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A comprehensive assessment of social cognition from adolescence to adulthood

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ABSTRACT

While it is well accepted that the social brain undergoes prolonged development throughout the teenage years, behavioral evidence of this development from adolescence to adulthood are lacking. The current study thus investigated multiple aspects of social cognition in 30 adolescents of 12–17 years, 32 young adults of 18–21 years, and 27 adults of 22–30 years. The Integrated Social Cognition Battery (mentalizing, social knowledge, emotion recognition) and a self-reported empathy questionnaire were administered, along with non-social cognition tests (selective attention, working memory, executive functions). Adolescents' scores were significantly lower on the cognitive empathy subscale and emotion recognition task, even while taking into account other developing non-social cognitive functions. No difference was found regarding mentalizing, social knowledge, and other aspects of empathy. The results suggest a protracted development of some components of social cognition across adolescence, while others seem to be already developed. A nuanced understanding of social cognition development is discussed.

1. Introduction

Adolescence has been conceptualized by Dahl (2004) as “that awkward period between sexual maturation and the attainment of adult roles and responsibilities”, generally considered as ranging from 12 to 18 years of age (Drapeau & Cloutier, 2008; Steinberg & Morris, 2001). This stage of life is marked by extensive socialization during which peer relationships increase in importance and complexity, as adolescents spend gradually less time with their families and become extremely sensitive to acceptance and rejection by peers (Larson & Richards, 1991; Steinberg, 2005). In order to navigate successfully through these new social networks and to accomplish the developmental tasks of adolescence, such as forming romantic relationships, teens need to develop adaptive social skills and competence, including social cognition abilities (Havighurst, 1972; Scherf, Behrmann, & Dahl, 2012). Social cognition generally refers to the set of cognitive functions that allow humans to understand and interact with each other (Blakemore, 2008), and can be conceptualized as distinct from “non-social”, or general, higher-order cognitive abilities such as executive functions (Beauchamp & Anderson, 2010). Mentalizing, also referred to as theory of mind (ToM), represents a central component of social cognition and can be defined as the capacity to attribute various mental states to others, including beliefs,

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intentions, emotions and desires. In everyday situations, successful mentalizing typically requires a complex integration of both immediate and stored information about the person and the context (Achim, Guitton, Jackson, Boutin, & Monetta, 2013). Emotion recognition, which is the ability to recognize affective states based on the perception of social cues (e.g., faces or voices), is considered as an immediate source of perceptual information about a specific person that can contribute to mentalizing (Achim et al., 2013). Social knowledge, on the other hand, is a type of semantic memory about social situations that is retrieved during mentalizing judgements and considered as an unspecific source of information about the context (Achim et al., 2013). Another central process associated with social cognition is empathy, which is focused on the emotional experiences of others. Empathy includes the ability to vicariously share another's emotions (i.e., affective empathy) as well as the ability to adopt his or her psychological perspective (i.e., cognitive empathy), the latter being closely related to mentalizing ability (Decety & Jackson, 2004; Shamay-Tsoory, 2011). All of these functions interact to help us predict other people's behaviors and generate appropriate responses, such as engaging in prosocial behaviors (Green et al., 2008; Tousignant, Eugène & Jackson, 2016).

In the past years, longitudinal studies have shown undergoing structural brain development during adolescence in regions underlying social cognition, referred to as “the social brain”, mainly including the medial prefrontal cortex, temporoparietal junction and posterior superior temporal sulcus (Giedd, 2008; Gogtay et al., 2004; Mills, Lalonde, Clasen, Giedd, & Blakemore, 2014). Changes in brain activation have been observed in fMRI studies using various mentalizing tasks, consistently showing a decrease in dorsomedial prefrontal cortex activation from adolescence to adulthood (see Blakemore, 2012 for a review). Functional development has also been shown during facial emotion recognition tasks, mainly characterized by an increase in activation and connectivity of frontal and temporal regions from childhood to adolescence, followed by a plateau (Cohen Kadosh, Cohen Kadosh, Dick, & Johnson, 2011; Cohen Kadosh, Johnson, Dick, Cohen Kadosh, & Blakemore, 2013; Deeley et al., 2008). Concerning empathy, the available evidence point towards a prolonged development of the cognitive aspect of empathy during adolescence, which is related to mentalizing abilities, whereas the affective component of empathy might be already mature during childhood (Decety, 2010; Decety & Michalska, 2010). There thus seems to be ongoing development in the neural correlates of social cognition during adolescence, but the consequences of this development on adolescents' social cognition have been much less studied. Social cognition performances have been equated between groups in most of the fMRI studies presented here, and the majority of behavioral studies have focused on childhood. Part of the explanation for this lack of research is that one runs the risk of observing ceiling effects with adolescents when using the tasks designed to measure social cognition development.

The few behavioral studies that have examined the development of mentalizing abilities *per se* during adolescence have obtained rather contradictory data. Improvement in cognitive and affective mentalizing has been observed from adolescence to adulthood in a few studies (Sebastian et al., 2012; Vetter, Altgassen, Phillips, Mahy, & Kliegel, 2013; Vetter, Leipold, Kliegel, Phillips, & Altgassen, 2012). On the other hand, the study of Gunther Moor et al. (2012) suggests that ToM abilities develop *before* early adolescence, as measured by the Reading the Mind in the Eyes test. This task requires to attribute various mental states from photographs of the eye region of the face, and although some authors consider it to be an emotion recognition task, the stimuli are much more rich than typical emotion recognition tests (Achim et al., 2013). Similarly, using various second order mentalizing tasks, other recent work did not observe significant improvement after 13 years of age (Bosco, Gabbatore, & Tirassa 2014).

Concerning other aspects of social cognition, the literature is more scarce, especially for social knowledge and empathy for which there are almost no behavioral study during adolescence. A few studies have investigated the behavioral development of emotion recognition, among which significant differences between adolescents and adults were found using dynamic stimuli of basic emotions (Thomas, De Bellis, Graham, & LaBar, 2007). In a recent study by Lawrence, Campbell & Skuse (2015) using the Ekman & Friesen series representing static facial expressions, improvement has been observed from 6 to 16 years, but it remains unclear whether the performance continues to improve after this age. Using a task involving categorization of emotional expressions, Cohen Kadosh et al. (2013) did not find any differences between adolescents' and adults' performances.

Thus, while some studies suggest a protracted development of social cognition from adolescence to adulthood, others reveal that these abilities are fully developed by early to middle adolescence. These contradictions might be explained by the great variability in age groups and tasks chosen across studies, mainly including only one measure of social cognition. Social cognition comprises a wide range of functions that interact together in a complex manner and it seems necessary to integrate a variety of measures in order to have a clearer portrait of its development. Moreover, most of social cognition development models highlight the relationship between socio-cognitive abilities and higher order non-social cognitive functions, which are not always considered in social cognition studies. The SOCIAL model of Beauchamp and Anderson (2010) emphasizes the role of executive functions in social skills development, conceptualized as a broad set of functions comprising attentional control, cognitive flexibility, and goal-setting abilities. Channon and Crawford (2000) have even hypothesized that impaired mentalizing abilities could be directly attributed to disruption of broader executive functions, since there was no evidence of a double dissociation in their data. On another hand, other studies have suggested some independence between social and non-social cognitive functioning in typically-developing adolescents (Vetter et al., 2013) as well as in clinical populations (Rowe, Bullock, Polkey, & Morris, 2001). It thus appears crucial to control for higher order non-social cognitive functions when studying social cognition development, especially as these functions are still developing during adolescence (Conklin, Luciana, Hooper, & Yarger, 2007; Leon-Carrion, Garcia-Orza, & Perez-Santamaria, 2004; Luna, Garver, Urban, Lazar, & Sweeney, 2004; Taylor, Barker, Heavey, & McHale, 2015).

The present study aimed to achieve a comprehensive investigation of the developmental of social cognition from adolescence to adulthood by measuring four main components, including mentalizing, emotion recognition, social knowledge and empathy. To our knowledge, no study has performed such a complete assessment of social cognition development in adolescents. This study will thus enable to define which social cognition processes are underdeveloped or fully developed during adolescence, and how these processes are interrelated within the same sample. In order to specify the exact period during which it can be assumed that social cognition

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