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Letter

Neurodevelopmental and evolutionary origins of processing social interactions

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In their recent article in *TiCS* [1], McMahon and Isik present evidence to argue that the core of third-party social interaction perception is visual in nature, selectively relying upon a specialized region in superior temporal sulcus (STS). This view is presented in contrast to the prevalent notion that third-party social interaction perception is part of higher level social cognitive processes, supporting the attribution and interpretation of mental states. While the behavioral, computational, and neural evidence put forward to support McMahon and Isik's claims [1] is compelling and may well account for human adult brain function, critical research examining the neurodevelopmental and evolutionary origins of processing third-party social interactions has been overlooked and needs to be integrated to arrive at a more complete picture of how processing social interaction is achieved in the human brain.

From a developmental perspective, neuroimaging research using fMRI with children and adults [2] shows that only adults and older children (9–11 years of age), but not younger children (6–8 years of age), display selectivity in STS when processing third-party social interactions. This suggests a rather protracted developmental time course of the cortical specialization for third-party social interaction processing within STS, extending well into school age, with much time for learning from social experience. Furthermore, there now exists neuroimaging evidence using functional near-infrared spectroscopy (fNIRS) demonstrating that human infants (ranging in age from 6 to 13 months) selectively recruit medial prefrontal cortex (mPFC) associated with higher level social cognitive processes [3,4], but not superior temporal cortex, as implied by McMahon and Isik's model [5], when processing third-party social interactions. In this study, infants' mPFC responses were enhanced when processing third-party social interactions compared with two control conditions (individual actions by two actresses and inverted social interactions), thus providing evidence for the functional specificity of the response within this brain region. Across studies, this brain region has been shown to be involved in various forms of high-level, multi-sensory, social perception and cognition in human infants [3,6]. Critically, the finding of mPFC involvement during third-party social interaction processing in human infants is in line with prior work showing similar involvement of this brain region in adults [7], indicating developmental continuity in mPFC engagement during third-party social interaction processing. The overlooked evidence from these developmental neuroimaging studies stands in contrast to McMahon and Isik's proposal [1] and instead supports the notion that third-party social interaction processing is part of higher level social cognitive and mentalizing processes localized in mPFC [6,8,9].

From an evolutionary perspective, existing work in Old World (rhesus macaques) and New World (common marmosets) monkeys has identified various brain regions selectively responding to movies of social interactions of other monkeys [10,11]. Across these studies, adult monkeys consistently showed specialized responses in mPFC when observing third-party social interactions of conspecifics. In conjunction with the human developmental neuroimaging work outlined above, this research with non-human primates points to the possibility that third-party social interaction processing in mPFC is evolutionarily preserved and early developing, as it is seen in monkeys and human infants alike.

The evidence reviewed above provides a critical addition to McMahon and Isik's account [1] by showing that, while third-party social interaction processing represents an early developing feature of human brain function, it is unlikely to initially rely on specialized visual processes localized in STS. Instead, the existing neurodevelopmental evidence suggests that, similar to what has previously been proposed in the domain of face processing [12], reliance upon highly specialized visual brain processes localized in posterior parts of the human brain in adults, as described by McMahon and Isik [1], may be a developmental outcome of ontogenetically antecedent high-level, multi-sensory, top-down processes localized in mPFC. This proposal is in line with the emerging notion that mPFC function has an active role in guiding social perception, cognition, and learning during early human brain and behavioral development [3,6].

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