestion at different points in the road system. There are also many other relevant criteria, such as, for instance: safety, other road users, cost, construction sequencing, maintenance, noise pollution, air quality and impact on natural habitats. While these criteria are mostly easily recognisable, they are not all commensurable with each other, such that there is no one way to resolve definitively between them, nor is it possible to optimise against an overall goal without this being distorting. Further, the interactions between these different criteria and the limitations they set on each other in the specific situation that is at hand only become clear as particular solutions are developed, discussed and enacted. Taking a broader scope, one might also challenge the premises under which the project is advanced: having explored the likely consequences of the new motorway, we may take a different view on whether it is a worthwhile project and consider alternative options instead.

6. While such situations resist exhaustive analysis and conventional linear problem solving, designers deal with them as a matter of course and without regarding them as being problematic. In so doing, they develop and refine not just their design proposals but also the questions to which these proposals respond. Indeed, as Nigel Cross (2007: 100) points out, designers treat even well-formed problems as if they are ill-defined, an approach that has the benefits of testing the assumptions that are given at the outset and searching for new opportunities.

7. **Griffiths** (§6) gives two counter examples – those of scientific and musical instruments – where questions are very tightly constrained. Indeed, these situations are so constrained that they might well not be considered as instances of design activity in that they respond to a plan rather than create one. The musical instrument example, which is perhaps better understood in terms of craft, is closely related to the existing tradition of musical performance in which each instrument must be usable. These constraints can, however, be understood as a result of a wider design process, one where the configuration of the musical instrument has co-evolved slowly over several generations together with the traditions of musical performance to which they are related (this is comparable in architecture to the development of a vernacular tradition). The development of scientific instruments can be thought of, similarly, as blurring with

that of scientific experimentation itself, as is reflected in accounts of scientific practice (target article §10). What is learnt in experiments using the instruments generates new criteria for further experiments and so new or refined instruments. Thus we can think of this as one overall process, which we could characterise either in terms of science or design, encompassing scientific experimentation and the construction of the instruments that support this.

8. **Griffiths** (§8) asks the question of to what extent an SOC account of design can be convincing to those that do not share its epistemological position. I do not see this as a question of different design epistemologies but of different degrees of explicitness about the epistemology that is acted out in design, and different ways of making this explicit. What designers do in practice is not always what they describe themselves as doing, as discussed by **Herr** and **Hohl**. It is in retrospect that the paths taken seem clear and, as it is this clarity that is what designers need to communicate, the messy process by which this clarity is developed usually remains unremarked on. Making these sorts of processes explicit is a core concern of design research and something to which SOC can contribute. The purpose of this is not, as I see it, to reconfigure design practice in some specific way. Rather, articulating what would otherwise remain tacit helps maintain what is already special about design (including attitudes towards values, as raised by both **Herr** §2 and **Hohl** §§7f), something that can otherwise become lost.

9. This relation of SOC to design practice in terms of making the implicit explicit may, as **Griffiths** (§8) suggests, inform how SOC might be advanced more generally. Cybernetic processes are implicit in everyday life and, as with design, making these processes explicit reinforces what is special about them, which can otherwise become lost in the context of other concerns. Looked at in these terms, SOC's relation to practice is not limited to where its epistemological position is explicitly shared. It can enjoy a broad relation to practice in terms of implicitly cybernetic processes, while still contesting the ways in which particular practices are conventionally understood.

Material agency and viability

10. **Griffiths** points out tensions between RC and Andrew Pickering's (1995) account of material agency. As **Griffiths** (§11) notes, there is not necessarily a conflict here and it seems to me that such tensions can be defused, or at least sharpened to more precisely the points at issue.

11. This is supported by the case of design, which while constructivist in orientation is compatible with ideas of material agency, even if this was not emphasised in my account. This is both in terms of the media with which designers think and the technologies and industries with and in which they work:

- Media plays an active role in how designers work. It is important to how they deal with complexity (Gedenryd 1998), model the material and spatial (Sweeting 2011), and construct new possibilities (the process of sketching that Ranulph Glanville 2006, 2007 emphasises is one that needs to be embodied in media of some kind). This includes the digital technologies, as discussed by **van Stralen**,

as well as the more obvious materiality of the analogue. Accounts of the active role of instruments in science, such as that given by Pickering (1995), can be read as if referring to the design studio (target article §10).

- What is materially and technologically feasible is a crucial constraint on what designers propose. This is especially the case where designers try to use materials in forms to which they are particularly suited, as can be summarised by architect Louis Kahn's oft-quoted conversation with a brick – "You say to a brick, 'What do you want, brick?' And brick says to you, 'I like an arch.' And you say to brick, 'Look, I want one, too, but arches are expensive and I can use a concrete lintel.' And then you say: 'What do you think of that, brick?' Brick says: 'I like an arch'."[1] As well as this material-focused approach, material agency can be seen in the way that technological changes have transformed the nature of material constraints (discussed by **van Stralen** §§2, 4), and it remains an important factor even where design approaches are focused elsewhere.

12. The principle move in RC is to change the orientation of epistemology from a concern with how we know (or do not know) about any real world beyond our experience, to a focus on this experience itself. This relocates epistemology to the realm of experience, in which (our experience of) the material is important to include (as is evident in design). While, therefore, RC can be contrasted with the material where this is meant in the sense of the real, there is no conflict between RC and our material experience. Indeed, the latter can be encompassed in the notion of viability, which is central to Ernst von Glasersfeld's account. RC is not a licence for unconstrained construction. Von Glasersfeld (1990) gives the example of not being able to walk through a desk, and thus being unable to maintain a viable idea of the world that would allow him to do this. This is an example of a material condition in which we experience epistemological, not just practical, resistance.

13. Von Glasersfeld sometimes referred to viability in terms of "fit". In RC, this is in the sense of "fitting with" or evolutionary fit, and so perhaps better phrased in terms of the elimination of the unfit. There is no sense of correspondence to the real and much room for contradictory explanations to be viable in our experience at different times. This is not to be confused with the athlete's notion of fit, of an idea becoming fitter and fitter in the sense of a closer match to the goal of the real. In this latter view, while it may still be acknowledged that we do not have access to the real, our experience is claimed to be a good guide to it in any case because of the constraints that are imposed on it, thus returning to a correspondence view of epistemology. The main point at issue here is, as I see it, not about material agency per se but whether this is understood in terms of the real or in the realm of experience, and about how this is then put to work epistemologically.

[1] https://www.theguardian.com/artanddesign/2013/feb/26/louis-kahn-brick-whisperer-architect

14. Similarly to what I have said above regarding the relation between SOC and design, I think that RC is agile enough to engage with the material and the performative across the "whole range of scientific and design activities" (**Griffiths** §9), while also contesting what is at stake epistemologically in these. Indeed, RC can help provide the honesty that Glanville (2014) suggests will efface the differences between different research traditions (target article §14; and as expanded on by **Hohl**).

Designing systems

15. **Cabral**'s call for an increased focus on the systemic nature of objects is something that I support. The issue as I see it, and as **Cabral** (§3) points to, comes back to what, especially in architecture, is a surprising gulf between theories regarding how we understand, on the one hand, what is designed and, on the other, the process through which design occurs. Recent work has addressed this in part by seeing architecture in terms of its place within the building industry (Lloyd Thomas, Amhoff & Beech 2016). From the vantage point of SOC, there are further, more designerly opportunities for bridging between these areas. The work of **Jelić** is significant in this regard, establishing an account of architectural experience in commensurable terms to constructivist accounts of design practice. I have previously suggested there is potential in connecting conversational accounts of design with conversational accounts of architectural experience (Sweeting 2011), while in the context of the target article one can also understand particular examples such as the Fun Palace as being part of SOC enquiry not just resulting from it (**Cabral** §9; **Jelić** §4; Sweeting 2015a).

16. The building of such bridges does not, however, guarantee in what manner they will be crossed. In making the argument in the target article – that design is a form of SOC even where SOC is not explicitly referenced – it was important for me to refer to work in design beyond figures such as Cedric Price, Nicholas Negroponte and John Frazer, who were explicitly influenced by cybernetic ideas. My reference to Peter Eisenman is not therefore intended to validate his architecture but to point to the formal similarities between his work and second-order science (SOS) that are of interest whatever we think of his proposals. Indeed, the sort of critiques put forward by **Cabral** and others, such as that of Robin Evans (1985), may inform how SOS and SOC can be developed: as **Cabral** (§8) puts it, "it is not enough to be self-reflexive and simply engaged to explore the full potential of being an SOC observer". The question of how to design such systems is an open one, and a topic on which design research and cybernetics might collaborate.

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