REASSESSING RIGOUR, RE-CYCLING RESEARCH

Towards a Conversation on the Form of Enquiry

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Abstract. Circular causality, circular logic and subjectivity are rejected by many scientists while some designers regard them as keys to understanding the design process. With this paper I hope to stimulate a discussion about a largely unquestioned foundation of our field: the form of enquiry. Taking (as others before) this form to be circular, I examine the implications of and for research and education. Ideally, this discussion should inspire a new branch in our field: A philosophy of computer-aided design research.

Keywords. Control; design; science; logic; causality.

A year ago, I questioned (Fischer, 2008) an assumption underlying scientific[1] research *about* and *for* design (Frayling, 1993): the notion that designing as such is scientifically observable. Can one observe experimentally controlled designing, from an objective *locus observandi*? Can designing and its observation occur separately and independently? Focusing on two scientific criteria – objective observability of phenomena under investigation and rational explicitness of descriptions presented as underlying those phenomena – I introspectively suggested that one cannot observe designing by others and noted that my attempts to observe and describe my own designing overburden me. Some senior conference attendants apparently took my cautioning against pseudo-scientific portrayals of designerly action as a stance against science and expressed dissatisfaction with my non-scientific, self-observing mode of

1. Used here as it is upheld as a scholarly ideal: conventional natural science.

enquiry. One responded (in delicious self-defiance): "Don't make circular statements – circular statements can only affirm themselves!" Here I take this instruction as a point of departure from which I examine influences of linear (Western, modern) logic on computing, science, and education and question them based on a circular view of designerly processes. It has been suggested that taking circularity as necessarily vicious and avoiding it leads to misunderstanding understanding from the ground up (Heidegger in Winograd and Flores, 1986). The views of some of its proponents notwithstanding, science does not dismiss any kind of circularity categorically. "Earth revolves around the Sun" and "Animals consume O and produce CO_2 while plants consume CO_2 and produce O." are fixtures of contemporary scientific belief. They do not aim at affirming themselves but at describing circularity-involving phenomena that, in these cases thankfully, still affirm themselves. Science rejects the circular drawing of inferences from premises which already contain the conclusion (Engels, 1980: pp.54ff). Assuming that basic digital operations resemble neural operations, for example, and that therefore brains implement formal logic in the way computers do, is circular since digital electronics were modelled after descriptions of some observed nervous activity in terms of formal logic in the first place (McCulloch and Pitts, 1943). Science rejects and linearises circular causality. "Life on Earth is due to energy in the Sun" is accepted while "…and energy in the Sun is due to Life on Earth" is rejected. Following this pattern, "The thermostat controls the furnace" is accepted while "…and the furnace controls the thermostat" is unjustifiably ignored. Similarly, processes of designing are oftentimes described in terms of linear causality (following Shannon, 1948) while designers typically experience it as circularly causal: "I sketch this because of something I saw in my previous sketch, which I drew because of something in my preceding sketch etc." Or: "I say this because of what you said because of what I said etc." (Glanville, 2007). In education, "Needs and values of societies determine classroom activities" is accepted without much acknowledgment of classroom activities also determining needs and values of societies. Similar ignorance of circularity is found in computing where flow charts connect beginnings to ends of coded sequences, defying recursion and infinite loops (consider microcontrollers) and where waterfall models of software development fail to reflect processes of debugging and revision. Reasons for this selective ignorance are, I believe, twofold: On the one hand, it allows for, and helps justify, the maintenance of power relations in reward- (i.e. utility-) oriented hierarchies. On the other hand, it allows logic modelling which, in its conventional form, is inadequate to handle circularity. This is why science rejects circularity in its descriptions. Logic statements such as "A causes B" are accepted while "A causes B, B causes A" or just "A causes A" are rejected. While circularity of this kind can be observed (life

produces life, violence produces violence, etc.), its scientific consideration is rejected due to limitations of formal logic. Science itself, however, violates this rejection. Regarding the subject of its enquiry (Nature) as a closed (as in: shut off) system free of extra-natural causation, it explains natural phenomena strictly in terms of other natural phenomena. This leads to circularity amongst scientific descriptions. Mass, for example, is described in terms of matter next to descriptions of matter in terms of mass (see Bernhart, 1986). Science also rejects paradoxical statements such as "I am a liar". Working on the *Principia Mathematica*, Russell spent five years trying to accommodate paradox in logic only to end up declaring it illegal (Segal, 1986) in a move that is on the one hand designerly and on the other hand affirming the authority of the scientific doctrine. Designers, meanwhile, are ready to work on paradoxical grounds: "Less is more". The concept of linear time and, based on it, of linear causality, progress and the imperative of economic growth, are cultural choices to which alternatives are conceivable and available. Historically, the Western linearisation of what most other cultures regard as circular (Macy, 1991: p. 29) can be traced back to Aristotle's responses to the problems that occur when circular causality enters formal logic: The *unmoved mover* (blueprint for unaffected agency), subject-predicate form (blueprint for the distinction between tools and materials, programmes and data etc.) and syllogisms (major premise, minor premise: conclusion; blueprint for linearised process descriptions that acknowledge circular closure in awkward footnotes at best. See for example Dorst and Vermaas, 2008: p.18). The syllogistical portrayal of co-occurring events as connected by linear causality (questioned by Hume, see Shanks 1985) in effect re-affirms the disjunction between formal science and designing: Science describes phenomena descriptively in terms of *causae efficientis* ("because of") while designing aims at intentional change prescriptively in terms of *causae finalis* ("in order to"). Science offers correct conclusions while designing eliminates undesirable premises. Besides difficulties of formal logic Aristotle acknowledges circularity in the acquisition and development of practical knowledge. This is echoed in Schön's (1983) notion of reflective practice, the notion of research *through* design (Frayling's 1993 mode of design research that scientists find difficult to relate to) as well as in the description of scientific practice as an oscillation between normal and revolutionary phases (Kuhn, 1962) and as a process in which earlier choices and designs re-enter later ones (Weinberg, 1975). The ultimate instrument of observation and reasoning, the nervous system, is a closed (as in: containing loops) system that produces and processes more signals than it receives from its perceptive organs. Contrary to the notion of linear directedness of intentional action, the neural foundation of intentionality has been shown to be essentially circular (Freeman, 1999). It is not my objective to eliminate the scientific method from our field. Science

offers benefits where control, clarity, rationality, finite descriptions, organisational accountability and technical predictability are desired. Necessary and beneficial as these are, however, do we want these exclusively and everywhere? In a sea of irrationality, scientific logic is a life raft but in a desert of rationality I thirst for a drop of freedom-to-choose. Modern, Western(ised) life (including design research) is dominated by the benefits of science to the extent that they turn into penalties. The instruments of scientific enquiry, scientifically focused education and digital control, all modeled on linear logic, re-affirm linear logic. This results in the neglecting and rejection of values and options, the achievement and safeguarding of which have motivated scientific rationality in the first place. Unsustainable exploitation of natural resources, digital control of ever more aspects of personal life and thought, learners who are trained to consume instruction rather than to ask difficult questions, teachers who aim at little more than at rewarding the display (or punishing the absence) of expected, formally correct behaviour, inconclusive quarrels regarding scientific "truth" about climate change and the idea of "fixing" ecological, economical and social systems in the way watchmakers fix watches are only some consequences of the doctrine of rational control. Of the few options we have in tackling these, designerly enquiry, education for critical thinking and digitally afforded sustainability seem to be the amongst the more promising. No other field of academic research combines our grasp of human needs, designing, education, computing *and* science. This should put us in a critical position as we face the choice between being part of the problem and being part of the solution. This is the background against which at least a part of our field should position and evaluate itself. The questioning of unquestioned assumptions and the willingness to take on board an open-minded discourse on our philosophical foundations are first steps. Before we brush circularity and designerly rigour aside in favour of scientific rigour, let us consider how people and their cultures bring about artefacts and environments while artefacts and environments bring about peoples' cultures. Let us consider how design challenges and design outcomes are sought and made together, begging each other. Let us consider the iterative social processes that shape scientific discourse and creative innovation. Let us consider how we design tools using tools. Let us consider how designing and learning leave traces in us that change us and enter into subsequent designing and learning (defeating the scientific criterion of reproducibility!). Let us consider how researching designing is human enquiry into human enquiry: We are looking at ourselves and each other looking at ourselves and each other. Let us realise that we are places at which the universe looks at itself. Then let us ask ourselves whether we want to measure what we experience by the standard of scientific logic or whether we want to measure scientific logic by the standard of what we experience.

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References

Bernhart, R.K.: 1986, *Dictionary of Science*. Hammond, Maplewood.

Dorst, K. and Vermaas, P.E.: 2005: John Gero's function-behaviour-structure model of desiging: a critical analysis, *Research in Engineering Design* **16**, 17–26.

Engel, S.M.: 1980, *Analyzing Informal Fallacies*, Prentice Hall, Englewood Cliffs.

Fischer, T.: 2008, Obstructed magic, *in* Nakpan, W. et al. (eds), *CAADRIA Proc*. Pimniyom Press, Chiang Mai, pp. 278–284.

Frayling, C.: 1993, Research in art and design, *RCA Research Papers* **1**(1), 1–5.

Freeman, W.: 1999, Consciousness, intentionality and causality, *J. Concs. Stud.* **6**, 143–172.

Glanville, R.: 2007: Grounding difference, *in* A. Müller and K.H. Müller (eds), *An Unfinished Revolution?* Edition Echoraum, Vienna, pp. 361–406.

Kuhn, T.: 1962, *The Structure of Scientific Revolutions*. U of Chicago Press, Chicago.

Macy, J.: 1991, *Mutual Causality in Buddhism and General Sys Theory*. SUNYP, Albany.

McCulloch, W. and Pitts,W.: 1943, A logical calculus of the ideas immanent in nervous activity. *Bulletin of Mathematical Biophysics* **5**, 115–133.

Shanks, D.R.: 1985, Hume on perception and causality, *Hume Studies* **11**(1), 94–108.

Schön, D.A.: 1983, *The Reflective Practitioner*. London, Temple Smith.

Segal, L: 1986, *The Dream of Reality*. W. W. Norton & Co, New York.

Shannon, C.E.: 1948, Math. theory of comm. *Bell Sys. Tech. Jour.* **27**, 379–423, 623–656.

Winograd, T. and Flores, F.: 1986, *Understanding Computers and Cognition. A New Foundation for Design*, Addison Wesley, Reading.

Weinberg, G.M.: 1975, The simplification of science and the science of simplification *in* Weinberg, G.M.: *Introduction To General Systems Thinking*, Wiley, New York, pp. 501–505.