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A Critical Analysis of the Concept of Resilience Skills From an Enactivist Perspective

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ABSTRACT

This paper offers a critical analysis of the concept of professional skill and cognition as it is conceived in the field of resilience engineering which is concerned with understanding how adaptive capacity is configured in complex sociotechnical systems. It is argued that the current disembodied and representationalist approach, separating thinking from acting, cannot accommodate resilience understood as adaptive capacity. Instead, an enactivist approach, emphasizing the constitutive coupling between embodied action and environment, is suggested as an ontological basis for research on resilience and adaptability in work.

Keywords: Resilience, Enactivism, Embodied cognition, Professional skill

INTRODUCTION

Resilience engineering (RE) is often described as an alternative approach to safety management emphasizing the ability of organizations and professionals to cope with complexity and disruption rather than to follow rules and procedures (Bergström et al. 2015; Hollnagel et al. 2006; Patriarca et al. 2018; Righi et al. 2015). Safety, on this account, does not result from merely avoiding known hazards but depends on a capacity to handle unexpected events and manage variability in performance that emerge from the dynamic interactions between sociotechnical systems and their changing environments (Bergström and Dekker 2014). The definitions of resilience are many but often circle around the concept of adaptability as seen in some of the most cited formulations: "resilience, as a form of adaptive capacity, is a system's potential for adaptive action in the future when information varies, conditions change, or new kinds of events occur, any of which challenge the viability of previous adaptations, models, or assumptions" (Woods 2009). Resilience, in other words, is all about being cognitively coupled and attuned to the contingencies, or uniqueness, of a situation in order to anticipate and respond to it in adequate ways. However, as will be argued in this paper, the conceptualization of cognition and professional skills underlying most research in RE precludes our understanding of resilience as situational adaptive capacity.

Resilience and Emergent Properties

The need for operational resilience is often justified by the concepts of emergence and complexity attributed to sociotechnical systems and their environment (Bergström et al. 2015). In an essay on emergence, complexity and resilience, Pariès (2006) argues that certain physical, biological, psychological and social properties of the world, including societies, economies, ecosystems, organizations, consciousness, and life itself, cannot be reductively explained because of their underlying complexity: "Now, if one tried to generate an explanation of my waking-up, from the properties of the atoms composing my body, the challenge might well be simply insuperable. Only a living being can wake up. No atoms of my body are living, yet I am living" (Pariès 2006: 45). What follows from this understanding of emergence, as something more than the sum of a system's parts, is that resilience in a sociotechnical system cannot be measured or modeled by listing the system's components and functions since no emergent property can be derived from such an inventory, which is what the Functional Resonance Analysis Method (FRAM) aims to do. Another interesting implication of Pariès (2006) example is that a system's emergent properties cannot be centrally controlled by internal representations of the system's environmental interactions nor does the existence of the properties depend on internal models or representations of the system and its environment. If, for instance, a system's adaptive capacity is an emergent property, resulting from the dynamical interaction between humans, technologies and environments then "no 'process representation', no understanding of the collective goal, no grasp on the conditions for collective efficiency is needed at the individual agent level" (Pariès 2006: 50).

What is needed at the individual and team level, as proposed in this paper, is skillful coping and embodied know-how enacted by experienced practitioners responding to affordances in an environment to which they are constitutively coupled. From this enactivist understanding of cognition, minds do not represent the world in order for humans to act successfully in it since cognition and embodied actions always already presuppose being-in-the-world (Thompson 2007). Hence, skilled coping and adaptive capacity does not require representation for it to be successful (Dreyfus 2014). Yet, researchers in RE seem to suffer from what Varela et al. (1991) called a "cartesian anxiety" in that they tend to assume a dualism between system and environment (and cognition and action) and hence invoke models and representations as necessary structures to bridge the gap they have created and to accommodate resilience (and intelligence/knowledge) in systems.

Wachs et al. (2016: 228) argue for instance that resilience skills are emergent which they think "conveys the idea that interactions between agents 'set the stage' for resilient performance, which cannot be developed and deployed in a fully controlled manner" and that "the key property of RSs (i.e. resilience) is not found in any of the interacting elements, thus being a novel property arising from interactions". However, in the next sentence the authors state that "while it is intuitive that RSs arise from interactions, there is no framework for tracking the factors intervening in these interactions neither for analyzing how these can be influenced". Hence, while acknowledging that

"emergent phenomena arise from the interactions among several variables, and [that] they have unique properties that are not found in any of the interacting variables" they also aim, inconsistently, to map and influence the factors which they claim contribute to the development of these properties.

Resilience Skills: From Mental Modeling to Situated and Embodied Performance

Most studies on resilience training attempt to model the components of resilient systems and spend a lot of ink on arranging and listing categories of generic labels allegedly referring to various necessary skills as forming a part of such systems. A wide variety of categories of resilience skills have been proposed and exemplified in the literature. So much so that the concept has come to mean any "individual and team skills of any type necessary to adjust performance" (Saurin et al. 2014). Definitions and examples of resilience skills are often formulated from a normative and rationalist goal-oriented perspective; whatever ability that theoretically or empirically (in a particular case study) contributes to handling disruption is potentially counted as an important skill (Bergström et al. 2015). Wachs et al. (2012) attempt, for instance, to redefine and operationalize non-technical skill from a resilience perspective but end up listing procedure-like rules of how to deal with predefined situations (for instance, "plan and to check the equipment and materials that are necessary to undertake the task"). Wahl et al. (2020) associate resilience skill with "(1) the ability to recognize anomalies and solve problems in a flexible manner, (2) the ability to define limits of action through shared knowledge with peers, and (3) the ability to operate the system with confidence". Son et al. (2020) performed a literature review and identified collective sensemaking (understood as "creating a 'common operating picture" through information management), team decision making (where system-wide information sharing is seen as the most important precursor), interaction and coordination (to brief and debrief on incident information) as important features of resilience in emergency management. Wachs and Saurin (2018) see resilience skill as one type of "resource for action" on a par with procedures and other "social, material and cognitive" components in a joint cognitive system that "provide useful information to support operators in conducting a reasonable course of action to achieve a goal". Bergström et al. (2010) and Gomes et al. (2014) focus on coordination and control in team performance as an essential skill in resilience while some authors link resilience with the human ability to improvise (Lundberg and Rankin, 2013; Rankin et al. 2013). Wachs et al. (2016) argues that a commonality between these concepts of resilience skill is "the use of the individual or team as the unit of analysis, and their concern with performance for dealing with unexpected situations".

Common epistemological and ontological assumptions in how resilience skills are conceptualized in RE include objectivism, disembodiment and representationalism. These assumptions stem from the classical functionalist and dualist information processing paradigm in cognitive science (albeit applied at a purportedly higher organizational level including artifacts and joint cognitive systems in RE). This means that resilience engineering does not

differ from the traditional disembodied and objectivist approach in human factors that many in the resilience and cognitive systems engineering community try to contrast themselves against (Bergström and Dekker 2014; Wachs et al. 2012). More specifically, the paradigm of mental representation plays a major role in both traditional human factors and the literature on resilience and is often expressed as a prerequisite for adaptability. This is for instance seen in Bergström et al. (2011b: 3) who, citing Hutchins, argue that from "the approach of analysing cognition as distributed, the focus shifts from the human as an information-processor to the work in which the human engage together with other team players as people (spread over hierarchical boundaries) and technological systems". Extending the cognitive (information) process to the environment and maintaining the functionalist approach of control does little, however, in abandoning the old cartesian disembodied approach. Bergström et al. (2011b: 5) acknowledge the importance of the production of meaning as a social and experiential process ("in complex systems an observer cannot measure behaviors or errors, because each behavior and error is a construction made by the observer herself") and the pragmatist insight that "the interaction context offers guidance for the action at the same time as it is constructed by the action carried out". However, these insights are absent when expanding on their account where they emphasize "control of information flow" "constant monitoring" "information sharing strategies", instead (Bergström, et al. 2011a; Bergström et al. 2010).

Although resilience is often framed as "something a system or an organisation does, rather than something a system or an organisation has" (Hollnagel et al. 2006: 347) when actually described it is often phrased in terms of *having* knowledge and *representing* the environment and its own performance in order to anticipate and respond adequately. A much-cited characterization of resilience, formulated by Hollnagel, which many researchers in resilience engineering follow emphasizes four "essential abilities": knowing what to do and how to respond to disturbances, knowing what to look for and how to monitor the environment and its own performance, knowing what to expect and how to anticipate development of events, and finally, knowing what has happened and learn from experience. While this definition is open for embodied and situated approaches, most associate it with traditional human factors notions like "monitoring" (Morel et al. 2008: 3) and "mutual situation awareness" (Gomes et al. 2014) which introduces an unnecessary ontological gap between cognition, action and context.

Bergström et al. (2009) argue for instance that over-reliance on fixed roles and procedures impedes resilience but think that generic (non-domain specific) competencies are needed to handle escalating situations (Bergström et al. 2011). These generic skills include, according to the authors, information management, communication and coordination, decision making and effect control. It is, however, peculiar to maintain that general knowledge could solely guide action in situations that, by definition, are idiosyncratic, dynamic and situation specific (event-driven), as implied by the notions of adaptive capacity in complex situations (Suchman 2007). Generic competencies suffer from the problem that they are not, by conceptual implication, situated

and thus insufficient for adaptation. It is conceptually incoherent to characterize a competence as *generic* that, by stipulation, consist in acting based on a dynamical interaction with a unique situation and its contingencies. Indeed, in a simulation experiment conducted by the same authors, the set of generic competencies, now identified in the actual performance of participants, were described, for instance, as "redistribution of task based on situation", "quick reaction to contingencies" or "dynamically adjusting strategies". Notwithstanding their own labeling of these skills, nothing could be less generic and more situated than the situated actions and competencies described by (Bergström et al. 2011; Bergström et al. 2009).

Since most research in resilience engineering build on Hollnagel's and Woods' theoretical work it is worth examining some of their ontological assumptions. Knowing, in Hollnagel and Woods (2006) understanding, is an "encapsulated experience" in the form of a "model of the world". This is, according to Hollnagel and Woods (2006: 349) "obviously important both for knowing what to expect (anticipation) and for knowing what to look for or where to focus next (attention, perception)". They think that "it is almost trivial to say that we need a model… A model helps us to determine which information to look for and brings some kind of order into chaos by providing the means by which relationships can be explained…provides an explanation or brings about an understanding of an event such that effective mitigating actions can be devised" (Hollnagel and Woods 2006: 352). This representationalist approach to cognition, following from the cartesian dualism between the mind and the world adopted by Hollnagel and Woods, also leads to a perspective on learning which is reduced to mean "model updates": "the surprise event challenges the model and triggers learning and model revision—a kind of model surprise" (Woods, 2015, p. 6).

The Alternative Enactivist Ontology of Resilience Skills

Enactivism is a particular conception of embodied cognition which grew out of a rejection of classical functionalist information-processing cognitive science (Gallagher 2017; Thompson 2007; Varela et al. 1991). The heart of enactivism is the idea that all cognitive systems enact, or bring forth, the word in which they exist, and that reality is not pregiven but co-constructed by the organism. This view rejects the notion of mental modeling/representation and the separation between system and world (Dreyfus 2014). From an enactivist perspective, anticipation, response, monitoring and learning are only possible by a deep (constitutive) co-embeddedness of cognition, the lived body and the material and social environment. Like resilience, enactivism is grounded in dynamical systems theory, but in contrast to the former it also has a strong impulse from phenomenology and thus acknowledges lived human experience (Gallagher and Zahavi, 2008). The emphasis on lived experience accounts for the fact that resilience, or adaptability, requires expertise and skill which is grounded in previous know-how or *phronesis* (Kinsella and Pitman 2012). Being an expert or skilled in a particular domain partly means that one is able to anticipate and adapt one's actions to perturbations or disruptions that fall within one's experiential domain of expertise or behavioral

repertoire. Morel et al. (2008) asserted for instance that "craftspeople are very resilient because they rely on a high level of adaptability, based on the actors' expertise, linked to an exposure to frequent and considerable risk". This conception of skill is also what makes training a meaningful activity. Anticipation and adaptability is, moreover, dependent on, or structured by, professional vision (Goodwin 1994) and the perceived affordances (Gibson 1977) in the environment.

CONCLUSION

Although framed primarily as a sociotechnical systems property, most studies on resilience focus on the sharp-end (Bergström et al. 2015; Righi et al. 2015) and claim that "skills will often be the last line of defense, especially during unexpected situations" (Saurin et al. 2014). This paper has been concerned with how professional skills are conceptualized in RE and proposes an alternative enactivist framework for understanding adaptive capacity. Many studies in RE reify professional skills, conceiving of them as immutable and fixed disembodied objects or tools that can be studied, modeled, manipulated (redesigned) and applied with the methods of engineering. The assumption that skills of experts and professionals are ontologically separated from the world in which they are formed is significative of the resilience engineering approach. However, since adaptive capacity in any cognitive system cannot be achieved by representations of the world, as the history if cognitive science, AI and robotics has shown us (Clark 2001), the disembodied and objectivist perspective imposes severe restrictions on our understanding of how resilience is or can be enacted in organizations and leads us astray in formulating a sound account of how resilience can be trained. Thus, the paper has identified and argued for the need to abandon the cartesian representationalist approach that is fundamentally misplaced in the study of adaptive capacity and professional skill. Successful adaptations to unanticipated events in complex situations require deeply embodied skills. The task for the research to come on resilience is to elaborate on the enactivist implications for training and organization.

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