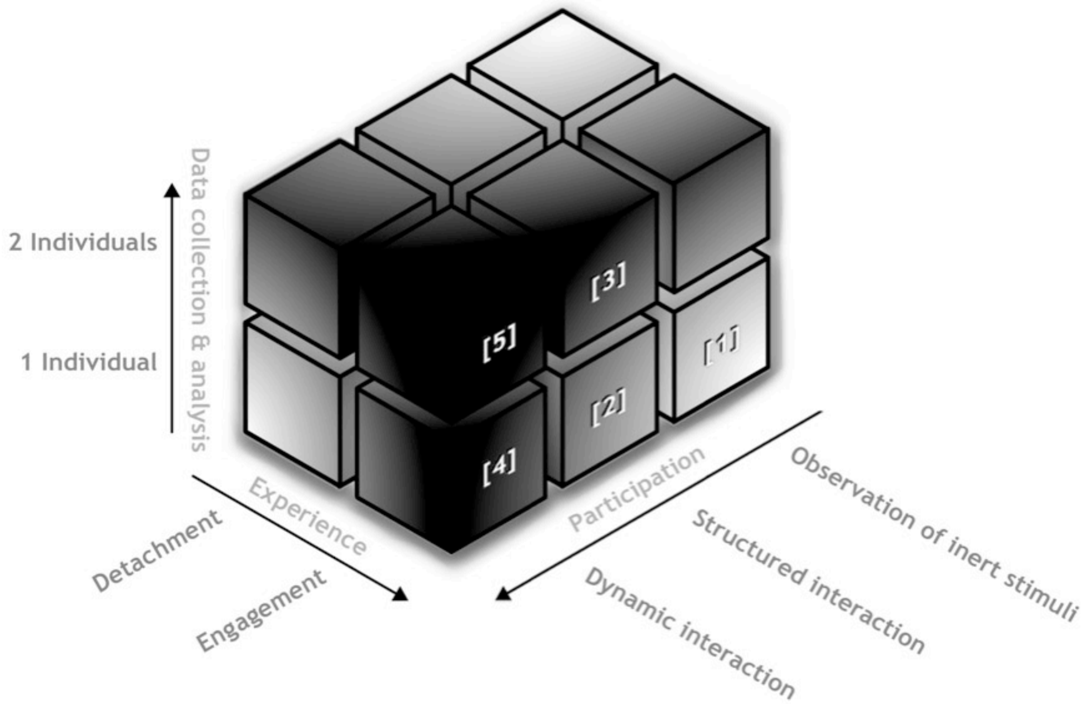
How and why do people learn to be social and what is the role of interaction therein? The burgeoning field of social neuroscience has begun to illuminate the complex biological bases of human social cognitive abilities. Many investigations have focused, in particular, on the neural correlates of our capacity to grasp the mental states of others. Two neuroanatomically distinct large-scale networks have gained center stage as the neural substrates of social cognition: the so-called "mirror neuron system" (MNS) and the "mentalising network" (MENT). The former has been taken as evidence for a simulationist account of social cognition and is believed to give us a "first-person grasp" of the motor goals and intentions of other individuals. The latter has been seen as providing evidence for a "Theory Theory" account of social cognition believe to give us an inferential, reflective (and what might be called a 'third-person') grasp of others' mental states. The apparent disparity between these sets of results may, however, arise from differences in the experimental paradigms used, which run the danger of presupposing the very theoretical frameworks they claim to test. Consequently, both of these paradigms are investigating actual, but limited domains of social cognition. Both are, in effect, committed to spectator theories of knowledge. They have focused on the use of "isolation paradigms", in which participants are required to merely observe others or think about their mental states rather than participate in social interaction with them. Consequently, it has remained unclear whether and how activity in the large-scale neural networks described above is modulated by the degree to which a person does or does not feel actively involved in an ongoing interaction and whether the networks might subserve complementary or mutually exclusive roles in this case. **In a recent paper that outlines the core theoretical assumptions of the project (*Schilbach & Timmermans et al. 2012 Behav Brain Sci*), we propose an approach to the investigation of social cognition focused on 'second-person' engagements and interaction.** This approach, we argue, will help social neuroscience to really go social. The figure below lists crucial dimensions along which a "second-person" approach could develop. **In this project**, we focused primarily on 2 aspects: in paradigms of type [5], participants are engaged in dynamic interaction with one another, and behaviour of both participants is analysed, which we did for people with High Functioning Autism partnered with healthy control participants. Paradigms of type [2] do not allow for dynamics to develop, but allow a participant to see the effect of their behaviour on others, which makes for a more controllable experimental environment.



Implicit vs explicit sensitivity to interaction dynamics in adults with High Functioning Autism (HFA)

It has been suggested that persons with HFA have more problems with automatic or implicit aspects of social cognition. However, research increasingly demonstrates that many faculties relevant to implicit social cognition remain intact, such as mirroring, action representation, and various instances of implicit learning. **Within this project we established that, in adults with HFA, implicit learning is intact and comparable**

with a control group of healthy participants, when IQ is controlled for. Furthermore, people with HFA do not spontaneously make information more explicit (*Timmermans et al., in preparation (a)*). Therefore, the tendency of persons with HFA to make social information more explicit must be related specifically to a deficit in the social domain.

Since people with HFA seem to be able to learn structured information implicitly, it has been suggested that their trouble with social situations might be due to the fact that social cognition depends on rapid, implicit detection of noisy contingencies (and automatic responses to them). Within this project, we sought to establish to what degree HFA persons are able to dynamically adapt their behaviour to actually ongoing interaction with another person, in a context with severely limited bandwidth, but with extremely noisy contingencies. At the same time, we want to establish whether HFAs have more conscious access to certain aspects of ongoing interaction. To this end, we created interactive dyads in which people with HFA interacted with healthy control persons in a minimalist virtual environment. **We found that (a) HFA persons behave identically to healthy controls in that HFAs implicitly adapt their behavior dynamically to the ongoing interaction, without being consciously aware that they do so; (b) Both control and HFA groups' changes in interaction dynamics depend principally on the reactivity of the other person to their HFA person's action, and not on the other person's mere movement or animacy (*Timmermans et al., in preparation (b)*).**

The Non-verbal Turing test (NVTT)

The NVTT is based on interactive eye-tracking, which allows participants to interact with an anthropomorphic virtual character whose gaze behaviour is responsive to where the participant looks on the stimulus screen in real time. This allows to investigate the effect of seeing someone react to one's actions. In the paradigm, the character's gaze reactions are systematically varied along a continuum from a maximal probability of gaze aversion to a maximal probability of gaze-following during brief interactions, thereby varying contingency and congruency of the reactions. We investigated how these variations influenced whether participants believed that the character was controlled by another person (i.e., a confederate) or a computer program. In a series of experiments, the human confederate was either introduced as naive to the task, cooperative, or competitive. **Results of a first set of experiments (*Pfeiffer et al. 2011 PloS ONE*) demonstrate that people's sensitivity to self-initiated congruency depends on shared intentions: in a "naive" context, people only take positive contingency into consideration, but negative contingencies only in a "cooperative" context. This change in sensitivity appears to be largely automatic.**

A second series of experiments (*Pfeiffer et al, in preparation*) with people with HFA shows that they exhibit the same overal behavioral pattern as control subject, BUT judgments in "naive" interaction are more strategic, which could be related to people with autism having less activation of the reward system (ventral striatum) than healthy controls, the latter having been shown to recruit the ventral striatal areas when experiencing self-initiated joint gaze.

Imaging data (fMRI) on the first experiment (*Pfeiffer & Timmermans et al., in preparation*) show that "naive" interaction judgments are indeed mediated by the reward system, whereas "cooperative" interaction judgments recruit mPF & attention structures. So, whereas much research into social cognition and interaction looks at cooperative, contexts, these results suggest that "open" interaction may be treated differently by our brain altogether. **Furthermore, in in "naive" interaction, this reward seems to be present from the first trials, but only at a much later stage when a cooperative context is present. Finally, positive and negative contingencies are encoded by different neural systems; only positive self-initiated contingency relates to increased reward-related activity.** (parametric activation of ventral striatum/ nucleus accumbens according to congruency (positive contingency,) and parametric activation of fronto-parietal attention network (IPS, FEF, dlPFC) with negative contingency).

Taken together, his would suggest that in natural interaction, when no cooperative context is present, people's motivation to engage further in interaction and "close the social loop" might depend crucially on experienced reward at the start of such interaction. Putitatively, it might even be the case that we engage in interaction, not necessarily to communicate or cooperate, but because it makes us, or at least our brain, feel good.