

## **Abstract**

**Introduction:** Adolescence is a critical period for the development of mentalizing – the imaginative capacity to understand one's own and others' behaviour in terms of underlying mental states. Yet, factors and mechanisms underlying individual differences in adolescent mentalizing remain poorly understood. This exploratory study examined whether and how a) age and gender and b) psychological difficulties correlate with mentalizing performance in adolescents from the general population.

**Methods:** 89 adolescents from Geneva, Switzerland (54 females, age 12-17 years) completed a computerized task of mentalizing and a self-report measure of psychopathology.

**Results:** Mentalizing performance improved with age. Males showed lower scores on the mentalizing task and made more hypermentalizing errors than females. The main findings revealed a negative association between mentalizing performance and self-reported attention problems. Post-hoc analyses further demonstrated that self-reported attentional difficulties were particularly associated with weaker scores on items requiring mentalizing about intentions, while self-reported withdrawal/depression symptoms were particularly associated with weaker scores on items requiring mentalizing about emotions and thoughts.

**Conclusion:** The present study highlights a negative association between attentional difficulties and mentalizing performance in community adolescents. Moreover, it provides preliminary evidence suggesting that age, gender and psychological difficulties can be distinctively associated with patterns of correct and incorrect mentalizing in community adolescents. Implications for future research and clinical practice are discussed.

**Keywords:** Adolescence; Mentalizing; Individual differences; Age; Gender; Attention difficulties

## **Introduction**

Adolescence represents a critical developmental period for the maturation of mentalizing abilities – the imaginative capacity to understand one’s own and others’ behaviour in terms of underlying mental states (Fonagy, 1991; Frith & Frith, 2006). A growing number of studies have provided strong empirical evidence demonstrating that mentalizing abilities undergo protracted development in adolescence, coupled with significant structural and functional maturational changes in the “social brain”, a network of brain regions implicated in social-cognitive processes (S. J. Blakemore, 2008; Choudhury, Blakemore, & Charman, 2006; Taylor, Barker, Heavey, & McHale, 2013). Simultaneously, as the dynamics of the adolescent’s social world gradually gain in richness and complexity, more learning opportunities arise to shape the developing brain. Therefore, learning about others’ mental states is shaped by brain development and individual experiences in a transactional manner (Fonagy, 2002). However, intrinsic and extrinsic factors underlying individual differences in this fundamental developmental process remain largely unknown. There are several key issues contributing to the paucity of research in this area.

First of all, one of the major challenges in the study of mentalizing in any population – and in adolescents in particular – lies in the methodology, that is in the experimental measures used to assess mentalizing abilities. Traditional mentalizing tasks have been predominantly designed for children and may yield ceiling effects in older individuals. Moreover, most of currently existing tasks tap into basic components of social cognitive abilities, such as emotion recognition e.g. Reading the Mind in the Eyes Test (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001); false belief understanding e.g. Strange stories test (Happé, 1994); or perspective taking e.g. Director Task (Dumontheil, Apperly, & Blakemore, 2010; Keysar, Lin, & Barr, 2003). Such measures are limited in their capacity to capture the

complexity of social interactions and interpersonal functioning in real life. Thus, these may fail to assess mentalizing in a way that is reflective of the capacities employed in everyday social situations. Another limitation lies in the categorical “right or wrong” selection of answers, which fall short when probing intra- and inter-individual variations in performance. Importantly, due to the multidimensional nature of mentalizing abilities (Fonagy & Luyten, 2009), there are likely to be many factors influencing responses on mentalizing tasks. In summary, these methodological challenges call for age-appropriate, theoretically informed and ecologically valid tasks that would enable to interpret variations in performances between and within individuals (Brizio, Gabbatore, Tirassa, & Bosco, 2015). An example of such a task is the Movie for Assessment of Social Cognition (MASC) (Dziobek et al., 2006) – an ecologically valid and sensitive tool (Fossati, Borroni, Dziobek, Fonagy, & Somma, 2018). This computerized task offers a unique advantage to study individual differences in performance by assessing aspects of both cognitive and affective components of mentalizing, and providing a thorough examination of correct as well as incorrect mentalizing patterns.

In addition to methodological limitations, existing studies tend to overlook the effects of basic determinants of individual differences in mentalizing, such as age and gender. While it is well-documented that age is positively correlated with socio-cognitive abilities, highlighting their gradual development from childhood into adolescence and early adulthood (Dumontheil et al., 2010; Taylor et al., 2013), we note that the relative and independent contribution of age, within a multivariate design, is still often confounded with other possible determinants of function. Here, gender represents one important potential determinant. A considerable number of studies in adults and adolescents show that females tend to perform better on social cognition tasks than males (Baron-Cohen et al., 2001; Bosco, Gabbatore, & Tirassa, 2014; Kirkland, Peterson, Baker, Miller, & Pulos, 2013; Van der Graaff et al., 2014). However, specific factors and processes associated with this female advantage in performance

remain unclear (Rutherford et al., 2012; Van der Graaff et al., 2014). Besides, contradictory findings have also been reported. For example, a male advantage in emotional understanding was previously documented in adults (Russell, Tchanturia, Rahman, & Schmidt, 2007). Thus, the relative and independent contribution of gender as a potential determinant of individual differences in adolescent mentalizing is yet to be examined.

Lastly, and perhaps most importantly, the relationship between psychological difficulties in adolescence and individual differences in mentalizing is poorly understood. One of the hallmarks of adolescence is socio-emotional vulnerability, accompanied by a heightened risk for the emergence or exacerbation of psychopathological symptoms (Casey, Jones, & Hare, 2008; Paus, Keshavan, & Giedd, 2008). It is possible to hypothesize that psychological difficulties, considered on a continuum from typical to pathological manifestations, could have a particularly important impact on social cognition schemas, and notably, on developing mentalizing skills. Accordingly, accumulating evidence points to a link between psychopathology and mentalizing (Bateman & Fonagy, 2004; Fonagy & Luyten, 2009; Sharp & Venta, 2012). Indeed, mentalizing difficulties in adults have been documented across a range of psychiatric entities (Cotter et al., 2017; Gallagher & Varga, 2015). For example, using the MASC described above, clinical studies point to decrements in performance in narcissistic personality disorder (Ritter et al., 2011), paranoid schizophrenia (Montag et al., 2011), depression (Wolkenstein, Schönenberg, Schirm, & Hautzinger, 2011) and borderline personality disorder (Preißler, Dziobek, Ritter, Heekeren, & Roepke, 2010). Mentalizing problems detected by the MASC have also been documented in children and adolescents with mental health problems (Quek et al., 2018; Sharp & Venta, 2012). Yet, in a similar fashion to the methodological limitations reviewed above, the unique contributions of psychological difficulties to mentalizing performance most often lack a multivariate assessment. Although clinically informative, existing studies employing the MASC (Ha, Sharp, Ensink, Fonagy, &

Cirino, 2013; Kalpakci, Vanwoerden, Elhai, & Sharp, 2016; Quek et al., 2018; Sharp et al., 2013; Sharp, Ha, Michonski, Venta, & Carbone, 2012; Sharp & Vanwoerden, 2014) tend to focus on specific diagnostic entities, lack healthy control groups, and do not systematically examine relationships between various psychological difficulties and mentalizing. Moreover, there is a general lack of studies examining correlates of MASC performance in the general population and in adolescents in particular. Nonetheless, two recent studies employed the MASC in non-clinical community adolescents (Fossati et al., 2018; Quek et al., 2018). However, these studies did not examine psychological correlates of MASC performance in their adolescent samples.

Hence, studies of non-clinical, general population adolescents are needed to elucidate whether and how different domains of psychological difficulties, when assessed together, may contribute to maladaptive mentalizing patterns in adolescence. In the context of growing interest in transdiagnostic approaches to psychopathology (Cuthbert, 2014; Nolen-Hoeksema & Watkins, 2011), unravelling psychological difficulties implicated in transactional processes underlying the development of adult mentalizing skills is of paramount importance, both for the study of typical and atypical developmental trajectories of socio-cognitive processes.

The main rationale of the current exploratory study is to address the gaps in the literature described above, with the aim to elucidate individual differences in adolescent mentalizing performance, as assessed by the MASC. Specifically, we aim to cross-sectionally investigate whether and how a) demographic variables (age and gender) and b) the degree of psychological difficulties are associated with individual differences in mentalizing performance in a community sample of adolescents.

## **Methods**

### *Participants*

Adolescents from the community were recruited by undergraduate students as part of their course requirements at the University of Geneva Faculty of Psychology and Educational Sciences. Inclusion criteria for this community convenience sample were age (12 to 17 years), proficiency in French, enrolment in age-appropriate school curricula and absence of past or current psychiatric treatment and/or neurological conditions, as assessed by a self-report demographics questionnaire. One participant was excluded as he reported having an ADHD diagnosis and was medicated with Methylphenidate at the time of the study. All adolescents and their parents/legal representatives gave informed written consent for the participation in the study.

### *Measures*

#### *Movie for Assessment of Social Cognition (MASC)*

The MASC (Dziobek et al., 2006) is a computerized task assessing mentalizing abilities. The French version of the task was employed.

Participants are asked to watch a 15-minute movie featuring four characters interacting during a dinner party. The movie stops at different moments during the plot and participants are asked a multiple choice question about the characters' mental states: intentions (e.g. "Why did Anna say that?"), emotions (e.g. "What is Mary feeling?") or thoughts (e.g. "What is Ben thinking?"). The task comprises 45 multiple choice test questions, resulting in a maximum total score of 45. 19 items assess inference of intentions, 18 items – inference of emotions and 8 items – inference of thoughts. For each question, four answer options are provided, each option characteristic of a particular mentalizing pattern: a) *Correct mentalizing*,

referring to balanced inference of others' mental states b) *Hypermentalizing*, indicating an excessive allocation of mental states c) *Undermentalizing*, referring to reduced use of others' mental states and d) *Lack of mentalizing*, representing a complete absence of mentalizing. Thus, four scores for each type of mentalizing patterns are computed, for each type of mental state (intentions, emotions, thoughts). In addition, 6 control questions requiring non-social inferences are asked to control for correct understanding of the task.

MASC performance was examined in terms of raw scores, that is the total number of correct responses. Similarly, MASC errors were analysed separately in terms of the total number of Hypermentalizing, Undermentalizing and Lack of mentalizing errors.

#### *Youth Self Report Scale (YSR)*

The YSR (Achenbach, 1991) is a self-report measure of psychopathology used to assess the presence and severity of psychological difficulties in adolescents. The French version of the questionnaire was used.

This screening tool comprises 112 items referring to the occurrence of emotional and behavioural problems over the past 6 months: e.g. "I don't sleep much" or "I find it difficult to concentrate". Each item is scored on a 3- point scale (0= 'not true', 1= 'somewhat or sometimes true', or 2 = 'very or often true'). The YSR items can be grouped into 8 psychopathology syndrome subscales, which evaluate the presence of the following difficulties: Anxious/Depressed, Withdrawn/Depressed, Somatic Complaints, Social Problems, Thought Problems, Attention Problems, Rule Breaking behaviour, Aggressive Behaviour. For each subscale, a total T-score is computed. A T-score of 65 represents the cut-off for clinically significant symptomatology. T-scores for each syndrome scale were used for the analysis of YSR scores.

### *Statistical Analysis*

All the data was analyzed with SPSS for Macintosh, version 23 (IBM Corp). First, sample characteristics were examined in terms of age, gender, YSR scores and MASC performance.

Second, potential relationships between independent variables (age, gender and YSR scores) and MASC performance were explored. Effects of age were examined using partial correlations controlling for gender. Effects of gender were analysed with ANCOVA's controlling for age. Subsequently, partial correlational analyses controlling for age and gender were conducted to examine associations between the YSR syndrome subscales scores and MASC scores. The Bonferroni correction was used to adjust for multiple comparisons.

Third, stepwise multiple regression analyses were conducted to examine the independent contribution of age, gender and YSR scores to MASC performance.

The last two steps of this statistical procedure were performed to a) examine whether and how demographic and psychological variables are associated with successful MASC performance (total correct score) b) examine whether and how these variables are associated with patterns of incorrect MASC performance (total Undermentalizing and Hypermentalizing error scores).

Finally, to clarify the nature of the relationships identified in the main analysis, post-hoc stepwise regression analyses were conducted on the three subcomponents of the total MASC score: mentalizing about intentions, emotions and thoughts.

## **Results**

### *Descriptive statistics*

The final sample included 89 adolescents aged from 12 to 17 years (54 girls, mean age = 15.43, SD = 1.59). The age distribution in the sample was as follows: 12-13 years (n= 6), 13-14 years



(n= 12), 14-15 years (n= 12), 15-16 years (n= 29), 16-17 years (n= 13), 17-18 years (n= 17). There was a significant age difference between boys and girls ( $t(87) = 2.95, p = 0.004$ ), with boys being one-year younger (mean=14.84, SD= 1.60) than girls (mean = 15.82, SD = 1.47).

Participants' scores on the YSR syndrome scales are displayed in Table 1. Overall, the mean scores obtained on the YSR syndrome scales were within the normal range. These results are broadly consistent with epidemiological studies (Costello, Egger, & Angold, 2005; Merikangas et al., 2010). Independent samples t-tests (Bonferroni set at  $p = 0.006$ ) showed no significant differences in YSR T-scores between boys and girls ( $p > 0.02$ ).

[INSERT TABLE 1]

#### *MASC performance*

Participants' performance on the MASC is shown in Tables 2 and 3. Table 2 displays raw scores of the total number of correct responses obtained on the MASC. Table 3 shows the prevalence and types of mentalizing errors.

[INSERT TABLE 2]

[INSERT TABLE 3]

In our community sample, the mean percentage of correct responses on the MASC (see Table 2) was of 66% (34% of mentalizing errors). In terms of responses reflecting incorrect mentalizing (see Table 3), Hypermentalizing errors were the most prevalent (17%), followed by Undermentalizing (13%) and finally by Lack of mentalizing (4%). The prevalence and variance of Lack of Mentalizing errors were insufficient to be considered for further statistical analysis. Thus, only Undermentalizing and Hypermentalizing errors were further explored.

*Relationships between age, gender, self-reported psychological difficulties and MASC performance.*

Consistent with previous research, age was significantly associated with total MASC scores ( $r = 0.390, p < 0.0001$ ). Older adolescents tended to obtain more accurate responses on the MASC (Figure 1).

[INSERT FIGURE 1]

We further observed significant gender differences in mentalizing performance. After controlling for age, girls obtained a significantly higher number of correct responses on the MASC than boys ( $F(1, 86) = 5.43, p < 0.05$ ). Gender differences were further observed in the analysis of mentalizing errors. Interestingly, boys made significantly more Hypermentalizing errors than girls, when controlling for age ( $F(1, 86) = 16.95, p < 0.001$ ). No gender differences were noted in terms of Undermentalizing errors.

Potential associations between YSR scores and MASC performance were explored with partial correlational analysis controlling for age and gender (see Table 4). The Bonferroni correction for eight comparisons was applied ( $p$  set at 0.006).

Total MASC scores were negatively associated with self-reported attentional difficulties ( $r = -0.337, p = 0.002$ ). There was also a trend for a negative association between MASC performance and Withdrawn/Depressed scores ( $r = -0.290, p = 0.007$ ). There were no significant associations between YSR scores and Undermentalizing or Hypermentalizing scores.

[INSERT TABLE 4]

To further look into the relative and independent contributions of our independent variables to mentalizing performance, stepwise multiple regressions were conducted a) on total MASC scores and b) on the MASC Undermentalizing and Hypermentalizing scores. Age, gender and YSR syndrome scores were entered as predictor variables.

MASC total scores were best predicted by a model with age, gender, and YSR Attention Problems, which together accounted for over a third of the variance in the outcome variable ( $F(3, 85) = 14.395, p < 0.001, R^2_{Adjusted} = 0.313$ ). Other YSR syndrome scores did not significantly contribute to the model and these variables were removed by the stepwise analysis (see Table 5).

In terms of mentalizing errors, stepwise regression models identified age ( $b = -0.238, p = 0.024$ ) as a weak albeit significant predictor of Undermentalizing error scores ( $F(1,87) = 5.243, p = 0.024, R^2_{Adjusted} = 0.046$ ). On the other hand, gender ( $b = 0.452, p < 0.001$ ) revealed to be a strong predictor of variance in Hypermentalizing error scores ( $F(1,87) = 22.374, p < 0.0001, R^2_{Adjusted} = 0.195$ ).

#### *Post-hoc analyses*

To better understand the results above, additional stepwise regression analyses were conducted on the subcomponents of the total MASC score, namely on responses reflecting inference of different types of mental states: Intentions, Emotions and Thoughts (see Table 6).

Variance in Mentalizing about Intentions was best predicted by a model with age and Attention Problems scores ( $F(2, 86) = 7.966, p = 0.001, R^2_{Adjusted} = 0.137$ ). Mentalizing about Emotions scores were best accounted for by a model with age and YSR Withdrawn/Depressed scores ( $F(2,86) = 11.457, p < 0.0001, R^2_{Adjusted} = 0.192$ ). Finally, Mentalizing about Thoughts was best predicted by gender and YSR Withdrawn/Depressed

scores ( $F(2, 86) = 7.77, p = 0.001, R^2_{Adjusted} = 0.133$ ). Specifically, when controlling for age, girls performed better on items requiring inference of others' thoughts ( $F(1, 86) = 6.57, p = 0.01$ ).

[INSERT TABLE 5]

[INSERT TABLE 6]

## **Discussion**

The present exploratory correlational study sought to elucidate individual differences in adolescent mentalizing performance, as assessed by a promising research tool – the Movie for Assessment of Social Cognition (MASC). To the best of our knowledge, this is the first investigation reporting associations between demographic variables, self-reported psychological difficulties and correct as well as incorrect MASC performance in an adolescent community population. We demonstrated that age, gender, attention problems and, to a lesser extent, withdrawal/depression symptoms may show different patterns of associations with different aspects of mental state inference. Below we discuss these findings drawing on mentalization theory (Fonagy & Luyten, 2009) as well as experimental and clinical evidence. We conclude with a discussion of this study's limitations and pinpoint implications for future research and clinical practice.

### *Correct and incorrect mentalizing*

Given the lack of studies employing the MASC to study social cognition in non-clinical adolescents (Fossati et al., 2018), it is important to briefly discuss the descriptive results characterizing MASC performance in our community subjects. Hypermentalizing errors were most prevalent in the current sample, followed by Undermentalizing errors. This is consistent

with previous reports in typically developing adolescents (Fossati et al., 2018; Quek et al., 2018). Maladaptive mentalizing strategies, such as under- and over-attribution of mental states could reflect ongoing socio-emotional learning and adjustment to novel interpersonal complexity in adolescence. This supports the notion of ongoing maturation of social cognitive abilities from childhood to adulthood (S.-J. Blakemore & Mills, 2014; Dumontheil et al., 2010; Taylor et al., 2013).

Importantly, these descriptive results warn caution for the interpretation of findings from clinical studies. For example, accumulating evidence emphasizes the prevalence of hypermentalizing errors in patients with borderline personality disorder (Sharp et al., 2013; Sharp et al., 2011). Yet, the number of hypermentalizing errors documented in our non-clinical sample (mean = 7.62, SD = 3.14, mean age = 15.43 ) was comparable to the amount of errors reported in several studies of adolescents with BPD (e.g. Sharp et al., 2011: mean = 8.11, SD = 4.08, mean age = 15.5; Quek et al., 2018: mean = 8.94, SD = 3.95, mean age = 15.65) and other psychiatric conditions (e.g. Sharp and Vanwoerden, 2014: mean = 7.94, SD = 3.77, mean age = 15.39; Ha et al., 2013: mean = 7.86, SD = 4.06). A similar remark was reported by Fossati and colleagues, who documented markedly lower average MASC scores in their non-clinical adults than previously reported in the literature (e.g. Dziobek et al., 2006; Preißler et al., 2010). It is possible that such discrepancies could have emerged from using a convenience sample from the general community, rather than a carefully selected healthy control sample. Yet, this observation encourages further investigations of the psychological correlates of MASC performance in the general population as well as in highly selected typically developing controls. It also emphasizes the necessity to include healthy control groups in clinical studies using the MASC in order to achieve meaningful evaluation of mentalizing performance in clinical populations.

### *Demographic correlates of mentalizing*

The first line of our results replicated and extended the previously documented effects of age and gender in socio-cognitive performance (Baron-Cohen et al., 2001; Dumontheil et al., 2010; Van der Graaff et al., 2014). Age was associated positively with correct mentalizing scores and negatively with undermentalizing errors. With age, mental state information may become increasingly relevant to the maturing mind of the adolescent, consistent with research showing that the ability to infer others' mental states improves from early to late adolescence (Dumontheil et al., 2010). Interestingly, age was not predictive of hypermentalizing errors in the regression models. In line with this, a recent study comparing MASC performance in non-clinical adolescents and adults demonstrated comparable performances between the two groups (Fossati et al., 2018). The authors suggested that excessive attribution of mental states is the most frequently observed error type not only in adolescents, but also in adults.

Next, we replicated the female advantage in mentalizing performance previously reported in non-clinical and clinical populations (Baron-Cohen, Knickmeyer, & Belmonte, 2005; Lai, Lombardo, Auyeung, Chakrabarti, & Baron-Cohen, 2015), which stresses the need to control for gender differences in studies with adolescent populations. Besides, we showed that girls obtained better scores particularly on MASC items requiring inference of others' thoughts. However, given that only eight items assessed thoughts inference (compared to 19 and 18 for intentions and emotions inference, respectively), this result needs to be further explored in studies with larger samples. The present results extend the general female advantage effect in considering gender differences in mentalizing errors. Gender uniquely predicted hypermentalizing errors in the regression models. This is the first direct gender comparison for the use of hypermentalizing strategies, which revealed that adolescent boys

hypermentalize more than adolescent girls. Similar observations were discussed in a previous study of older adolescents (Fossati et al., 2018). Given the difference in female and male sample sizes in the present report, this observation remains speculative. Moreover, the nature of gender differences in mentalizing development remains to be clarified by further investigations. For example, girls tend to reach puberty earlier than boys (Susman et al., 2010) and pubertal changes have been associated with fluctuations in socio-cognitive performance (Keulers, Evers, Stiers, & Jolles, 2010; McGivern, Andersen, Byrd, Mutter, & Reilly, 2002). Alternatively, social interactions in adolescence may place slightly different demands on socio-cognitive skills in males and females (Bagwell, Schmidt, Newcomb, & Bukowski, 2001; Hughes & Dunn, 1998).

#### *Psychological correlates of mentalizing*

The key result of this study revealed that amongst all studied syndromes of psychopathology, self-reported attention difficulties were most strongly associated with total MASC scores. Accordingly, mentalization theory postulates that adequate development of mentalizing may be dependent upon attentional control during early development (Fonagy & Target, 2002). Joint attention and other attentional mechanisms are thought to be critical for both social and non-social learning in infants and young children (Mundy & Newell, 2007; Striano, Chen, Cleveland, & Bradshaw, 2006). Yet to date, the link between attention and mentalization has been rarely researched in children, and even more scarcely in adolescents. To the best of our knowledge, this is the first empirical evidence showing that attention problems are associated with MASC performance in community adolescents.

Interestingly, a recent study by Perroud and colleagues (Perroud et al., 2017) documented that mentalizing abilities, as measured by self-reported certainty and uncertainty about mental states may be compromised in adults with Attention Deficit/Hyperactivity

disorder (ADHD). The authors argued that mentalizing could represent a key process associated with core attentional and hyperactive/impulsive symptoms as well as emotional difficulties in ADHD. However, how ADHD symptomatology interacts with ongoing maturation of social cognitive abilities during development still requires in-depth research. For example, preliminary evidence suggests that children and adolescents with ADHD tend to perform poorly on social cognition tasks (Bora & Pantelis, 2016). Notably, decreased performance has been demonstrated on emotion recognition tasks involving facial (Sinzig, Morsch, & Lehmkuhl, 2008; Williams et al., 2008) as well as contextual cues (Da Fonseca, Segulier, Santos, Poinso, & Deruelle, 2009). In ADHD adolescents, Sibley and colleagues reported deficits in performance on tasks tapping social comprehension and social problem solving (Sibley, Evans, & Serpell, 2010). The authors concluded that adolescents with ADHD may have trouble understanding and generating appropriate responses in social situations, which may be at least partially responsible for their interpersonal problems. Together with our findings, this area of literature emphasizes the need to investigate in detail the relationship between attentional difficulties and mentalizing development in adolescents with and without ADHD.

We now turn to the discussion of our post hoc results, demonstrating that attention problems were particularly associated with inferring other's intentions, while withdrawal/depression symptoms – with inferring others' emotions and thoughts. This pattern of results raises a number of interesting questions for future research. First, our preliminary results hint that different psychological mechanisms may be more or less associated with adaptive inference of cognitive (e.g. intentions, beliefs) versus affective (e.g. emotions) mental states. For instance, in the present report adaptive inference of emotions was particularly associated with affectivity. This is consistent with previous clinical reports associating mentalizing difficulties to persistent negative affect and to emotion dysregulation (Fischer-



Kern et al., 2013; Sharp et al., 2011). Future research is thus warranted to elucidate the relative contribution of specific affective processes (e.g. emotional arousal, emotional awareness, emotion regulation) to adaptive and maladaptive emotion inference in both clinical and non-clinical populations. On the other hand, we documented that adaptive inference of intentions was particularly associated with attentional difficulties. This stimulates a further research question, addressing the role of one's ability to pay attention to different types of social cues in adaptive mentalizing. For example, mentalization theory distinguishes the processes of *internal* versus *external* mentalizing. Internal mentalizing focuses on cues related to others' mental interiors and thus involves active reflection and cognitive control, while external mentalizing involves decoding and interpretation of external, easily detectable cues (e.g. eye gaze, facial and postural expressions etc.) and is typically considered to be an automatic and rapid process. It could be interesting to explore whether individual differences in the capacity to pay attention to internal versus external cues may impact mentalizing abilities. Hence, future studies adopting this working hypothesis could clarify the mechanisms implicated in the documented here relationship between attentional difficulties and inference of others' goal-directed, intentional behaviour.

In summary, the current study demonstrated that age, gender, attention problems and withdrawal/depression can be distinctively associated with different aspects of mental state inference. The present findings have important clinical implications. First, they bolster the importance of assessing psychological difficulties in typically developing adolescents, as not only they affect future mental health, but also the development of socio-cognitive processes, which are key for adaptive social functioning. Our findings further highlight the need to address mentalizing development from the point of view of transactional processes, influenced by demographic and psychological factors, and affecting mental health and resilience (Fonagy, 2018). Furthermore, current results emphasize the need to elucidate the profile of mentalizing

problems in ADHD youth, which is one of the most common comorbidities in paediatric mental health (Biederman, Petty, Clarke, Lomedico, & Faraone, 2011; Polanczyk, Willcutt, Salum, Kieling, & Rohde, 2014). In light of considerable socio-emotional difficulties and interpersonal problems prevalent in ADHD youth (Bora & Pantelis, 2016; Sibley et al., 2010; Uekermann et al., 2010), the study of individual differences in mentalizing development warrants particular consideration in this clinical population. Additionally, complementary psychological interventions targeting mentalizing abilities, or other socio-cognitive abilities, could represent beneficial strategies specifically aimed at improving socio-emotional functioning in adolescents with attention difficulties.

#### *Limitations and Future Directions*

The present study had several limitations. First, the small community sample of this study warns to interpret our results as preliminary. More specifically, younger adolescents (age 12-13 years) were under-represented and there were more girls than boys in our sample. We therefore encourage replication and extension of current findings in larger samples, with more balanced age and gender distributions. The control for additional demographic variables such as socio-economic status could also be beneficial for enhancing the generalizability of these preliminary results.

A second limitation concerns the lack of an interview measure to assess the severity of psychological problems in our community adolescents. Specifically, the history of past and current psychiatric problems was assessed here with a self-report demographics questionnaire. A diagnostic psychiatric interview could have been beneficial to ensure the reliability of the sample's inclusion criteria.

Third, we did not include measures of executive functioning, which may contribute to the overall model of mentalizing in adolescents. Crucially, the executive attention brain

network, allowing a successful monitoring and regulation of attention processes, is still developing in adolescence, alongside the social cognitive networks (Sherman et al., 2014; Taylor et al., 2013). Cognitive mechanisms (e.g. sustained attention, working memory, inhibition, flexibility) potentially underlying the association between attention problems and mentalizing need to be elucidated in future studies.

Finally, the cross-sectional nature of this study prevents from drawing conclusions regarding the predictive effects of psychological difficulties on mentalizing development. Future longitudinal studies are needed to confirm and elucidate the roles of affective and cognitive difficulties in mentalizing development from childhood through adolescence and into adulthood. Besides, longitudinal designs could provide further insight into fluctuations in mentalizing performance across the life-span, clarifying the roles of age and gender at different developmental stages.

At last, future research could benefit from the development of new mentalizing tasks, which are more closely related to mental state inference in everyday life. For example, tasks sensitive to idiosyncratic emotional arousal patterns could allow to explore differences between mentalizing under emotional activation as opposed to passive inference of mental states.

### **Conclusion:**

The current study provides preliminary evidence highlighting age, gender, attention problems and withdrawal/depression symptoms as important factors differentially associated with correct and incorrect mentalizing performance in community adolescents. Demographic variables and psychopathological mechanisms should thus be considered in an integrative developmental model of adolescent mentalizing. In light of previously documented

socio-cognitive deficits and interpersonal problems in ADHD youth, this study emphasizes the critical role of attention in the development of mentalizing and highlights the need for adapted interventions addressing mentalizing difficulties in this heterogeneous clinical population.

## References:

- Achenbach, T. M. (1991). *Manual for the youth self-report and 1991 profile*: Department of Psychiatry, University of Vermont Burlington.
- Bagwell, C. L., Schmidt, M. E., Newcomb, A. F., & Bukowski, W. M. (2001). Friendship and peer rejection as predictors of adult adjustment. *New directions for child and adolescent development*, 2001(91), 25-50.
- Baron-Cohen, S., Knickmeyer, R. C., & Belmonte, M. K. (2005). Sex differences in the brain: implications for explaining autism. *Science*, 310(5749), 819-823.
- Baron-Cohen, S., Wheelwright, S., Hill, J., Raste, Y., & Plumb, I. (2001). The "Reading the Mind in the Eyes" Test revised version: a study with normal adults, and adults with Asperger syndrome or high-functioning autism. *The Journal of Child Psychology and Psychiatry and Allied Disciplines*, 42(2), 241-251.
- Bateman, A. W., & Fonagy, P. (2004). Mentalization-based treatment of BPD. *Journal of Personality Disorders*, 18(1), 36-51.
- Biederman, J., Petty, C. R., Clarke, A., Lomedico, A., & Faraone, S. V. (2011). Predictors of persistent ADHD: an 11-year follow-up study. *J Psychiatr Res*, 45(2), 150-155. doi:10.1016/j.jpsychires.2010.06.009
- Blakemore, S.-J., & Mills, K. L. (2014). Is adolescence a sensitive period for sociocultural processing? *Annual review of psychology*, 65, 187-207.
- Blakemore, S. J. (2008). Development of the social brain during adolescence. *Q J Exp Psychol (Hove)*, 61(1), 40-49. doi:10.1080/17470210701508715
- Bora, E., & Pantelis, C. (2016). Meta-analysis of social cognition in attention-deficit/hyperactivity disorder (ADHD): comparison with healthy controls and autistic spectrum disorder. *Psychol Med*, 46(4), 699-716. doi:10.1017/S0033291715002573
- Bosco, F. M., Gabbatore, I., & Tirassa, M. (2014). A broad assessment of theory of mind in adolescence: the complexity of mindreading. *Consciousness and cognition*, 24, 84-97.
- Brizio, A., Gabbatore, I., Tirassa, M., & Bosco, F. M. (2015). "No more a child, not yet an adult": studying social cognition in adolescence. *Front Psychol*, 6, 1011. doi:10.3389/fpsyg.2015.01011
- Casey, B., Jones, R. M., & Hare, T. A. (2008). The adolescent brain. *Annals of the New York Academy of Sciences*, 1124(1), 111-126.
- Choudhury, S., Blakemore, S. J., & Charman, T. (2006). Social cognitive development during adolescence. *Soc Cogn Affect Neurosci*, 1(3), 165-174. doi:10.1093/scan/nsl024
- Costello, E. J., Egger, H., & Angold, A. (2005). 10-year research update review: the epidemiology of child and adolescent psychiatric disorders: I. Methods and public health burden. *Journal of the American Academy of Child & Adolescent Psychiatry*, 44(10), 972-986.
- Cotter, J., Granger, K., Backx, R., Hobbs, M., Looi, C. Y., & Barnett, J. H. (2017). Social cognitive dysfunction as a clinical marker: a systematic review of meta-analyses across 30 clinical conditions. *Neuroscience & Biobehavioral Reviews*.
- Cuthbert, B. N. (2014). The RDoC framework: facilitating transition from ICD/DSM to dimensional approaches that integrate neuroscience and psychopathology. *World Psychiatry*, 13(1), 28-35.
- Da Fonseca, D., Seguíer, V., Santos, A., Poinso, F., & Deruelle, C. (2009). Emotion understanding in children with ADHD. *Child Psychiatry & Human Development*, 40(1), 111-121.

- Dumontheil, I., Apperly, I. A., & Blakemore, S. J. (2010). Online usage of theory of mind continues to develop in late adolescence. *Developmental Science*, *13*(2), 331-338. doi:10.1111/j.1467-7687.2009.00888.x
- Dziobek, I., Fleck, S., Kalbe, E., Rogers, K., Hassenstab, J., Brand, M., . . . Convit, A. (2006). Introducing MASC: a movie for the assessment of social cognition. *Journal of autism and developmental disorders*, *36*(5), 623-636.
- Fischer-Kern, M., Fonagy, P., Kapusta, N. D., Luyten, P., Boss, S., Naderer, A., . . . Leithner, K. (2013). Mentalizing in female inpatients with major depressive disorder. *The Journal of nervous and mental disease*, *201*(3), 202-207.
- Fonagy, P. (1991). Thinking about thinking: some clinical and theoretical considerations in the treatment of a borderline patient. *Int J Psychoanal*, *72* ( Pt 4), 639-656.
- Fonagy, P. (2002). The internal working model or the interpersonal interpretive function. *Journal of Infant, Child, and Adolescent Psychotherapy*, *2*(4), 27-38.
- Fonagy, P. (2018). *Affect regulation, mentalization and the development of the self*: Routledge.
- Fonagy, P., & Luyten, P. (2009). A developmental, mentalization-based approach to the understanding and treatment of borderline personality disorder. *Dev Psychopathol*, *21*(4), 1355-1381. doi:10.1017/S0954579409990198
- Fonagy, P., & Target, M. (2002). Early intervention and the development of self-regulation. *Psychoanalytic Inquiry*, *22*(3), 307-335.
- Fossati, A., Borroni, S., Dziobek, I., Fonagy, P., & Somma, A. (2018). Thinking about assessment: Further evidence of the validity of the Movie for the Assessment of Social Cognition as a measure of mentalistic abilities. *Psychoanalytic Psychology*, *35*(1), 127.
- Frith, C. D., & Frith, U. (2006). The neural basis of mentalizing. *Neuron*, *50*(4), 531-534. doi:10.1016/j.neuron.2006.05.001
- Gallagher, S., & Varga, S. (2015). Social cognition and psychopathology: a critical overview. *World Psychiatry*, *14*(1), 5-14.
- Ha, C., Sharp, C., Ensink, K., Fonagy, P., & Cirino, P. (2013). The measurement of reflective function in adolescents with and without borderline traits. *Journal of adolescence*, *36*(6), 1215-1223.
- Happé, F. G. (1994). An advanced test of theory of mind: Understanding of story characters' thoughts and feelings by able autistic, mentally handicapped, and normal children and adults. *Journal of autism and developmental disorders*, *24*(2), 129-154.
- Hughes, C., & Dunn, J. (1998). Understanding mind and emotion: longitudinal associations with mental-state talk between young friends. *Developmental psychology*, *34*(5), 1026.
- Kalpakci, A., Vanwoerden, S., Elhai, J. D., & Sharp, C. (2016). The independent contributions of emotion dysregulation and hypermentalization to the "double dissociation" of affective and cognitive empathy in female adolescent inpatients with BPD. *Journal of Personality Disorders*, *30*(2), 242-260.
- Keulers, E. H., Evers, E. A., Stiers, P., & Jolles, J. (2010). Age, sex, and pubertal phase influence mentalizing about emotions and actions in adolescents. *Developmental Neuropsychology*, *35*(5), 555-569.
- Keysar, B., Lin, S., & Barr, D. J. (2003). Limits on theory of mind use in adults. *Cognition*, *89*(1), 25-41.
- Kirkland, R. A., Peterson, E., Baker, C. A., Miller, S., & Pulos, S. (2013). Meta-analysis Reveals Adult Female Superiority in "Reading the Mind in the Eyes Test". *North American Journal of Psychology*, *15*(1), 121.

- Lai, M.-C., Lombardo, M. V., Auyeung, B., Chakrabarti, B., & Baron-Cohen, S. (2015). Sex/gender differences and autism: setting the scene for future research. *Journal of the American Academy of Child & Adolescent Psychiatry, 54*(1), 11-24.
- McGivern, R. F., Andersen, J., Byrd, D., Mutter, K. L., & Reilly, J. (2002). Cognitive efficiency on a match to sample task decreases at the onset of puberty in children. *Brain and cognition, 50*(1), 73-89.
- Merikangas, K. R., He, J.-p., Burstein, M., Swanson, S. A., Avenevoli, S., Cui, L., . . . Swendsen, J. (2010). Lifetime prevalence of mental disorders in US adolescents: results from the National Comorbidity Survey Replication–Adolescent Supplement (NCS-A). *Journal of the American Academy of Child & Adolescent Psychiatry, 49*(10), 980-989.
- Montag, C., Dziobek, I., Richter, I. S., Neuhaus, K., Lehmann, A., Sylla, R., . . . Gallinat, J. (2011). Different aspects of theory of mind in paranoid schizophrenia: evidence from a video-based assessment. *Psychiatry Res, 186*(2), 203-209.
- Mundy, P., & Newell, L. (2007). Attention, joint attention, and social cognition. *Current directions in psychological science, 16*(5), 269-274.
- Nolen-Hoeksema, S., & Watkins, E. R. (2011). A heuristic for developing transdiagnostic models of psychopathology: Explaining multifinality and divergent trajectories. *Perspectives on Psychological Science, 6*(6), 589-609.
- Paus, T., Keshavan, M., & Giedd, J. N. (2008). Why do many psychiatric disorders emerge during adolescence? *Nature Reviews Neuroscience, 9*(12), 947.
- Perroud, N., Badoud, D., Weibel, S., Nicastro, R., Hasler, R., Kung, A. L., . . . Debbané, M. (2017). Mentalization in adults with attention deficit hyperactivity disorder: Comparison with controls and patients with borderline personality disorder. *Psychiatry Res, 256*, 334-341. doi:10.1016/j.psychres.2017.06.087
- Polanczyk, G. V., Willcutt, E. G., Salum, G. A., Kieling, C., & Rohde, L. A. (2014). ADHD prevalence estimates across three decades: an updated systematic review and meta-regression analysis. *International journal of epidemiology, 43*(2), 434-442.
- Preißler, S., Dziobek, I., Ritter, K., Heekeren, H. R., & Roepke, S. (2010). Social cognition in borderline personality disorder: evidence for disturbed recognition of the emotions, thoughts, and intentions of others. *Frontiers in behavioral neuroscience, 4*, 182.
- Quek, J., Melvin, G. A., Bennett, C., Gordon, M. S., Saeedi, N., & Newman, L. K. (2018). Mentalization in Adolescents With Borderline Personality Disorder: A Comparison With Healthy Controls. *Journal of Personality Disorders, 1*-19.
- Ritter, K., Dziobek, I., Preißler, S., Rüter, A., Vater, A., Fydrich, T., . . . Roepke, S. (2011). Lack of empathy in patients with narcissistic personality disorder. *Psychiatry Res, 187*(1), 241-247.
- Russell, T. A., Tchanturia, K., Rahman, Q., & Schmidt, U. (2007). Sex differences in theory of mind: a male advantage on Happé's "cartoon" task. *Cognition and Emotion, 21*(7), 1554-1564.
- Rutherford, H. J., Wareham, J. D., Vrouva, I., Mayes, L. C., Fonagy, P., & Potenza, M. N. (2012). Sex differences moderate the relationship between adolescent language and mentalization. *Personality Disorders: Theory, Research, and Treatment, 3*(4), 393.
- Sharp, C., Ha, C., Carbone, C., Kim, S., Perry, K., Williams, L., & Fonagy, P. (2013). Hypermentalizing in adolescent inpatients: treatment effects and association with borderline traits. *Journal of Personality Disorders, 27*(1), 3-18.
- Sharp, C., Ha, C., Michonski, J., Venta, A., & Carbone, C. (2012). Borderline personality disorder in adolescents: evidence in support of the Childhood Interview for DSM-IV Borderline Personality Disorder in a sample of adolescent inpatients. *Comprehensive Psychiatry, 53*(6), 765-774.

- Sharp, C., Pane, H., Ha, C., Venta, A., Patel, A. B., Sturek, J., & Fonagy, P. (2011). Theory of mind and emotion regulation difficulties in adolescents with borderline traits. *Journal of the American Academy of Child & Adolescent Psychiatry, 50*(6), 563-573. e561.
- Sharp, C., & Vanwoerden, S. (2014). Social cognition: Empirical contribution: The developmental building blocks of psychopathic traits: Revisiting the role of theory of mind. *Journal of Personality Disorders, 28*(1), 78-95.
- Sharp, C., & Venta, A. (2012). Mentalizing problems in children and adolescents. *Minding the child: Mentalization-based interventions with children, young people and their families, 35-53*.
- Sherman, L. E., Rudie, J. D., Pfeifer, J. H., Masten, C. L., McNealy, K., & Dapretto, M. (2014). Development of the default mode and central executive networks across early adolescence: a longitudinal study. *Developmental cognitive neuroscience, 10*, 148-159.
- Sibley, M. H., Evans, S. W., & Serpell, Z. N. (2010). Social cognition and interpersonal impairment in young adolescents with ADHD. *Journal of Psychopathology and Behavioral Assessment, 32*(2), 193-202.
- Sinzig, J., Morsch, D., & Lehmkuhl, G. (2008). Do hyperactivity, impulsivity and inattention have an impact on the ability of facial affect recognition in children with autism and ADHD? *Eur Child Adolesc Psychiatry, 17*(2), 63-72. doi:10.1007/s00787-007-0637-9
- Striano, T., Chen, X., Cleveland, A., & Bradshaw, S. (2006). Joint attention social cues influence infant learning. *European Journal of Developmental Psychology, 3*(3), 289-299.
- Susman, E. J., Houts, R. M., Steinberg, L., Belsky, J., Cauffman, E., DeHart, G., . . . Halpern-Felsher, B. L. (2010). Longitudinal development of secondary sexual characteristics in girls and boys between ages 9½ and 15½ years. *Archives of pediatrics & adolescent medicine, 164*(2), 166-173.
- Taylor, S. J., Barker, L. A., Heavey, L., & McHale, S. (2013). The typical developmental trajectory of social and executive functions in late adolescence and early adulthood. *Dev Psychol, 49*(7), 1253-1265. doi:10.1037/a0029871
- Uekermann, J., Kraemer, M., Abdel-Hamid, M., Schimmelmann, B. G., Hebebrand, J., Daum, I., . . . Kis, B. (2010). Social cognition in attention-deficit hyperactivity disorder (ADHD). *Neurosci Biobehav Rev, 34*(5), 734-743. doi:10.1016/j.neubiorev.2009.10.009
- Van der Graaff, J., Branje, S., De Wied, M., Hawk, S., Van Lier, P., & Meeus, W. (2014). Perspective taking and empathic concern in adolescence: gender differences in developmental changes. *Developmental psychology, 50*(3), 881.
- Williams, L. M., Hermens, D. F., Palmer, D., Kohn, M., Clarke, S., Keage, H., . . . Gordon, E. (2008). Misinterpreting emotional expressions in attention-deficit/hyperactivity disorder: evidence for a neural marker and stimulant effects. *Biological psychiatry, 63*(10), 917-926.
- Wolkenstein, L., Schönenberg, M., Schirm, E., & Hautzinger, M. (2011). I can see what you feel, but I can't deal with it: impaired theory of mind in depression. *Journal of affective disorders, 132*(1), 104-111.



