Understanding Social Interactions: A Neuroimaging Coordinate-Based Meta-Analysis

Maria Arioli (IUSS, Pavia) and Nicola Canessa (IUSS, Pavia)

Previous qualitative meta-analytic evidence suggested that the mirror and mentalizing systems exert complementary roles in decoding others' intentions (Van Overwalle and Baetens, 2009). Against this functional segregation, however, growing evidence shows that both systems can be engaged when processing observed social interactions, likely underpinning the decoding of action meaning and actors' mental states, respectively (Arioli et al., 2017; Catmur et al., 2015). Such conflicting interpretations highlight the need of quantitative meta-analytic evidence summarizing the results of single studies, to unveil the common and specific contributions of the mirror and mentalizing systems in social intention understanding.

This study aims thus to identify the brain structures consistently involved in decoding social intentions regardless of specific tasks/stimuli, via an activation likelihood estimation (ALE) meta-analysis of 28 previous neuroimaging studies, assessing 454 peak-coordinates in 618 participants. The general processing of social interactions was consistently associated with the key-nodes of both mirror (premotor and posterior middle temporal cortex) and mentalizing systems (ventro- and dorso-medial prefrontal cortex alongside cingulate cortex). Other 2 ALE analyses highlighted both overlapping and specific regions among this network and either the mirror system ("action representation"; 735 peak-coordinates from 34 experiments with 598 participants), and mentalizing system ("mental states representation"; 450 peak-coordinates from 30 experiments with 685 participants). Alongside regions traditionally associated both with the mirror (premotor and posterior middle temporal cortex) and mentalizing (medial prefrontal and posterior middle temporal cortex) systems, processing social interactions recruited specific activations in other portions of posterior temporal cortex. Conversely, brain regions exceeding this "social understanding" network were specifically associated with the processing of action meaning by the mirror system (inferior frontal and parietal cortex), and mental states by the mentalizing system (superior temporal gyrus).

Social intention understanding is thus supported by, but not completely reduced to, the specific contributions of the mirror and mentalizing systems.