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Social cognition in adolescence: Social rejection and theory of mind



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ABSTRACT

Neuroimaging studies have shown continued structural and functional development in neural circuitry underlying social and emotional behaviour during adolescence. This article explores adolescent neurocognitive development in two domains: sensitivity to social rejection and Theory of Mind (ToM). Adolescents often report hypersensitivity to social rejection. The studies presented here suggest that this is accompanied by reduced responses in brain regions involved in emotion regulation. Studies on social rejection in adolescents with autism spectrum conditions will also be discussed. ToM is another social cognitive domain which undergoes neurocognitive development between adolescence and adulthood. ToM refers to the ability to understand others' thoughts and intentions. Neuroimaging data suggest that the ability to integrate emotional information into ToM decisions continues to develop between adolescence and adulthood. In sum, these studies demonstrate ongoing development of social and emotional cognition during adolescence at both behavioural and neural levels, providing a neurocognitive framework for understanding adolescent behaviour.

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La cognición social en la adolescencia: el rechazo social y la teoría de la mente

RESUMEN

Los estudios de neuroimagen han conocido un continuo desarrollo estructural y funcional de los circuitos neuronales que subyacen al comportamiento social y emocional en la adolescencia. Este artículo explora el desarrollo neurocognitivo adolescente en dos dominios: la sensibilidad al rechazo social y la teoría de la mente (TM). Los adolescentes refieren a menudo hipersensibilidad al rechazo social. Los estudios que se presentan sugieren que se acompaña de una disminución de las respuestas en regiones cerebrales vinculadas a la regulación emocional. También se comentarán los estudios sobre rechazo social en adolescentes con trastornos del espectro autista. La teoría de la mente es otro campo cognitivo social que subyace al desarrollo neurocognitivo entre adolescencia y edad adulta. Dicha teoría alude a la capacidad de comprender los pensamientos e intenciones de los demás. Los datos de neuroimagen sugieren que la capacidad de integrar la información emocional en decisiones de teoría de la mente sigue desarrollándose entre la adolescencia y la edad adulta. En síntesis, tales estudios demuestran que hay un desarrollo continuo de la cognición social y emocional durante la adolescencia tanto en el nivel comportamental como neuronal, proporcionando un marco neurocognitivo para explicar el comportamiento adolescente.

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Human adolescence is a period of physical, psychological, and social transition between childhood and adulthood (Spear, 2000). While it is difficult to define the precise onset and end point of

adolescence, it has been described as beginning with the onset of puberty and ending with a stable commitment to an adult role (Damon, 2004). For the purposes of this article, adolescence will be broadly defined as the second decade of life. While there are undoubtedly cultural influences at play, adolescence is often characterised by an increase in emotional lability and risk-taking behaviours. Epidemiological data also suggest that adolescence is a key time for the onset of psychological disorders characterised

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by emotional dysregulation (Kessler et al., 2005). These include internalising disorders such as depression and anxiety, as well as externalising disorders such as conduct disorder.

It has been suggested that this vulnerability results from ongoing brain development occurring during adolescence, particularly in brain regions responsible for high level cognitive abilities such as planning, decision-making, and regulating emotions (e.g., Paus, Keshavan, & Giedd, 2008). In the last 15 years, the availability of safe and non-invasive neuroimaging methods such as magnetic resonance imaging (MRI) has revolutionised the study of adolescence. It is now known that significant development occurs in the brain's grey and white matter and that those brain regions which are latest to mature are those responsible for complex human behaviours, notably the prefrontal cortex and temporo-parietal regions (Giedd et al., 1999; Gogtay et al., 2004; Shaw et al., 2008; Sowell et al., 1999). Different brain regions have also been shown to mature at different rates and with differing trajectories; for example, Shaw et al. (2008) found that evolutionarily older parts of the brain, such as the limbic system, mature in a simpler linear trajectory than regions that evolved more recently, such as the neocortex. Neurotransmitter systems also continue to develop; for example the dopaminergic system undergoes substantial remodelling during adolescence (Steinberg, 2008).

Research is currently engaged in further linking specific adolescent behaviours with particular patterns of brain development. Several recent models of the link between adolescent brain and behaviour have proposed the idea of a 'developmental mismatch' between parts of the brain involved in processing emotional and reward signals (including regions such as the amygdala and ventral striatum) and those responsible for regulating these responses (e.g., parts of the prefrontal cortex) (Casey, Jones, & Hare, 2008; Nelson, Leibenluft, McClure, & Pine, 2005; Steinberg, 2008). During adolescence, it is hypothesised that the development of regulatory regions lags behind that of emotional processing regions, rendering the adolescent brain a 'fast car with poor brakes'. Although this formulation is undoubtedly oversimplified, it provides a useful framework and generates predictions that can be tested using methods such as functional magnetic resonance imaging (fMRI).

In addition to emotional processing, regulation, and behaviour, it is also important to consider the role of social development in adolescence. Indeed, the social environment is crucial in shaping the adolescent brain (Blakemore, 2008). The role of peers is vital, with evidence suggesting that by mid-adolescence, individuals spend more time with their peers than with their parents (Steinberg & Silverberg, 1986). Also important is the increasing ability of adolescents to think abstractly about themselves and other people. This means they have a more sophisticated understanding of complex social phenomena such as reputation, social hierarchy, personality traits, and how others see them (the 'looking glass self') than they did at an earlier age (Harter, 1990; Parker, Rubin, Erath, Wojslawowicz, & Buskirk, 2006; Sebastian, Burnett, & Blakemore, 2008).

Social Rejection in Adolescence

Given this ongoing development in both affective (emotional) and social domains, several researchers have investigated whether 'developmental mismatch', resulting in poor emotion regulation, could interact with social cognitive development to account for social behaviours commonly seen in adolescence. One phenomenon that captures the overlap between social and emotional processes particularly well is sensitivity to social rejection in adolescence. Social rejection, or ostracism, refers to being deliberately ignored or excluded by an individual or a group (Williams, 2007). In adolescence, social rejection is often used as a form of relational

aggression or bullying, with one study (Wang, Iannotti, & Nansel, 2009), reporting that 27.4% adolescent girls had been excluded or ignored by peers at school. Boys may also use relational aggression but girls are more likely to do so, and to be upset when they are the victim (Crick & Nelson, 2002; Wang et al., 2009). Self-report studies have suggested that adolescents might be more sensitive to social rejection than both adults and younger children in everyday life (Kloep, 1999; O'Brien & Bierman, 1988). However, the social, cognitive, and neural processes underlying this effect have only recently been investigated experimentally.

As a starting point, it is important to establish whether adolescent sensitivity to social rejection can be replicated in the laboratory. If so, this would suggest that the phenomenon is not just an artefact of the adolescent social environment (e.g., social hierarchies at school). In recent years, the 'Cyberball' paradigm (Williams, Cheung, & Choi, 2000) has been used extensively to experimentally investigate responses to social rejection in a wide range of populations. Cyberball is a computer game in which participants are told that they are playing a game of 'catch' over the internet with two other players, and that the researchers are interested in 'mental visualisation ability' during the game. In fact, the actions of the other players are pre-programmed by the experimenter to either include or exclude the participant in a systematic way. Reactions to this manipulation can then be measured (see Williams, 2007, for a review).

Cyberball was used to test adolescent responses to social rejection (focusing on females only) in a study by Sebastian, Viding, Williams, and Blakemore (2010). Twenty-six early adolescents (aged 11–13), 25 mid adolescents (aged 14–15), and 26 adult female controls were first included and then rejected in successive rounds of Cyberball. Self-reported mood and anxiety levels were measured at baseline (i.e., before playing Cyberball), after inclusion, and finally after rejection. (Condition order was not randomised in order to avoid possible negative spillover effects from the rejection to the inclusion condition). Relative to adult females, both adolescent groups reported lower overall mood following rejection. The early adolescents also reported greater anxiety. The mid-adolescents did report high anxiety following rejection, but anxiety was also high following inclusion (relative to baseline). One possible conclusion from this finding is that social interaction in general can be anxiety-provoking at this age. Indeed, the mean age of onset for social phobia occurs in mid-adolescence at age 15 (Mancini, Van Ameringen, Bennett, Patterson, & Watson, 2005). In contrast, all groups reported that they had been excluded by the other players to a similar degree and reported the experience as feeling equally real. This suggests that adolescents (at least adolescent girls) respond more strongly and negatively to social rejection than do adults, even when there are no objective differences in the perception of the rejection episode.

Social Rejection and the Adolescent Brain

The behavioural study reported above suggests that sensitivity to rejection in adolescence can be elicited under experimental conditions, even when the rejection encounter is very brief and has no long term consequences for social reputation. It is therefore interesting to consider what factors might underlie this effect. One hypothesis is that ongoing brain development in regions responsible for processing and regulating responses to social rejection may contribute. Eisenberger, Lieberman, and Williams (2003) used the Cyberball paradigm together with fMRI in adults and found that activity in right ventrolateral prefrontal cortex (VLPFC) during social rejection (relative to inclusion) was negatively related to self-reported distress, i.e., a greater response in this region was associated with reduced rejection-related distress. One possibility

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