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On the epistemology and ethics of communicating a Cartesian consciousness

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ABSTRACT

Researchers have made situation awareness into a researchable, scientific concept and generated practical progress mainly by modeling it on a natural-scientific ideal of empiricism and positivism. Crucially, in the manner of Cartesian dualism, it assumes that the world is objectively available and apprehensible, and can be compared to the internal corresponding mirror (the SA) of it. This has involved epistemological and ethical sacrifices. Most importantly, people now get blamed for losing SA. This happens in research, investigations, media and judicial contexts, where in hindsight it is pointed out that their "mind" did not get the crucial bits of "matter" that were supposedly available to them.

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1. The causal power of losing a construct

Peering wearily into the cradle of the concept in the mid-nineties, aviation safety veteran Charlie Billings wondered aloud whether the intercession of "situation awareness" was necessary to explain what causes people to see, or miss, or remember seeing, something. "It's a construct!" he said in a keynote at a foundational conference on situation awareness. "Constructs cannot cause anything!" (Billings, 1996).

Charlie Billings passed away in 2010. By then, loss of situation awareness (i.e. loss of a construct) had become the favored cause for an epidemic of automation/human performance-related mishaps in aviation and in other settings. A full 85% of reports produced by the Australian Transportation Safety Bureau in 1996 (ATSB, 1996) contained references to a "loss of situation awareness." A meta-analysis of over 300 civil aviation incident reports conducted by human factors researchers indicated that that loss of situation awareness causes more incidents when the captain is at the controls than when the first officer is, and that the pilot flying is more likely to lose situation awareness than the pilot not flying (Jentsch et al., 1999).

Of course, Giddens would argue that the findings reported in a study like that are only as stable as the two subsequent interpretations that brought them fourth. Human factors, after all, is an activity in which humans study humans. Humans are self-reflecting actors, not objects in the natural world that do not answer back. For Giddens, this involves a double hermeneutic. First, there are the interpretations among those people who are studied in human factors research. The second hermeneutic applies to the human

researchers themselves, who are, of course, constituted in a particular context that offers a particular set of constructs, methods, and techniques. In an earlier Jones and Endsley (1996) study, like the one above, interpretation governed both the reporters' reflections on their own performance (the description of the errors they committed and reported in their choice of words in an incident reporting system) and the researchers' subsequent classification of those errors. None of this holds any trans-historic truth values that can progress human factors or safety science toward a greater accumulation of facts or "science."

But there are more important concerns than that. Clearly, neither lay nor researcher communities had much time for Charlie Billings' cautions. Fifteen years hence, loss of a construct causes a majority of aviation accidents (Jentsch et al., 1999; Jones and Endsley, 1996). On the face of it, the popular, intuitive appeal and subsequent swift adoption have given situation awareness (and the causal power of its loss) a kind of consensus authority: everybody uses it, so everybody uses it. This in spite of consistent calls for caution in addition to Billings' (Dekker, 2000; Dekker et al., 2010; Flach, 1995; Sarter and Woods, 1991; Smith and Hancock, 1995). That a construct is popular, however, should not be confused with it being "scientific." Consensus authority will eventually fail to prop up an otherwise bad idea. So in order to keep using situation awareness as a cause—and apparently credibly so—human factors researchers have to see situation awareness as a good idea, a researchable one, a scientific one. This has involved a number of tacit philosophical operations that cast the study of situation awareness research a natural sciences project. Some would argue that SA amounts to a project that has generated practical progress. The question considered in this paper is whether the necessary epistemological and ethical sacrifices have been worth it.

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2. The epistemology

In the natural scientific interpretation, advances in research and technological progress go hand in hand and are founded on a cumulative production of knowledge. The resulting epistemology (i.e. how human factors gets to know things) is positivist, empiricist and cognitivist. Positivism and empiricism together hold that the only accurate knowledge we can obtain from the world (or from human functioning in it) is based on sensory experience. The only things we can know, in other words, are those we can see, and which can be positively verified by experimenting more. Key operations to be mastered by researchers are experimentation to make the invisible things visible. This is perhaps why ergonomics is, to a degree, uneasy with mental life but more comfortable with information processing (physically manifested and made visible in radios, computers and other engineered artifacts), and largely avoids direct discussions of consciousness but can describe situation awareness in progressively greater detail (as made visible in a post-task questionnaire). Another goal is the explanation and prediction based on context-free theories. Such ambitions were articulated, for instance, in the pronouncement that human factors was moving "toward a theory of situation awareness" (Endsley, 1995b).

The natural science model has been, and in many ways continues to be, the ideal shared by human factors in its study of human activity (Lützhoft et al., 2010). Natural—or hard—science lies at the core of many fields' scientific identity. Hard science functions as a kind of index against which any field's epistemological confidence gets ranked. Situation awareness research is no exception (Endsley, 2006; Jentsch et al., 1999). The visible results of natural sciences and the prestige these have bestowed on them does not make it surprising that human factors would aim to imitate their paradigm, as social sciences in general have long attempted (Hancock and Szalma, 2004; Vicente, 2000). Durkheim, father of modern sociology, sought to develop a distinct scientific methodology for social sciences that logically pulled the natural sciences into the realm of human activity with objectivity, rationalism and their approach to causality (Durkheim, 1901). Freud longed for the certainties of natural sciences too: he "envied the physicists and mathematicians who can stand on firm ground" (p. 27) whereas he was left to "hover, so to speak, in the air" (Flyvbjerg, 2001). The close affinity of human factors with the "hard" world of engineers probably encourages it to pursue a credibility and language which carries over into the settings it wishes to impact (Batteau, 2001).

Interestingly, as John Flach has pointed out, theorizing on situation awareness ends up mostly covering the "awareness" part, much less the "situation" (Flach, 1995). Theory aims predominantly to explain human performance by reference to what goes on in the mind—how the mind forms a mirror of the world around it (Dekker and Lützhöft, 2004). The stance taken by situation awareness research, as it was by information processing psychology (Wickens, 1984) is a cognitivist one: answers to how people make sense of the world are sought in presumed mechanisms of mind (Neisser, 1976). Such questions, about the link between objects in the world and images in the mind, are at least as old as Aristotle's version of empiricism. For human factors psychology they have served to sustain a particular ontology (a belief about how the world or reality "works"): that mind and matter are separate, as Rene Descartes suggested. This is the correspondence view of knowledge: human awareness forms an internal picture that *corresponds*, as accurately as possible, to the external world perceived through the senses.

The correspondence idea lends situation awareness research its ultimate security. There is, as Parasuraman and colleagues put it, a "ground truth," something stable, knowable and known, to stand on (Parasuraman et al., 2008). When investigating situation awareness in scientific experiments,

> . . .there is a "ground truth" against which its accuracy can be assessed (e.g., the objective state of the world or the objective unfolding of events that are predicted) (p. 144).

This "ground truth" can be known independent of an observer's perspective—which completes the natural scientific ideal of a dispassionate, neutral experimenter. The researcher, as observer, can claim safe independence from what is observed. The "ground truth", after all, cannot be negotiated or contaminated. It is out there, for all to see, unaffected by the background, values, interests or any other confounds an observer might bring along. This epistemological stance represents a kind of a-perspectival objectivity, a "view from nowhere" (Nagel, 1992), a value-free, background-free, position-free view that is true (the "ground truth"). This re-affirms the classical or Newtonian view of nature (an independent world exists to which we as researchers, with proper methods, can have objective access) and rests on the belief that observer and the observed are entirely separable. Situation awareness research thus derives its legitimacy from an ideal natural science model by imitating its original ontology and epistemology. To the extent that this produces tangible and usable results that improve displays, performance and safety (as offered by many of the contributions in this special issue), there is no reason to be critical. Except, of course, at the self-sustaining and self-fulfilling "episteme" (a set of legitimated procedures, institutions and knowledges) of any SA-technology military-industrial complex (Foucault, 1980).

But each philosophical position makes analytic (and ultimately practical) sacrifices. William James once raised this with a metaphor which applies aptly to the investigation of situation awareness today (James, 1890):

> . . .the definite images of traditional psychology form but the very smallest part of our minds, like a river consists of nothing but pailsful, spoonsful, quartpotsful, barrelsful and other moulded forms of water. Even were the pails and the pots all actually standing in the stream, still between them the free water would continue to flow. It is just this free water of consciousness that psychologists resolutely overlook. Every definite image in the mind is steeped and dyed in the free water that flows around it (p. 255).

The dynamics of experience still represents a daunting research problem (Flach et al., 2008). Snapshots of short-term memory (e.g. SAGAT) are the sorts of spoonsful that are treated as "data" in situation awareness research today (Endsley, 1995a), which resolutely liberate the researcher from engaging with the dynamics of consciousness. The separation between observer and observed makes little sense in his metaphor: elements are not 'out there' in a situation waiting for a mind to become aware of them, do all kinds of operations on them and finally attach meaning to them. If they were, it assumes an antecedent chaos that requires some intrapsychic glue (e.g. SA operations) to prevent percepts from falling apart (Heft, 2001). The Gestalt movement was in part a protest against such Wundtian elementarism (Wundt, 1973), proposing that one immediately experiences (perceives) meaningful wholes rather than their elementary parts. In the words of Wertheimer (Woods et al., 2002):

> I am standing at the window and see a house, trees, sky. And now, for theoretical purposes, I could try to count and say: there are. . .327 nuances of brightness [and hue]. Do I see '327'? No; I see sky, house, trees. (p. 28)

Wertheimer inverted the empiricist claim and the central assumption of situation awareness: meaning is not the result of mental operations on elementary stimuli (Heft, 2001). On the contrary, it takes painstaking mental effort (counting 327 nuances of