Predictive modeling of higher-cognitive processes involved in social engagement based on electroencephalography (EEG)

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Among social signals, gaze contact is one of the most important, as it is often involved in initiation of social contact and engagement [1]. Gaze contact is furthermore crucial in shaping the course of social interaction [2]. We conducted a human-robot interaction (HRI) study [3] to investigate the electrophysiological correlates (EEG) of two important aspects of social engagement: (1) the *intention to initiate eye contact* and (2) the distinction between the observer being *leader or follower (functional role in interaction)* of an established gaze contact between human and robot (iCub). In particular, our experiment made use of a belief manipulation that intended to make participants believe that they were able to willfully influence the robot's behavior during interaction. Post-hoc data analysis of EEG oscillatory processes revealed a decrease in anterior and posterior alpha power, an increase in anterior left hemispheric gamma-power and a decrease in central beta-power when participants were intending to make eye contact with the humanoid (1), in comparison to a baseline rest period. Furthermore, for the comparison of leader versus follower (2) in terms of gaze contact, we found an even stronger difference of left hemispheric beta- and gamma-band activity, but an absence of any difference between being initiator or responder in terms of alpha activity. By using Support Vector Machine (SVM) classifiers with RBF kernel we showed that these patterns can be modeled with high within-participant accuracies of avg. 80.4% (1) and avg. 77.0% (2), respectively. Leave-one-participant out validation yielded promising across-participant accuracies of avg. 64.2% (1) and 61.0% (2), respectively. This work shows the technical feasibility of predictive modeling of higher-cognitive states involved in social engagement. The predictive models can ultimately be employed in passive Brain-Computer Interfaces (BCIs).

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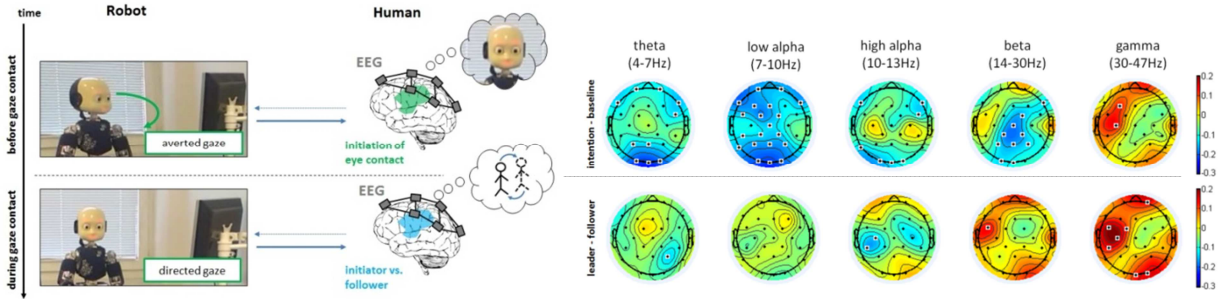

Figure 1: Two processes of social engagement (left). Grand average electrophysiological patterns found with respect to the two processes of social engagement (right). Reprinted from [3].