

What about consciousness during learning?

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Abstract: Though we fully agree that unconscious processing produces explicit representations that form the conscious phenomenal experience of the subject, identifying phenomenal experience with stable patterns of activation in a PDP network seriously limits O'Brien & Opie's thesis. They fail to recognize the constructive role of consciousness during the learning episode itself, reducing consciousness to a resulting outcome of the learning episode. We illustrate how consciousness can guide and shape the formation of increasingly structured representations of the world by presenting a brief outline of a model for speech segmentation.

One of O'Brien & Opie's (O&O's) main theses is that "explicit representations . . . are the products of unconscious processes" and that identifying "phenomenal experience with the vehicles of explicitly representation in the brain" construes consciousness as a "fundamental feature of cognition." This thesis is clearly not in line with the dominant *Zeitgeist* in cognitive psychology, which largely discards consciousness and phenomenal experience from its main explanatory concepts. However, it finds some echo in our own account of implicit learning (see, for instance, Perruchet & Vinter 1998). In our account, unconscious *processes* and conscious *representations* are conceived as the front and the reverse of a sheet of paper. As the analogy illustrates, they are both intrinsically associated and radically different: radically different, in the same way that any overlap between the front and the reverse is obviously impossible; and intrinsically associated, any dissociation between the front and the reverse being likewise impossible. In implicit learning, intrinsically unconscious processes serve the function of generating conscious representations, hence shaping the phenomenal experience of the subject. Noticing the similarity of O&O's position and ours seems important, especially because both views stem from very different backgrounds. O&O's is a philosophical approach to connectionism, whereas we rely on experimental and developmental psychology, without any commitment to a connectionist perspective.

However, we no longer follow O&O when they identify each phenomenally experienced representation with the generation of a stable pattern of activation in a PDP network. The authors do not define clearly what they mean by a "stable" pattern of activation in neurally realized PDP networks. We can infer that they mean the final relaxation state presented by a net after training, when activity is fully stabilized, linking inputs and outputs in a coherent way. If we take this interpretation for granted, this entails a radical dissociation between phenomenological experience and learning. Indeed, learning is linked with the period during which the weights of the net adjust themselves while each new input is processed, and phenomenological experience emerges when the weights no longer change.

This dissociation raises an obvious problem. O&O's position

leads to the paradoxical claim that there is no phenomenal experience during learning. Consider, for example, a connectionist modelling approach to speech segmentation such as Elman's (1990) SRN model, the objective of which is to reproduce the human ability to correctly segment a continuous speech stream into words. Activity in the net will be fully stabilized when the net has learned to segment the utterances correctly. But what about the phenomenal experience of the input at the beginning of the presentation of the linguistic corpus, before the relaxed states are achieved? It is obvious that a human subject phenomenally experiences the perceived input, even while appropriately structured representations are not yet available.

Moreover, because consciousness is not introduced during the learning episode itself, O&O fail to recognize the possible role played by the initial conscious representations in the formation of the ultimate representations. Consciousness appears as a terminal or final state of what has been learned by the net, without the "vehicles of explicit representations" having an active role in the formation of the subsequent explicit representations. Consciousness is a fundamental feature of cognition in the sense of a final or resulting feature, not in the sense of a constructive feature. In our view, the conscious explicit representations forming the momentary phenomenal experience of the subject play an active role in the process of formation of subsequent, better structured explicit representations.

The way initial, poorly structured conscious representations may contribute to learning can be illustrated by a brief outline of the principles of *PARSER* (see Perruchet & Vinter, in press, for a detailed presentation), a nonconnectionist model for speech segmentation. We started from the consideration that, faced with a continuous speech stream in an unknown language, humans naturally segment this information into small and disjunctive "chunks," each chunk embedding a few primitives. In *PARSER*, this initial parsing is simulated by a random generator. The chunk, or percept, forms the content of the subjects' momentary phenomenal experience. It also enters as a unit in memory, and is ascribed a weight. This weight is increased if the chunk is perceived again, and decreased from a certain quantity to simulate forgetting, and possibly interference, each time another percept is processed. Crucially, as long as the weight of a memory unit is above a certain threshold, this unit has the property of guiding perception. Thus, the new conscious units progressively substitute for the primitives of the system. As a consequence, when a chunk already stored in memory is present in the input, it will be perceived as a unitary percept, instead of being cut off in several parts. This makes the model very efficient for extracting the regularity from the input. As a matter of fact, after some training, most of the items present in memory are the words of the language, because the probability of drawing the same chunk (or encountering the same percept) repeatedly is higher if this percept is a word, or a part of a word, than if it straddles word boundaries. Thus in *PARSER*, the words emerge through some kind of natural selection process, the nonwords being progressively forgotten because too rarely repeated.

The point is that, in our model, the conscious representations are not only the final products of learning, as in O&O's theory: they are present as the very beginning of training and serve throughout the learning process, thanks to their ability to constrain the coding of the incoming information. In Piagetian terms, ascribing a role for phenomenal consciousness in the formation of structured representations allows our model to re-integrate "assimilation," along with "accommodation," in adaptive processes.