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The Developmental Neuroscience of Moral Sensitivity

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Abstract

Though traditional accounts of moral development focus on the development of rational and deliberate thinking, recent work in developmental affective neuroscience suggests that moral cognition is tightly related to affective and emotional processing. Functional magnetic resonance imaging studies show age-related changes in response to empathy-eliciting stimuli, with a gradual shift from the monitoring of somatovisceral responses in young children mediated by the amygdala, insula and medial aspect of the orbitofrontal cortex, to the executive control and evaluation of emotion processing implemented by the ventromedial prefrontal cortex in older participants. These data indicate that the development of moral reasoning involves the increasing integration of empathic emotion-related somatovisceral responses with more complex social-reasoning abilities.

Keywords
amygdala, empathy, insula, moral reasoning, ventromedial prefrontal cortex

Traditionally, moral reasoning was considered a product of conscious, gradually developing cognitive processes and deliberations. More recent research, however, provides evidence that conscious cognitive processes account for only part of the human moral compass. Studies of both adults and young children suggest that the mechanisms behind moral intuitions are sometimes unknown to the individuals who are experiencing those intuitions (Greene & Haidt, 2002), and that even preverbal infants express what appear to be nascent moral evaluations (Hamlin, Wynn, & Bloom, 2007). In this essay, we focus on the representation of social events linked to "moral sensitivity"—an automatic tagging of social events with affective values. We discuss recent neurodevelopmental research exploring the neural response to seeing other people in distress, and offer support for the notion that affective arousal plays an important role in the development of moral sensitivity. We argue that developmental neuroscience can play a critical role in illuminating the mechanisms that underlie moral sensitivity throughout development, by demonstrating the contribution of affective processing to the moral calculus.

Early Emergence of Moral Tendencies

Behavioral studies provide evidence that within the first year of life, infants engage in rudimentary forms of social, and potentially moral, evaluation and action. For example, infants as young as 6 months of age preferentially interact with an agent who helped, rather than hindered, the actions of another character (Hamlin et al., 2007). Prosocial behaviors such as altruistic helping also emerge early in childhood. By 12 months of age, infants begin to comfort victims of distress. Around 14–18-month-old infants exhibit spontaneous, unrewarded instrumental helping behaviors (Warneken & Tomasello, 2009).

These naturally emerging behaviors are thought to be motivated by sympathetic emotion, or concern for the wellbeing of others. Furthermore, during the second year of life, children's empathic responses increase. Empathy is the ability to share and understand the feelings of others; and sympathy refers to feelings of concern about the welfare of others (Decety, 2010). Although the contextual cues that link moral emotions to social norms are variable and shaped by culture, empathy has a key

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role both in the formation and cohesion of human groups, and in the observance within groups of a moral code.

There is empirical evidence that experiencing empathy for the predicament of others may increase prosocial action, and decrease aggression and other antisocial behavior (Eisenberg & Eggum, 2009). Empathic response acts as a proxy in alerting the individual to the moral salience of a situation by bringing discomfort, and thus serves as an antecedent to moral judgment. Further, empathy dysfunction in children with callous unemotional traits (Cheng, Hung, & Decety, in press) and adults with psychopathy (Blair & Blair, 2009) may result from the reduced sensitivity to others' distress cues, despite the appropriate comprehension of basic or complex emotions potentially remaining intact.

Findings from affective neuroscience, as well as evolutionary psychology and primatology, indicate that both affective reactions and cognitive reasoning contribute to moral judgments, yet in many contexts, automatic affective processes dominate. Converging results from lesion and functional neuroimaging studies implicate the specific role of a neural circuit of reciprocally connected regions, notably the orbitofrontal cortex (OFC), anterior cingulate cortex (ACC), insula (AIC), amygdala, and posterior superior temporal sulcus (pSTS) in moral cognition (Moll, de Oliviera-Souza, & Eslinger, 2003). Each of these regions is an integral contributor to emotion processing.

Perceiving Others in Distress

Pain serves protective functions not only by warning the person suffering that something is awry, but also by impelling expressive behaviors that attract the attention of others. It has been argued that the long history of mammalian evolution has shaped maternal brains to be sensitive to signs of suffering in one's own offspring (Haidt & Graham, 2007). In many primates and other social animals, this sensitivity extends beyond the mother–child relationship, such that all typically developed individuals dislike seeing others suffering.

A growing number of fMRI studies have documented that the same neural circuit involved in the experience of physical pain is also involved in the perception or imagination of another individual in pain. This neural network includes the ACC, AIC and periaqueductal gray (PAG), and constitutes a physiological mechanism that mobilizes the organism to react—with heightened arousal and attention—to threatening situations, providing a strong signal that can promote empathic concern (Decety, Michalska, & Akitsuki, 2008).

The Neurodevelopment of Empathy

Developmental studies provide unique opportunities to examine how components of the empathy system develop and interact. Decety and Michalska (2010) conducted an fMRI study with participants ranging from 7 to 40 years of age, who viewed video clips depicting people in pain, being harmed either accidentally or intentionally by another individual. Results at the group level showed that attending to painful situations caused by accident was associated with activation of the pain matrix, including the ACC, AIC, PAG, and somatosensory cortex. Interestingly, when watching a person intentionally inflicting pain onto another, regions that are consistently engaged in mental-state understanding and affective evaluation—medial prefrontal cortex (mPFC), pSTS and OFC—were additionally recruited. The younger the participants, the more strongly the amygdala, posterior insula, and supplementary motor area (SMA) were activated when they watched accidental painful situations.

A significant negative correlation between age and degree of activation was found in the posterior insula, while a positive correlation was found in its anterior portion. This posterior-to-anterior progression of increasingly complex representations in the insula might provide a foundation for the integration of the individual homeostatic condition with their motivational condition and sensory environment. In line with evidence that regulatory mechanisms continue to develop into late adolescence, greater signal change with increasing age was found in the prefrontal regions responsible for cognitive control. Overall, this pattern of age-related change in the amygdala, insula, and prefrontal cortex can be interpreted in terms of the frontalization of regulatory capacity, providing a greater top–down modulation of activity within more primitive emotion-processing regions (Yurgelun-Todd, 2007).

Another important age-related change was detected in the OFC in response to the scenarios depicting intentional harm. Activation shifted from its medial portion (which is integral in guiding visceral and motor responses) in young participants to the lateral portion (which integrates external sensory features of a stimulus with the homeostatic state of the body) in older participants. The pattern of developmental change in the OFC thus seems to reflect a gradual shift from the monitoring of somato-visceral responses in young children to the executive control of emotion processing in older participants.

Part of the developmental process in moral judgment may consist of acquiring more elaborated empathic responses. This transition might result both from experience with situations that evoke affect, as well as better developed distancing, distracting, display, and avoidance patterns that buffer against emotional evocation. Empathic emotional response in the young child may be stronger, whereas prosocial behavior is less differentiated. With age and increased maturation of the prefrontal cortex and its reciprocal connections with the amygdala, children and adolescents may be better able to internalize moral values and norms by integrating contextual social information, such as in-group versus out-group processes, with motivational and basic emotional states, thus becoming more selective in their response to others.

Affective Responding as Antecedent to Morality

Given the importance of empathy for healthy social interaction, a neurodevelopmental approach that combines implicit measures of brain responses with explicit measures of empathy and moral evaluation contributes to elucidating the computational mechanisms underlying affective reactivity, emotion understanding, and moral cognition more generally. The empirical evidence presented here supports the view that the affective component of empathy plays a crucial and perhaps necessary role in the development of moral cognition.

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