Title: Inter-subject synchronization of respiratory activity and conscious processing

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Abstract:

Our brain is constantly monitored and regulated by the activity of homeostatic body processes. Most part of these brain-body interactions are processed by the autonomous nervous system and are traditionally considered unconscious. Yet, recent results have demonstrated a rich interaction between ongoing conscious processes and the aforementioned body activity.

Accordingly, respiration is a very special function because this activity is controlled by the autonomous system, yet it can be consciously controlled or indirectly disrupted by conscious process. For example, a recent paper shows that mental processes with no link to olfaction are phase-locked with nasal inhalation.

To further test the indirect modulation of respiratory rhythms by conscious processes, we recorded 12 healthy subjects with an auditive paradigm with 2 conditions: 1) attentional (A) where subjects had to pay attention to a story (synchronous across subjects), 2) non-attentional (NA) where subjects listened to a similar story but had to simultaneously count backwards between targets (asynchronous across subjects).

Our main prediction was that only in condition A the respiratory rhythms would be synchronized across subjects reflecting the coordinated cognitive processes engaged by the subjects.

Indeed, we found an increase of the inter-subject synchronization of the instantaneous respiratory frequency in the attention versus non-attentional condition (paired Wilcoxon test: p=0.02). We also found no differences in the average respiratory frequency between the two conditions, suggesting that the observed synchronization reflected a dynamic modulation of the respiration due to ongoing cognitive processes. We indeed found that the dynamical modulation of inter-subject synchronization can be explained by the prosodic and semantic content of the attended story.

These results demonstrate that respiratory activity can be directly affected by ongoing conscious processes, opening the door to use a similar strategy to indirectly evaluate ongoing conscious processing in non-communicative patients.