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Cognition without Behaviour: Cognitive Functions in Behaviourally Non-Responsive Individuals

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Structure

General

Patients, which are completely non-responsive albeit awake (i.e., not in coma), were first described by the famous German neurologist Ernst Kretschmer (1940) who designate this condition “apallic syndrome” meaning that there is no cortical activity altogether. In his description of the syndrome, Kretschmer used such terms as panapraxia (i.e., the complete lack of all functions of action control) and panagnosia (i.e. the complete lack of all cognitive functions). In the 1970ies, the not less famous Scottish neurosurgeon Bryan Jennett proposed a new name “vegetative state” (VS) for the patients of the kind as depicted by Kretschmer. While the term “apallic” (Greek “without cortex”) referred to anatomical and physiological entities, “vegetative” suggests that the patients lack a “subjective world” in form of feelings, thoughts, sensations, etc., while their vital functions such as respiration and circulation remains intact. The latter fact, again, strongly distinguishes this condition from coma.

For the last twenty years, a considerable body of data has been accumulated indicating that many VS patients do possess the abilities to cognitive processing at various levels of complexity. Because of the absence of any goal-directed behaviour, these data were obtained using direct measurement of patients’ brain responses by means of the electroencephalography (EEG), positron emission tomography (PET), and functional magnetic resonance imaging (fMRI). The data indicate that VS patients are definitely not “apallic” and that at least some of them are not “vegetative” either.

The proposed presentation critically reviews the empirical evidence of cognitive processing in VS and in two other conditions of behavioural non-responsivity: minimally conscious state (MCS) and locked-in syndrome (LiS). While VS is, by definition, a state of wakefulness without any subjective experience, MCS is characterized by minimal and highly instable signs of subjective awareness, and the LiS is defined as a condition in which consciousness and cognition are largely preserved but cannot be manifested in behaviour due to an extremely severe paralysis of the entire musculature including speech muscles. However, these statements describe the definitions of the respective states; since the rate of misdiagnoses is known to be very high, it is unclear how far these definitions characterize single patients..

The proposed review is broken down as follows:

1. Evidence of the preservation of main cortico-thalamic circuits necessary for cognitive operations.
2. Evidence of simple sensory processing.
3. Evidence of higher-level cognitive processing.
4. Evidence of language processing.
5. Evidence of subjective awareness.

Principal Conclusions

1 A significant portion of VS and MCS patients demonstrates clear markers of cognitive processing at different levels of complexity, including processing of semantic relations between linguistic objects.

2 Both VS and MCS populations are highly heterogeneous in respect of the number and nature of the obtained indicators of their cognitive functions. The overlap between these populations is much larger than might be expected on the basis of the different clinical diagnoses. At least one large subgroup of VS patients can be described that does not differ from MCS in terms of their cognitive abilities.

3 Semantic processing, sometimes at a high level of complexity, can be found in both VS and MCS patients. Notably, this processing is not necessarily related to conscious language apprehension. The two statements “the patient’s brain adequately processes semantic relationships between verbal stimuli” and “the patient understands semantic relationships between words” are not equivalent.

4 Speaking about consciousness, we should distinguish between high-level, language-based cognitive awareness, on the one hand, and low-level, language-independent subjective experience (e.g., experience of pain and pleasure), on the other hand. The former can be found in about 5 to 10% of VS and MCS patients; if found in VS, it unequivocally indicates a misdiagnosis. The latter can characterize a much larger patient group. However, criteria of low-level consciousness are disputable.

5 As expected on the basis of the clinical diagnosis, indicators of higher-level cognitive functions (including high-level consciousness) are obtained in LiS much more frequently than in VS and MCS. However, their manifestation in LiS is inferior as compared with normal population. Thus the idea that LiS is a state, in which cognitive abilities are fully intact and only their overt

expression is impossible due to the severe motor impairment, is not supported by the data.

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