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Presentation Abstract

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Abstract: The meaning of human communicative behaviors can seldomly be grasped through decoding schemes invariant to the sensory signals. In fact, conveying and understanding the meaning of a signal relies on knowledge and beliefs knowingly shared between interlocutors (common ground), dynamically adjusted as novel shared knowledge is generated among interlocutors. It remains unclear whether this shared dynamic updating relies on shared inferential mechanisms, or on sensorimotor brain-to-brain couplings. This study addresses this issue by testing for the cerebral consequences of manipulating common ground dynamics.
We used unfamiliar communicative interactions that required participants to create novel shared symbols from scratch, preventing the use of pre-established (linguistic) symbols. Twenty-seven pairs of participants were asked to jointly create a goal configuration of two geometrical tokens, using the movements of the tokens on a digital game board as the only available communicative channel. One member of a pair, the communicator, knew the goal configuration, and he moved his token on the game board with his right hand to inform an addressee where and how to position his token. Cerebral activity of each pair was simultaneously monitored with BOLD-sensitive fMRI, during the performance of two types of communicative problems (42 trials each). There were problems in which the pairs already had previously established common ground (‘Known’ trials, with stable performance), and problems in which common ground yet had to be established (‘Novel’ trials, with logarithmically increasing accuracy). The joint

neural dynamics evoked within pairs were contrasted with those evoked in participants from different pairs, using coherence analysis of the BOLD signal across pairs.
The left sensorimotor cortex (MNI [-38 -19 55]) showed stronger within- than between-pair coherence at 0.05 Hz (20 sec period) with a phase-lag of 0.7 π (7 sec). These parameters reflect the dominant experimental frequency and the average temporal gap between the movements of the participants in a pair. Crucially, the right superior temporal gyrus ([63 -6 9]) showed significantly stronger within- than between-pair coherence at 0.01 - 0.04 Hz (25 - 100 sec) with zero phase-lag, indicating a neural coupling that was specific for elements of a communicative pair, driven by temporal synchronization of their BOLD changes, over a time scale spanning several communicative trials. These findings suggest that updating of common ground, a feature crucial for human communication, relies on shared inferential mechanisms operating over temporal scales independent from transient sensorimotor events.

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