

# Beyond reduction with the representation: The need for causality with full complexity to unravel mental health

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## Abstract

In this commentary on Borsboom et al.'s target article, we argue that researchers should be aware of the historical development of models in neuroscience. Considering the importance of causality in anatomo-clinical approach and stressing the complexity of mental phenomenon, we provide new insight on reductionism and representation limitation.

Commentary/Borsboom et al: Brain disorders? Not really

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In the course of neuroscience history, and despite the multiplicity of studies carried out, the physiology of the nervous system was often conceived and developed along two distinct ways. These two paths coexisted for many years and were already in the work of Herbert Spencer (1864–1867). Between, on the one hand, the reaction or the reflex and, on the other, the spontaneous activity and the activity of the psyche, the evolution of the physiology of the nervous system reflects two conceptions of neuroscience. First:

With Ivan Sechenov, Claude Bernard, Charles Richet, and Ivan Pavlov, the study of psychic reflexes leads to the definition of the concept of conditioning as an adaptive learning mechanism, by strengthening a permanent association between a conditioned stimulus and a physiological response, whose function is anticipation .... It is with the rise of cybernetics, after the Second World War, and the central role of France in the East-West rapprochement in neurophysiology, that this line of research leads to the definition of adaptive neural mechanisms of learning as strengthening synapses. (Barbara 2008, pp. 2–3)

Second:

In an opposite way, biologists, ethologists, psychologists and neurologists characterize the adaptation of organisms by structured and innate psychic processes, which are part of the history of animal species, and not only of interactions with the animal's environment. In a Spencerian spirit, the British neurologist of the second half of the nineteenth century, John Hughlings Jackson (1835–1911), proposes hierarchical and organized psychic functioning, that is to say, elaborated over generations, and which can undergo degradations during pathological phenomena. This model leaves room for reflexes and automatics, but mainly describes sensory-motor integration and coordination at a higher level by prefrontal areas.... Jackson comes to admit that the study of the intellect is distinct and parallel to that of reflexes. (Barbara 2008, p. 3)

Beside these two paths, Francisco Varela (1946–2001) proposed his theory of enaction. This other adaptation model proposes that cognition is the permanent production of the world that emerges in the subject through the establishment of neuronal connections during a history that is not interrupted (Varela et al. 1991; cf. Barbara 2008). Thus, enaction theory conceives of the mind by emphasizing how the body and mind organize themselves and interact with the environment (Varela et al. 1991). In the same line, Stanislas Dehaene proposed that neural structures might serve predefined different fundamental functions such as reading languages and adapting to particular forms of writing (Dehaene 2007). Similarly, Collignon and colleagues showed that a new shape of the functional architecture and the connectivity of the visual cortex could take place during developmental periods of visual deprivation (Collignon et al. 2013). So, re-use of neurons would be a larger general phenomenon consisting in the diversion of cognitive functions formerly used for other purposes towards a new use in the context where the environmental conditions are new (Barbara 2008, de Ricqlès 2015). This “neural recycling” of Dehaene or the reshaping of Collignon et al. is similar to Steven Jay Gould's concept of exaptation. In their proposal, Borsboom et al. are not crystal clear whether they place their model in any of the historical pathways of neuroscience. Their proposal seems disembodied and a metaphor for psychic singularity. As such, the cognitive way would seem the option they implicitly choose. However, in the absence of causality, their model would be rather separate and apart from any adaptation or evolution model.

The representation proposed by Borsboom et al. in a graph with subjective and objective factors placed on the same foot is

only a reductive visual illustration of a complexity encountered daily in clinical practice. The printed representation of a subset of factors involved in psychic illnesses seems limited compared to mental associations of the clinician. Hence, metaphor and graphical representation might reassure those unacquainted with the clinical work. Indeed, beyond a seemingly superficial reflection that remains always subjective, a meticulous work of analysis and professional reflection takes place. In the same way that writing and speaking reduce and constrain concepts and perceptions, graph representation remains a drastic reduction both of the patient's suffering and of the clinical relationship. According to Edgar Morin, “We are still blind to the problem of complexity” (Morin 2005, p. 24). Complexity requires that we try to understand the relationships between the whole thing and the parts of the whole; however, knowledge of the parts is not enough to know the whole. Thus, for the principle of reduction, we substitute a principle which conceives the relation of mutual implication between the whole and parts. Generalized complexity would thus be a paradigm that would require the combination of a principle of distinction and a principle of conjunction. If, according to Morin, we have learned from our education to separate more than to connect, to know is both to separate and to connect. We must therefore make an effort to connect the parties to each other in all areas. Thus, in order to think complexity, we need a complex thought that connects more than it cuts out knowledge in fields exclusively centered on an object. According to Morin again, we must reject the paradigm of classical thought which was well formulated by Descartes and which is based on the disjunction between, for example, spirit and matter. A paradigm of complexity associating distinction and connection in mutual involvement should replace this separation (Juignet 2015). Thus, one of the epistemological consequences of complexity is that science is invited to become multi- and even transdisciplinary. In the context of Borsboom et al.'s proposal, the non-consideration of causality and the equalization of the different factors involved in mental pathology suggests a transdisciplinary view of complexity, focusing on the link between parties; however, it reduces the distinction between different areas and therefore erases their specificities. In other words, Borsboom et al. substitute complex interactions with simple linear correlations.

Medicine has relied on the search for causality using the anatomo-clinical approach, whether at a macro or micro level. This approach led to the identification of treatment to care for patients when it is not possible to cure them. However, in mental health, the approach was based on parallel movements of (1) hypotheses generation on mental functioning through metaphors (i.e., cybernetic, psychoanalytic, biological, and so on) that gave rise to various research protocols (either connectionist or cognitivist models, as described previously); and (2) redefinition of mental illness through pharmacological compounds efficacy, such as depression (with antidepressants) or anxiety (with anxiolytics). In the biological model of mental health, the use of dynamic causal models (Desseilles & Phillips 2016) makes it possible to represent brain functioning with directional graphs maintaining a causal dimension that seem crucial to the medical approach. As opposed to Borsboom et al.'s proposal, recent original models intuit that complexity of mental phenomenon might be emerging from biological models involving causal interactions (Friston 2010).

In view of all of the points discussed previously, we argue that causality with full complexity should be the approach of choice for unravelling mental health complexity.