« 10 » The following summarizes the preceding line of reasoning as a series of propositions in support of an argument:

- *Contra* Alrøe and Noe, "wicked problems" are not artefacts of the narrowness of scientific paradigms vis-à-vis real world problems, which requires state intervention for the problems to be treated adequately.
- On the contrary, what makes such Alrøe and Noe's problems "wicked" is that they reawaken the sciences' totalizing impulse – a legacy of their philosophical origins – which then leads to conflicting cross-disciplinary claims, on the basis of which the state must intervene.
- The emergence of this state-of-affairs is understandable against the backdrop of a systems-theoretic conception of "open systems." It amounts to a spontaneous generation of second-order perspectives in the process of system boundary extension.
- Moreover, to simplify matters, the state's legitimacy is granted – perhaps grudgingly – as a fair arbiter of these contesting second-order perspectival claims.
- However, science and technology studies, especially Latour's work, offers an alternative take on what such a resolution might look like. Instead of one or more sciences colonizing a previously "undisciplined" domain, solutions to wicked problems may end up forcing the sciences to cede some of their epistemic authority in exchange for stabilizing their position in society at large.
- In light of this alternative resolution of wicked problems, the sciences are then forced to redefine themselves as either systems or networks. The more that science agrees to the network-based self-understanding, the greater science's struggle to define its own epistemic distinctiveness (aka system boundary) in society.

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What is "Science"? For What Do We Need a "Polyocular Framework"?

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> Upshot • Alrøe and Noe are right in addressing Rittel and Webber's notion of "wicked problems" as crucial for interdisciplinary research. However, I cannot see that they are providing a sufficiently clear understanding of "science" in their concept of a "second-order science of interdisciplinary research," nor that their "polyocular framework" can contribute anything useful to addressing the practical challenges posed by wicked problems.

« 1 » When Horst Rittel and Melvin Webber introduced the extraordinarily influential concept of "wicked problems" in 1973, they already indicated that one of the most important features of these problems is that they can be described from a multitude of different perspectives. The first of the ten defining characteristics of a wicked problem is, according to them: "There is no definitive formulation of a wicked problem" (Rittel & Webber 1973: 161). Instead, there is a multitude of possible ways to describe a wicked problem or to formulate what the problem is. The reason they provide for this feature of wicked problems is that "every specification of the problem is a specification of the direction in which a treatment is considered." They illustrate what they conceive as the identity of problem formulation and envisioning of a solution by referring to poverty as a wicked problem:

> "Does poverty mean low income? Yes, in part. But what are the determinants of low income? Is it deficiency of the national and regional economies, or is it deficiencies of cognitive and occupational skills within the labor force? If the latter, the problem statement and the problem 'solution' must encompass the educational processes. But, then, where within the educational system does the real problem lie? What then might it mean to 'improve the educational system'? Or does the poverty problem reside in deficient physical and mental health? If so, we must add those etiologies to our information package, and search inside the health services for a plausible cause. Does it include cultural deprivation? spatial dislocation? problems of ego identity? deficient political and social skills? – and so on. If we can formulate the problem by tracing it to some sorts of sources – such that we can say, 'Aha! That's the locus of the difficulty,' i.e., those are the root causes of the differences between the 'is' and the 'ought to be' conditions – then we have thereby also formulated a solution. To find the problem is thus the same thing as finding the solution; the problem can't be defined until the solution has been found." (Rittel & Webber 1973: 161)

« 2 » Since wicked problems allow a multitude of different approaches that might contribute to their solution, the identity of problem formulation and of conceiving a solution implies that there will be a multitude of possible problem formulations.

« 3 » Thus, it seems to be clear that Rittel and Webber already have in mind what Hugo Alrøe and Egon Noe call in the target article a "polyocular framework for wicked problems," even though they do not use the term (nor something more colloquial such as "multi-perspectival"). This becomes visible in the fact that Rittel and Webber wrote, in 1973, that wicked problems should be approached…

> "based on a model of planning as an argumentative process in the course of which an image of the problem and of the solution emerges gradually among the participants, as a product of incessant judgment, subjected to critical argument." (Rittel & Webber 1973: 162)

« 4 » Alrøe and Noe do an excellent job of connecting the idea of the insufficiency of particular perspectives with Ronald Giere's "scientific perspectivism" and related discussions in philosophy of science. However, their most original contribution to perspectivity in general and research on interdisciplinarity in particular seems to be their claim that we need what they call a "second-order science of interdisciplinary research." Now, even though I agree with much in the article, I see two major problems that deserve, I think, further consideration.

« 5 » First, I am struggling to get an appropriate understanding of what this

"second-order science of interdisciplinary research" exactly is. Why is this supposed to be a "science"? Is it a "science" in the sense of an institution, as indicated by describing the "second-order scientific perspective" as an "autopoietic social system" with "its own organization" (§45)? Should there be departments of "second-order science of interdisciplinary research," corresponding science organizations with journals, and so on? Or at least a clearly identifiable, interdisciplinary research community as we find, for example, in the newly developed "Science of Team Science" (Börner et al. 2010)? Or is an institutional approach to "science" misleading, and should it be replaced by an understanding of science as a corpus of knowledge? I would be perfectly happy with a second-order "approach" to the problem of perspectivity, but I do not know what it means to discuss this as a "science." An "approach" would shift the focus from institutions and bodies of knowledge to a specific method – a "way," as the Greek *met-hodos* indicates, to deal with the problem that no particular perspective is sufficient to deal adequately with wicked problems.

« 6 » Even though a second-order "approach" to interdisciplinarity would indicate that wicked problems require us somehow to overcome the limitations of first-order, disciplinary perspectives, it still does not tell us what that exactly means. It seems to be clear that an answer to this question requires the formulation of fulfillment conditions. We need to know what it takes to distinguish a second-order approach from any other approach that tries to overcome first-order limitations. For example, do we already have second-order science of interdisciplinarity when we – trained in a specific but limited discipline – try to learn the language of another discipline? Do we have second-order science of interdisciplinarity when we conceive the wicked problem as a "boundary object" in the sense of Star & Griesemer (1989) that we approach by the disciplinary means that are available to us, and that we then simply send over to the experts of another discipline, hoping that the overall process will make sense even if we are not able to see it? Or does the characterization of "second-order science" require some sort of integration of a multitude of different perspectives?

« 7 » This last question leads directly to my second, more important problem. What exactly can be achieved by the proposed "polyocular framework"? For what can it be used?

« 8 » Alrøe and Noe provide the following definition (§17):

> "The term 'polyocular' has been constructed in analogy with binocular and monocular (Maruyama 1974), and here 'ocular' is used in nearly the same sense as perspective, but with a built-in social systems theoretical meaning in the form of the 'blind spot' of an eye (Latin: *oculus*)."

Thus, given that the Greek *polus* means "many," "polyocular" seems to stand for "multiperspectival, but in a way that each particular perspective leaves a blind spot." I hope this is indeed the intended definition. But what can we do with such a "polyocular framework"? How can it help us to cope with wicked problems?

« 9 » Unfortunately, I cannot see that this concept contributes anything to the very concrete challenge that is posed by wicked problems. The reason for this frustration of my expectation is that Alrøe and Noe's "three pivotal phases of a polyocular research project" as they are outlined in Table 1 of the target article (§58) only lead – on the level of interdisciplinarity – to what they call "polyocular understanding," a term that is somewhat further illuminated by the phrase "addressing the plethora of solutions." What does it mean to "address" a plethora of solutions? The elaboration of this phrase in §66 does not contribute much to a better understanding:

> "The third phase of polyocular research addresses the plethora of solutions offered by the perspectives involved. Polyocular understanding – the multidimensional space of understanding that can be established through polyocular observation and communication of the perspectival observations in Phase 2 – forms the basis for a shared or coordinated effort to instigating change and transformation."

« 10 » Already Rittel and Webber made clear in their seminal paper that the many perspectives from which a wicked problem can be observed need to be addressed. But the crucial question is obviously not that many perspectives should be addressed, *but how a shared, coordinated, or integrated perspective can be achieved.* Rittel and Webber themselves suggested, as quoted above in §3, an "argumentative process" in which a solution might emerge "gradually." This is an approach to solving wicked problems by integrating a multitude of perspectives in practice, an approach that I developed further in my own work (Hoffmann & Borenstein 2014).

« 11 » There are some indications – even though, again, not clearly enough articulated – that Alrøe and Noe seem to assume that such a shared, coordinated, or integrated perspective is, first, not possible and should, second, not even be attempted. At one point (§12) they write – without saying explicitly whether this is their position or just the one that results from the position discussed in this context: "different scientific perspectives see complex matters differently, and these differences cannot, and should not, be merged." If this is indeed true, why should we engage in any polyocular research project? If first-order perspectives can never be merged, how should we ever be able to cope with wicked problems? We can talk forever about the multitude of perspectives that come into play when we want to build a highway – an example used by Rittel and Webber. But at the end of the day there needs to be a decision: should it be built or not? Wicked problems are not important because they can be addressed forever, but because they need a decision, and because any decision seems to be impossible to justify. All this makes me sceptical about how Alrøe and Noe's "polyocular framework" could help to make good decisions when facing wicked problems.

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