Opening the black box of organizations in Science and Technology Studies: What STS can learn from pragmatist organizational theory and processual sociology

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(Chapter in edited volume *Sociology and Pragmatism: Renewing the Conversation*, eds. Neil Gross, Christopher Winship, and Isaac Reed)

In this chapter, I argue that one of the persistent theoretical omissions in STS—a lack of substantive theorizing on formal organizations (Vaughan 1999)—can be serviceably addressed by incorporating recent insights from pragmatist organizational theory and transactional approaches to processual sociology.

For decades, STS regarded studies of formal organizations as dependent upon reifying the "social" in ways that lead to artificial separation of human affairs from their environment. STS has only recently approached organizational phenomena since reconciling these concerns through theories that take a relational approach to conceptualizing organizational boundaries.

Dominant relational approaches in sociology (field theory) and STS (actor-network theory) have directed our attention to processes that enable the production and stabilization of networks that maintain formal organizations and their environments. Field theory draws our attention to ways actors mobilize resources to move strategically through environments comprising many social arenas with different rules for action. ANT has shown the importance of considering non-human agents as active rather than passive components of scientific and technological production. Actors must manipulate non-human "actants" to serve certain purposes, and these actants may resist such efforts to be enrolled in humans' efforts.

Though productive for STS, both field theory and ANT are primarily topographical—that is, they depict relationships spatially and flatten the depth of power relations to fit onto this correlational grid. They also tend toward reductivism, defining relations from the perspectives of dyadic ties between many nodes that can be aggregated up to capture the meso-level. I argue, using Martin's (2015) terminology, that this limits the extent to which field theory or ANT can imagine actors as inhabiting a "world" wherein minds can act self-consciously, procedurally, or collectively to complex sociomaterial environments whose affordances can be approached from various points of focus. This understanding of "world" suggests revisions that integrate Mead's social psychology as well as insights from contemporary cognitive science into social worlds theory as it is currently applied in STS.

Field theory and ANT are complicated rather than complex theories (Miller and Page 2007) in that they focus on decomposable rather than emergent or supervenient meso-level processes. Pragmatism, I argue with Whitford and Zirpoli (2014), Cohen (2007), and Simpson (2009), offers conceptual advantages by providing a theory that sensitizes the sociologist to the

following emergent meso-level phenomena that impinge upon organizational action and decision-making:

Iterative social learning processes: The pragmatist approach to social learning is exemplified in the concept of "double-loop learning", which acknowledges that problem-solving can involve multiple complex feedback loops (Argyris and Schon 1978). Double loop learning entails acting in the environment to change both habit and environment in ways that affect future inquiry. Given a long enough temporal span, we can follow organizations through successive iterations of learning to better grasp the complex and non-linear processes that remake the boundaries of organizations in the context of routine practices (Whitford and Zirpoli 2014). Maintaining a focus on formal organizations rather than diffuse networks or fields allows us to better analyze how situated actors can iteratively or recursively leverage local structures, rules, and politics to redefine situations in ways that impact the "multi-group, extra-local learning processes" (Valentine 2017) characteristic of technoscientific policy and practice.

Collective intelligence: Following from an emphasis on social learning processes, pragmatist organizational theory draws our attention to moments where collective intelligence or distributed cognition are instrumental to action (e.g. Alač and Hutchins 2004; Stark 2009). A pragmatist focus on distributed cognition can highlight processes wherein innovation is transactional rather than interactional—that is, genuinely emergent from collective exchange in the environment as opposed to cumulative from interactions among atomistic agents and actants. I specify how Mead (1932; 1934; 1938) and Dewey (with Bentley 1949) offer the theoretical basis for a transactional approach to these meso-level orders.

Scaffolding and encoding: Pragmatist organizational theory has made significant theoretical progress on the concept of scaffolding, which Orlikowski (2006) has shown through practice theory to be useful for analyzing local configurations between humans and technologies that allow for work to proceed according to orders negotiated in practice. Recent work has shown how important scaffolding has been for maintaining order in complex and heterogeneous work settings characteristic of high-tech innovation firms and team-based clinical units in large biomedical research facilities (Rossi et al. 2010; Valentine and Endmondson 2014). Building upon the previous two propositions, and drawing from Abbott's (2016) concept of encoding, a pragmatist approach to organizational theory can show how iterative moments of collective problem-solving produce orders that become integrated into wider technological, categorical, and material infrastructures over time (Bowker and Star 2000).

I offer an application of these theories in a review of my empirical work on HPV vaccine innovation at the National Cancer Institute, illustrating how vaccine technologies were outcomes of iterative social learning process that emerged from collective settings situated in laboratory and administrative routines. I show how the scaffolding NCI scientists erected to proceed with vaccine innovation allowed them to develop understandings of their actions as examples of "translational research". Over time, these collectives' evolving interpretations of vaccines-as-translation were encoded into policies and practices that would establish the material infrastructure for translational research in the US, reaching far beyond the boundaries of the NCI as an organization.

I conclude by noting that much of the cutting-edge theorizing in organization studies has been informed by boundary-pushing work in STS. As such, all three of these areas—sociology, organization studies, and STS—can benefit from ensuring that our inquiries are sensitive to the complexities formal organizations introduce into science and technology, and vice versa.