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What are the boundaries of unconscious semantic cognition?

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What are the scope and the limits, if any, of unconscious cognition? Can the human mind access to the meaning of a printed word without any awareness of the stimulus? During the last 20 past years, evidence supporting the existence of unconscious semantic processing of words accumulated (for a short review see Naccache, 2008). But still, many questions remain unanswered. How deep can these processes occur? Can multiple words, sets of words or complex syntactic structures such as sentences be processed unconsciously? Can multiple meanings of polysemous words be represented unconsciously?

In this issue of the EJM, Nakamura and colleagues report a study assessing precisely how many words can be integrated unconsciously (Nakamura *et al.*, 2018).

They presented subjects with series of masked flashed words followed by a consciously visible target, and probed priming effects through a combination of behavioural and event-related potentials (ERP) measures. While unmasked visible prime words influenced the processing of target words irrespective of the number of words separating the prime word from the target, masked priming effects were much more limited: semantic priming effects of masked words vanished when two or more masked words were inserted between the masked prime and the visible target. This result could suggest that unconscious semantic processing is limited to only two items (the masked prime and the inserted word), as proposed by the authors. Alternatively, given that the number of inserted masked word was confounded with the temporal distance between prime and target words, it may also simply reflect the short-lived limitation of unconscious representations. Future experiments manipulating the number of inserted words and the temporal gap as orthogonal factors will allow a better understanding this interesting result. One may also wonder if the masked words inserted between the prime and the target were really semantically processed and integrated unconsciously together.

While a recent ERP study demonstrated that two masked words presented simultaneously

could be semantically integrated (Van Gaal *et al.*, 2014), the Nakamura *et al.* study shows that this is also possible when the two words are presented sequentially.

The question of the depth of unconscious semantic cognition has been the subject of many phantasms among the general public, not to mention advertisers and politics. These limits have been fluctuating gently over the time thought. For instance, for more than 35 years, scientists used to consider that the multiple meanings of a polysemous words (e.g. the word “bank”, that can be the bank of the river or the bank where you save your money) could be processed in a parallel manner at the unconscious levels irrespectively to the contextual content (Marcel, 1980). This view was particularly popular among the general public, corresponding to a less “limited” or a “more open” unconscious mental life. Recently, trying to replicate this seminal work and, using a very similar ERP approach that the one reported by Nakamura in this issue, we demonstrated that unconscious semantic processing of polysemous word was actually very similar to what we observe in the conscious condition (Rohaut *et al.*, 2016). Unconscious semantic processing of polysemous words was strongly influenced by the current conscious semantic context. These strong influences of the current conscious posture on unconscious processing seem extremely general.

Finally, in addition to these fundamental scientific questions, it is important to note that understanding unconscious cognition is also of great interest in medical science. Probing residual cognition in unresponsive patients (in a comatose, vegetative or minimally conscious state) is of prime importance to better diagnose their level of consciousness and to elaborate a more reliable prognosis of their consciousness recovery. Capitalizing on fundamental research, several groups have attempt to develop reliable EEG semantic paradigms allowing to detect EEG signatures of unconscious semantic processing. To date, results have been very

mitigated though, mainly because of the great inter-individual variability that lead to a very poor sensitivity at the individual level, even in healthy subjects (Steppacher *et al.*, 2013; Balconi *et al.*, 2013; Cruse *et al.*, 2014; Erlbeck *et al.*, 2014; Rohaut *et al.*, 2015; Beukema *et al.*, 2016). Currently, one of the most promising approach could be the detection of brain modulations in response to the narrative content of natural speech (Iotzov Ivan *et al.*, 2017). This original approach that capitalize on fundamental research (Hasson *et al.*, 2004) emphasizes how fruitful can be the bidirectional approach of exploring cognition in both unconscious patients and conscious subjects.

Reference:

- Balconi, M., Arangio, R., & Guarnerio, C. (2013) Disorders of Consciousness and N400 ERP Measures in Response to a Semantic Task. *J. Neuropsychiatry Clin. Neurosci.*, **25**, 237–243.
- Beukema, S., Gonzalez-Lara, L.E., Finoia, P., Kamau, E., Allanson, J., Chennu, S., Gibson, R.M., Pickard, J.D., Owen, A.M., & Cruse, D. (2016) A hierarchy of event-related potential markers of auditory processing in disorders of consciousness. *NeuroImage Clin.*, .
- Cruse, D., Beukema, S., Chennu, S., Malins, J.G., Owen, A.M., & McRae, K. (2014) The reliability of the N400 in single subjects: Implications for patients with disorders of consciousness. *NeuroImage Clin.*, **4**, 788–799.
- Erlbeck, H., Kübler, A., Kotchoubey, B., & Vesper, S. (2014) Task instructions modulate the attentional mode affecting the auditory MMN and the semantic N400. *Front. Hum. Neurosci.*, **8**, 654.
- Van Gaal, S., Naccache, L., Meuwese, J.D.I., Loon, A.M. van, Leighton, A.H., Cohen, L., & Dehaene, S. (2014) Can the meaning of multiple words be integrated unconsciously? *Phil Trans R Soc B*, **369**, 20130212.
- Hasson, U., Nir, Y., Levy, I., Fuhrmann, G., & Malach, R. (2004) Intersubject synchronization of cortical activity during natural vision. *Science*, **303**, 1634–1640.
- Iotzov Ivan, Fidali Brian C., Petroni Agustin, Conte Mary M., Schiff Nicholas D., & Parra Lucas C. (2017) Divergent neural responses to narrative speech in disorders of consciousness. *Ann. Clin. Transl. Neurol.*, **4**, 784–792.
- Marcel, A.J. (1980) Conscious and preconscious recognition of polysemous words: Locating the selective effects of prior verbal context. *Atten. Perform. VIII*, 435–457.
- Naccache, L. (2008) Conscious influences on subliminal cognition exist and are asymmetrical: validation of a double prediction. *Conscious. Cogn.*, **17**, 1359–1360; discussion 1361-1363.
- Nakamura, K., Makuuchi, M., Oga, T., Mizuochi-Endo, T., Iwabuchi, T., Nakajima, Y., & Dehaene, S. (2018) Neural capacity limits during unconscious semantic processing. *Eur. J. Neurosci.*, **00**, 000-000.
- Rohaut, B., Alario, F.-X., Meadow, J., Cohen, L., & Naccache, L. (2016) Unconscious semantic processing of polysemous words is not automatic. *Neurosci. Conscious.*, **2016**.
- Rohaut, B., Faugeras, F., Chausson, N., King, J.-R., Karoui, I.E., Cohen, L., & Naccache, L. (2015) Probing ERP correlates of verbal semantic processing in patients with impaired consciousness. *Neuropsychologia*, **66**, 279–292.
- Steppacher, I., Eickhoff, S., Jordanov, T., Kaps, M., Witzke, W., & Kissler, J. (2013) N400 predicts recovery from disorders of consciousness. *Ann. Neurol.*, **73**, 594–602.