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Safety is a major challenge in high-risk organizations, which are characterized by a critical vulnerability to specific hazards, combined with the likelihood and probability of them occurring. Hollnagel (2014) proposed a compelling distinction between two paradigms in safety science that he called *Safety I* and *Safety II*. *Safety I* pertains to *defense*. It focuses on what goes wrong, attempting to eliminate failures, considering safety as a non-event, establishing material or organizational barriers, and “trapping safety into rules” (Bieder & Bourrier, 2013). *Safety II* pertains to *resilience*. It differs from *Safety I* in that it gives priority to what goes right, focusing on the ability to succeed under various conditions, treating failures as situated cases, and considering safety as embedded in everyday work practices. As such, resilience is viewed as the ability of the organization to adjust its functioning prior to, during, and/or following a shock or disturbance, so that this system can sustain required operations under both expected *and* unexpected conditions (Hollnagel, 2014).

Safety and organizational research indicates that fostering resilience in organizations is a promising way for improving safety, albeit concrete means to implement resilience are still lacking, especially in the educational field. As a matter of fact, most safety-related training programs are *Safety I*-oriented in that they consist of direct instruction of expected behaviors and procedures. However, training to address *Safety II* principles seems to be lacking. Thus, the purpose of this paper is to propose robust principles for the design of *Safety II* training. These principles are grounded in an enactive approach of activity and training. They are derived from past and current studies that we conduct in high-risk organizations (medical care, nuclear power plant, terrorist attack response, and high pressure gas storage).

### **An enactive approach of activity and training**

Our studies are conducted within an *enactive approach of activity* based on two main theoretical assumptions (Maturana & Varela, 1980):

- Human activity is conceptualized as an autonomous system proceeding from a global structural coupling between the actors and their environment (i.e. the environment is not independent of the actor and it does not preexist to the actor: it is *enacted* by the actor);
- This structural coupling is asymmetrical (i.e. meaning is not “available” in the environment: it *emerges* depending on what the actor experiences as relevant in the situation).

These *enactive* assumptions lead to:

- Exploring nonlinear dynamical system theory constructs and methods for exploring and improving resilience (self-organization, emergence, degrees of freedom, metastability, critical fluctuations, phase transitions, hysteresis...);
- Considering sensemaking as a suitable resilience-oriented framework for educational and organizational design (Weick, 2012);
- Identifying the most efficient ways for trainers to influence indirectly trainees’ environment, to the extent that meaning cannot lie in simple inputs from the trainer;
- Extending the training potential from the acquisition of predetermined and expected knowledge to a commitment to resilience.

### **Four resilience-oriented principles for the design of training situations**

Recent results obtained in past and current studies allow one to identify four robust principles for training design likely to improve individual, collective and organizational resilience, as promoted by the Safety II paradigm.

- *Encourage mimetic experiences.* Training situation must contain the relevant ingredients of actors' high-risk activity without necessarily simulating real-life work situations. The aim is rather to stimulate mimetic experiences which can be summarized in the following expression: “*not working – not ‘not working’*.” Mimetic experience is specific in the way that it is similar but not reducible to another experience, with simultaneous feeling of sameness and difference. Previous results showed for example that novice nurse anesthetists created new possibilities of action by amplifying their expectations and interpretations of the simulated scenarios they experienced in training (Horcik, Savoldelli, Poizat, & Durand, 2014). Concretely, training situation should maintain mimetic links with the targeted work conditions (i.e., being both formal and functional), while potentially being associated with a playful and non-utilitarian tone (e.g., simulation, miming, feigning, fiction, playing, narrative registers and story-telling...). These properties are likely to foster the actors' creativity and productive imagination.
- *Pay attention to attention and concernedness.* Training situation must promote an ecology and ethics of attention, and a sensitivity to operations. In working situation, operators must be encouraged to remain vigilant regarding the application of reliable actions, while being on the lookout of all possible events, others' needs, or any weak signals from their entire workplace. Importantly, attention is not only conceived as a selective focus or mere concentration. Rather, attention is conceived as a deep receptiveness. A current study shows, for example, that during inquiry-led scenarios using a virtual visualization device (panoramic views and 3D), nuclear power plant novice operators became aware and sensitive to configurational details of the reactor building. However, training situation must promote concernedness, that is, being concerned about work issues and challenge, being preoccupied with failure, and being ready without necessarily being active. The goal is to stay intentionally committed when facing an event appraised as a critical cause of collapse, especially when such an event implies the need to find new way of acting.
- *Perturb and turn into an event.* Eventually, training situation must switch (at least partially and momentarily) from “traditional”, sequential, curriculum-based training to perturbation-based training. In curriculum-based training, participants must acquire procedural knowledge and learn safety principles and rules (typical educational goals of the *Safety I* paradigm). In perturbation-based training, participants learn to face obstacles, to cope with stressful events, to make sense of peculiar or new situations, to overcome critical issues, etc. Such training allows a circular movement between “hazard” events (unexpectedly disturbing and disrupting the flow of work) and “rendez-vous” events during training sessions (aiming at reconsidering past events and/or considering future potential events). The trainees are required to enact new forms of activity, making sense through a mode C.S. Peirce's conceptualized as *abduction*. That means that “they start with some tangible clue and then discover or invent a world in which that clue is meaningful” (Weick, 2005, p. 433). For example,

a current study shows that during a terrorist attack scenario in a crisis management training, security agents had to cope with a shock state provoked by the announcement of two of their colleagues' (fake) death. This led them to imagine how to keep working efficiently in spite of the deep perturbation of their concentration and cognitive resources. Thus, trainers need to design environments in which trainees' activity is disturbed/perturbed in such a way that a transformation is needed. Then, trainers need to guide this transformation in a direction that they (and the trainees) deem most appropriate.

- *Support participatory-sensemaking and collective sensemaking.* Training situation must support interactions, information sharing, and joint sensemaking. Concretely, this requires i) the use of structured debates and controversies pertaining to the work activity with respect to both rule-based and managed safety; ii) the promotion of a reluctance to simplify interpretations, and of a deference to expertise. Such constructive debates are likely to occur through proscriptive, inquiry-led exercises, in which “what is not forbidden is allowed” (whereas in most of usual training schemes, what is not allowed is forbidden). As an example, after a “crew resource management” training, gas storage managers reported satisfaction linked to an improved awareness and understanding of others' knowledge, concerns, work constraints and prospective ideas.

## Conclusion

The present paper provides a foundation for the design of training situations operationalizing the *Safety II* paradigm. Such situations are not limited to the training examples we provided (simulation, virtual visualization, crisis management exercise, and crew resource management). The four principles are independent but complementary. They cannot be hierarchized but they can be locally prioritized according to a thorough diagnosis of organizational safety.

Education and training are conceived herein as high-order means to improve safety through resilience in high-risk organizations, fostering the capacity of the operators and organization to develop efficiently and in the long run. Importantly, this foundation for training implies a requirement: to accept that the outcomes of the training program may be challenging to assess. In any case, the most durable solutions to improve safety through resilience are to be found at the crossroad between organizational design and training/development policies.

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