Schizophrenia Research 210 (2019) 94–100

Contents lists available at ScienceDirect

Schizophrenia Research

journal homepage: www.elsevier.com/locate/schres

“A circle and a triangle dancing together”: Alteration of social cognition in schizophrenia compared to autism spectrum disorders

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A R T I C L E I N F O

Article history:
Received 9 November 2017
Received in revised form 21 February 2019
Accepted 27 May 2019
Available online 7 June 2019

Keywords:
Neurodevelopment
Asperger
Autistic
Psychosis
Early onset psychosis
Theory of mind

A B S T R A C T

Difficulties in social cognition are present both in persons with schizophrenia (SCZ) and persons with autism spectrum disorders (ASD). However, qualitative similarities and differences in this field remain unclear. The aim of this study was to explore attribution of intentionality in patients with recent onset SCZ in comparison to patients with high functioning ASD, and to explore relationships between alterations in attribution and clinical profile. Animated shapes are a non-verbal Theory of Mind (ToM) task involving the interpretation of geometric figure interactions in three conditions: random, goal-directed and ToM. We compared 51 young adults with SCZ, 32 with ASD and 23 healthy controls (HC) matched for age and gender. In random, goal-directed and ToM conditions, persons with SCZ attributed less intentionality with less appropriate answers than HC, while the same anomalies were only found in the ToM condition in persons with ASD. In SCZ, thought and langage disorganization and earlier age at onset were correlated with intentionality score in the random condition. Moreover, a mixed ToM impairment was found in SCZ, combining undermentalizing (for movements involving a mental state) similar to what was found in ASD, and overmentalizing (for random movements), related to dizorganization and precocity of the first psychotic episode. In the frame of the hypothesis of a continuum, these results underline both similarities and differences between autism and schizophrenia.

1. Introduction

Schizophrenia (SCZ) and autism spectrum disorders (ASD) are neurodevelopmental disorders. Our understanding of the links between the two diseases has evolved over time. Since the 1970s, these two conditions have been considered as distinct despite the proximity of some clinical features. More recently and following the literature supporting the neuro-developmental hypothesis of SCZ, the nature of these links was re-examined. Common vulnerability factors, particularly genetic (Autism Spectrum Disorders Working Group of The Psychiatric Genomics Consortium, 2017; Crespi and Crofts, 2012; Sullivan et al., 2012); Soler et al., 2018), epidemiological (Chisholm et al., 2015; Rapoport et al., 2009), cognitive (Eack et al., 2013) as well as neuroimaging studies (Baribeau and Anagnostou, 2013; Cheung et al., 2010) support the hypothesis of an autism-schizophrenia continuum. Persons with either SCZ or ASD share difficulties in social interaction with incidence on their quality of life (Barneveld et al., 2014; Maat et al., 2012). These difficulties are driven by impairments in social cognition (Couture et al., 2010, 2006), a concept that refers to the ability to construct representations of the relationships between oneself and others and to use those representations to guide social behavior (Adolphs, 2001). Social cognition encompasses Theory of Mind (ability to infer thoughts, beliefs, desires, emotions to oneself and others, ToM), emotional processing, attributional style, perception and social knowledge (Green et al., 2008). Social cognition has been widely explored in SCZ and ASD using various tests; however, few studies directly compared these persons in adulthood and results are contrasted, possibly due to differences in global functioning.

Some studies found common alterations in ToM (Chung et al., 2014; Couture et al., 2010; Craig et al., 2004; Murphy, 2006), and in emotion recognition tests (Eack et al., 2013; Sasson et al., 2007, 2016) in both disorders. Others found more severe difficulties in ASD (Bölte and Poustka,

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https://doi.org/10.1016/j.schres.2019.05.043
0920-9964/

2003; Ciaramidaro et al., 2015; Ozguven et al., 2010; Pilowsky et al., 2000; Sachse et al., 2014) or in SCZ (Lugnegård et al., 2013; Tobe et al., 2016). According to C. Frith, alterations in ToM should differ between ASD and SCZ, since the diseases impact ToM at different ages: very early in ASD, and later in SCZ (Frith and Corcoran, 1996). Moreover, in SCZ, the links between clinical profiles and performance in ToM remains contraversial. C. Frith (Frith, 1992) suggested that some symptoms of SCZ could emerge from aberrations in the attribution of mental states. Paranoid patients tend to “hypermentalize”, that is, to attribute intentions excessively and erroneously, whereas persons with prominent negative symptoms or disorganization “hypomentalize” (Frith, 2004).

Following Medalia and Bowie (2016), over or under mentalizing are associated with insufficient hypotheses or guesses about a person or an event often associated to the mechanism of ‘jumping to conclusion’. Actually, cognitive remediation programs, such as social cognition and interaction training (SCIT) provides mentalizing exercices in order to learn to generate alternative hypotheses when facing to an event, contributing to reduce jumping to conclusion mechanisms. SCIT method has been used in schizophrenia (Roberts et al., 2014), and in few persons with autism (Turner-Brown et al., 2008).

Animated geometric shapes tasks allow an exploration of the ToM, with non verbal support. These tasks consist in the attribution of actions and mental states to geometric shapes moving according to different conditions of actions: random, goal-directed and involving a mental state, with evaluation of four dimensions: degree of intentionality, appropriateness, degree of certainty and length of the answer. Groups of persons with ASD (Bal et al., 2013; Bliksted et al., 2016; Castelli et al., 2002; Marsh and Hamilton, 2011; Salter et al., 2008) or with SCZ (Bourgou et al., 2016; Das et al., 2012; Horan et al., 2009; Koelkebeck et al., 2013a; Pedersen et al., 2012; Russell et al., 2006) were tested, objectivizing an impairment in the attribution of mental states. To our knowledge, only one study directly compared ASD and SCZ and correlations with clinical dimensions were not explored (Lugnegård et al., 2013).

This study intends firstly to characterize Theory of Mind impairments and their relationships with clinical profiles in young adults with recent onset SCZ compared to HC; and secondly, to compare them to matched young adults with high functioning ASD.

2. Material and methods

2.1. Participants

One hundred and six persons aged 18 to 30 were recruited in this cross-sectional comparative study between 2012 and 2016, including (i) 51 persons meeting the DSM-IV-TR criteria for SCZ (American Psychiatric Association et al., 2000) but no history of ASD, (ii) 32 persons with ASD (High Functioning Autism and Asperger's syndrome) and (iii) 23 healthy control persons (HC) matched for age, sex and education level (number of years since first year of primary school). 75 participants had already been included in our previous study (recruitment until September 2015) (Martinez et al., 2017). Patients were recruited in the hospital-university department of the Sainte-Anne hospital and healthy control persons by advertising. Diagnostic Interview for Genetics Studies (DIGS 3.0, French version Krebs, 2003) (Nurnberger et al., 1994) was used to confirm SCZ diagnosis and to exclude comorbidity in ASD and axis 1 disorder in HC. ASD diagnosis was confirmed using the Autism Diagnostic Interview – Revised (Lord et al., 1994).

Exclusion criteria for all participants were intellectual disability (IQ < 70, assessed with WAIS-III (Wechsler, 1997); substance misuse or dependence (except nicotine) or use for >5 years, bipolar disorder, current or recent severe depression, suicidal risk, central neurological disease, treatment with benzodiazepines, antipsychotic dosage >400 mg Chlorpromazine equivalents, antidepressants started <3 weeks before the beginning of the study. For HC, additional exclusion criteria were personal psychiatric history, family history of SCZ or ASD in first- and second-degree relatives.

This study was approved by the ethics committee CPP IDF3 (clinical trial number EudraCT 2011-A00812-39). All participants received written and verbal information about the project and written consent was obtained before inclusion.

2.2. Psychopathological and cognitive assessments

All participants were assessed for general psychopathology with the Brief Psychiatric Rating Scale (BPRS). General intellectual efficiency was evaluated with WAIS-III (Wechsler, 1997). This psychometric test leads to determine the intellectual quotient (IQ), calculated through two indices. The verbal IQ includes verbal reasoning, working memory and vocabulary tasks; and the performance IQ comprises non verbal reasoning and abstraction, and processing speed tasks.

Patients with SCZ were evaluated with the Positive and Negative Symptom Scale (PANSS) (Kay et al., 1987) and with the Scale for Assesment of Negative Symptoms (SANS) (Andreasen, 1989). Disorganization was assessed with the Thought Language and Communication Scale (TLC) (Andreasen, 1986). Symptom Onset in Schizophrenia (SOS) (Perkins et al., 2000) was used to date onset of prodromal symptoms, and to determine age of first-episode psychosis, and DIGS was used for global psychiatric disease's history, including age at first contact with psychiatrist and first psychotropic drug. All clinical evaluations and WAIS-III were assessed by trained psychiatrist (GM) and psychologists (NB, CD).

2.3. Evaluation of social cognition: the animated shapes

In this study, we used the Animated Shapes task developed by Pouillès et al. (2007), stemming from Triangles task (Abell et al., 2000). Twelve silent animations, lasting 10 s each, are presented on a computer screen. Each animation shows two simple geometric figures (triangles, circles, squares) moving in a minimal environment (wall, door, enclosure). This task has been designed to minimize the intervention of complex cognitive functions.

Three types of modalities govern interactions between shapes: (i) ‘*random*’ (R): object movements involving neither goal nor mental state (for example: a ball is rolling freely, before decelerating to stop), (ii) ‘*goal-directed*’ action (G): movements of living beings involving a goal, but no mental state (for example: a square attempts to break a wall at three times before make it through), (iii) Theory of mind ‘*ToM*’: movements of living beings involving a goal and a mental state (for example: a mother is trying to bring out her child of a room, but he refuse. Finally, she pushes her out.). Four animated sequences are developed for each modality.

First, the persons were informed that they were going to see sequences of moving shapes, representing objects or living beings, and be asked to describe and interpret them. Each animated sequence was presented twice on a computer screen. The presentation order was random but identical for all persons.

Participants' verbal answers were recorded to be rated later by two psychiatrists (GM + EM), including one blind to the clinical status of the participant (EM). Meeting for training quotation with discussion, and readjustment were organized throughout the study, in order to maintain homogeneity of scoring. For each sequence, four scores were attributed: (i) intentionality, according to the degree of intentional mental states described (0 = non deliberate action; 1 = deliberate action, alone; 2 = deliberate action with somebody; 3 = deliberate action in response to other's action; 4 = deliberate action in response to other's mental state; 5 = deliberate action to influence other's mental state); (ii) appropriateness, according to the degree of correctness of answers (0 = no answer; 1 = inappropriate answer, wrong type of interaction; 2 = partially correct answer, good type of interaction but confused description; 3 = appropriate and clear answer); (iii) certainty, meaning the degree of certainty based on intonation (0 = silence; 1 = just a few words, incomplete sentences; 2 = hesitations, alternative answers; 3 = no hesitation, quick response); (iv) score for length of answers (0 = no answer; 1 = 1 sentence; 2 = 2 sentences; 3 = 3 or 4 sentences; 4 = >4 sentences). A total score per dimension was calculated for each type of animations, by adding the scores of the four corresponding sequences.

2.4. Statistical analyses

Statistical analyses were performed with IBM SPSS 20.0 software. Normal distribution of variables was tested by Kolmogorov-Smirnov test. Group differences on the Animated Shapes scores for clinical and cognitive variables were analyzed using 1-factor ANOVA, Tukey test for post-hoc analysis and univariate variance analysis to include gender as covariate Associations between variables were evaluated with Pearson correlation coefficients. Considering the exploratory nature of the second objective, Bonferroni corrections for multiple comparisons were applied only for post-hoc analysis between SCZ and HC.

3. Results

3.1. Demographic and clinical characteristics

Demographic and clinical characteristics are presented in Table 1.

No significant differences existed between the groups for age, gender and intellectual quotient (verbal IQ VIQ; performance IQ, PIQ and full scale IQ, FSIQ). Education level was higher in HC compared to ASD and SCZ, without differences between these two groups. The clinical symptoms severity score was similar in ASD and SCZ, as reflected by BPRS' scores.

3.2. Social cognition

The Animated Shapes results are presented in Table 2.

In the '*random*' condition, the appropriateness score was significantly lower in SCZ compared to HC ($p = 0.007$), with a trend for more intentionality in SCZ than HC ($p = 0.085$).

In the '*goal-directed*' condition, appropriateness and intentionality scores were lower in SCZ compared to HC (respectively $p = 0.016$ and $p = 0.024$).

Table 1
Demographic and clinical characteristics of the groups.

	ASD N = 32	SCZ N = 51	HC N = 23	ANOVA (° chi2)
Age	22.62 (3.5)	23.35 (3.6)	23.26 (3.1)	$p = 0.633$
Gender	25M/7F	42M/9F	19M/4F	$p = 0.27$ °
Education level	12.28 (2.3)	12.45 (2.5)	13.96 (1.6)	$p = 0.014$ *
VIQ	103.9 (14.2)	100.8 (13.3)	107.4 (12.5)	$p = 0.230$
PIQ	96.8 (18.9)	94.4 (13.2)	102.4 (9.9)	$p = 0.179$
FSIQ	100.6 (14.6)	98.1 (13.1)	105.4 (10.4)	$p = 0.162$
Age of Prodromes	–	14.89 (4.98)	–	
Age of FEP	–	19.09 (3.3)	–	
BPRS	45.03 (10)	45.84 (12.2)	–	NS
PANSS pos	–	14.22 (4.6)	–	
PANSS neg	–	19.1 (6.8)	–	
PANSS tot	–	67.02 (18.7)	–	
SANS	–	45.4 (20.8)	–	
TLC	–	8.52 (6.1)	–	

Mean score (Standard Deviation) of sociodemographic characteristics, psychopathological scales and WAIS III are presented.
IQ: Intellectual quotient, VIQ: verbal IQ, PIQ: performance IQ, FSIQ: full scale IQ, FEP: first episode psychosis, PANSS positive (pos) and negative (neg) subscales scores and PANSS total (tot) score, TLC: Though and language scale.
* $p < 0.05$.

In the '*ToM*' condition, appropriateness and intentionality scores were lower in both patient's groups as compared to HC (SCZ: $p = 0.001$, $p = 0.002$; ASD: $p = 0.018$ and $p = 0.026$).

In the three conditions, there were no significant differences between ASD and SCZ for appropriateness scores and intentionality. Scores for certainty and length of answers were similar in the three groups (Table 3).

The results were similar when gender was included as covariate (ANOVA p values: 0.009 and 0.084/0.022 and 0.033/0.002 and 0.002 for random/goal-directed/ToM appropriateness and intentionality, respectively).

3.3. Correlations

In SCZ, in the *random* condition, the score in TLC was negatively correlated with appropriateness score ($r = -0.410$, $p = 0.008$) and positively correlated with intentionality score ($r = 0.404$, $p = 0.009$). Age of the first episode psychosis was also positively correlated with appropriateness score ($r = 0.344$; $p = 0.034$) and tends to be negatively correlated with intentionality score ($r = -0.288$, p = 0.08). There was no significant correlation between performance on Animated Shapes and SANS or PANSS total scores.

4. Discussion

This study compared ToM abilities of young adults with SCZ to those of persons with ASD and healthy controls, using the Animated Shapes task. Our results confirmed that SCZ are significantly impaired in the attribution of intentions to others, and did not differ from persons with ASD. In SCZ, appropriateness and intentionality in the '*random*' condition were related to disorganization and age of onset of the disease, indicating that among SCZ, 'overmentalizing' is related to earlier and more disorganized forms of the disease. Altogether, Animated Shapes revealed a mixed ToM impairment in SCZ combining undermentalizing (for intentional actions states) and overmentalizing (for random movements).

4.1. Undermentalizing in SCZ

In '*ToM*' sequences, persons with SCZ attributed less mental states and therefore produced less appropriate answers compared to HC. This 'undermentalization' is concordant with other studies (Bliksted et al., 2014).

Undermentalizing was also found for '*goal-directed*' sequences. Data from the literature are inconsistent: some studies (Lugnegård et al., 2013; Pedersen et al., 2012) showing no differences between HC and SCZ, while other studies reported either a reduction in intentionality in SCZ (Bourgou et al., 2016; Horan et al., 2009; Koelkebeck et al., 2010), or an increase in intentionality (Russell et al., 2006).

The general cognitive impairment reported in SCZ might question the existence of a specific deficit in ToM. Indeed, Animated Shapes involves verbal memory and abstract reasoning. Their alterations could bias ToM assessment. However, general cognitive impairment has a moderate impact on social cognition (Bliksted et al., 2014; Fanning et al., 2012). Only 10 to 20% of the variance of social cognition, with the exception of emotion recognition (34%), depends on neurocognition (Fanning et al., 2012). Here, the selection of a task without involvement of verbal comprehension skills, the lack of difference between groups in the length of answers, and lastly the comparable IQ (especially verbal IQ) might suggest that the sole neurocognitive alteration in SCZ cannot account for the observed impairment in ToM.

4.2. Comparison of ToM abilities in SCZ and ASD

In the same way, in the "ToM" condition, ASD attributed less intentionality with less appropriate answers compared to HC. This folllows

Table 2
Animated shapes performances in ASD, SCZ and HC.

	ASD N = 28	SCZ N = 51	HC N = 23	Overall[a]	SCZ vs ASD[b]	SCZ vs HC[b]
Random appropriateness	10.4 (1.45)	9.74 (1.89)	11.07 (0.88)	$p = 0.01^*$	NS	0.007**
Random intentionnality	1.08 (1.19)	1.38 (1.67)	0.58 (0.75)	$p = 0.103$	NS	NS 0.085
Goal-directed appropriateness	9.68 (1.60)	9.33 (1.87)	10.52 (1.01)	$p = 0{,}032^*$	NS	0.024**
Goal-directed intentionnality	6.34 (1.62)	5.90 (2.00)	7.25 (1.26)	$p = 0.022^*$	NS	0,016**
ToM appropriateness	7.1 (2.3)	6.77 (2.25)	8.90 (1.4)	$p = 0.002^*$	NS	0.001**
ToM Intentionnality	12.62 (3.08)	12.10 (3.25)	14.95 (1.79)	$p = 0.002^*$	NS	0.002**

Mean (SD) scores for animated shapes are presented.
[a]One factor ANOVA, [b] Post hoc Tukey test, * p < 0,05, ** p < 0,025 (Bonferroni correction) NS : not significant.

results in previous studies, which found lower intentionality scores in children and adults with ASD compared to HC (Castelli et al., 2002; Lugnegård et al., 2013; Marsh and Hamilton, 2011; Salter et al., 2008; White et al., 2011).

Only one previous study directly compared persons with SCZ or ASD and HC (respectively $n = 36$, 53 and 50) using the Animated Shapes (Lugnegård et al., 2013): lower intentionality and appropriateness scores were found both in SCZ and ASD compared to HC, in the '*ToM*' condition. These deficits were more severe in SCZ compared to ASD (Lugnegård et al., 2013). Our study did not replicate this later result. However, several factors limit the comparability of the present sample with the former one, including the lack of information on psychopathology, IQ and level of education as well as the inclusion of persons with schizoaffective disorder, older age for patients with SCZ and restriction to persons with Asperger syndrome for patients with ASD. In addition, a meta-analysis from 10 studies assessing ToM abilities in SCZ ($N = 206$) or ASD ($N = 98$) using Animated Shapes did not show more severe impairments in SCZ (Bliksted et al., 2016). Furthermore, in this meta analysis, the intentionality scores in the '*ToM*' condition, were similar in ASD and SCZ, whereas ASD gave less appropriate answers than SCZ.

The results of studies comparing ASD to SCZ using other ToM tasks (Strange Stories, False Beliefs, Hinting task, Reading the Mind in the Eyes test, etc.) are contrasted, with either no significant differences (Chung et al., 2014; Couture et al., 2010; Craig et al., 2004; Murphy, 2006) or more severe deficits in ASD (Ciaramidaro et al., 2015; Ozguven et al., 2010; Pilowsky et al., 2000; Sachse et al., 2014).

4.3. Overmentalizing in SCZ

In *random* sequences, answers were significantly less appropriate in SCZ compared to HC, these persons tending to introduce a higher degree of intentionality in their interpretations. This trend to overmentalize in *random* modality has already been reported (meta-analysis (Bliksted et al., 2016)), or identified only within subgroups of persons with paranoid SCZ or with predominant negative symptoms or thought disorganization (Russell et al., 2006).

Although not statistically significant, the nature of *ToM* impairment was different in ASD and SCZ. Both had difficulties in the perception of mental states. However, SCZ tended to attribute goals to actions or mental states when they did not exist, in concordance with Frith and Corcoran' postulate (1996), suggesting that age of onset, which differs in ASD and SCZ, causes distinct deficits in ToM. persons with SCZ would develop ToM abilities in childhood. At the onset of the disease, awareness that others have intentions and beliefs would be preserved, but mentalization abilities would be used inadequately (Frith and Corcoran, 1996). Here, the mistakes in mental state attribution result in a trend of hyper- and undermentalizing. In ASD, the development of ToM would putatively be disrupted earlier in childhood, leading to a lack of awareness of others' desires and intentions that would result in a predominant undermentalizing.

A recent fMRI study investigated neural pattern associated with social cognition deficits assessed with Animated Triangles Task in 17 first-episode SCZ. Unlike healthy controls, persons with SCZ showed increased activity in a region of anterior medial prefrontal cortex (amPFC) while studying 'random' movements of shapes, as compared to the conditionof movements normally interpreted as 'intentional'. The authors concluded that these results were consistent with deficits in the ability to switch off mentalizing processes in potentially social contexts, instead increasing them when intentionality is not forthcoming (Emborg et al., 2018). The hypo-hyper-intentionality hypothesis was also tested in another fMRI study that found opposed connectivity patterns between the right posterior superior temporal sulcus and amPFC in the clinical groups, i.e. increased for SCZ, decreased for ASD (Ciaramidaro et al., 2015)

Table 3
Certainty and length of answers in ASD, SCZ and HC.

		ASD N = 28	SCZ N = 51	HC N = 23	Overall[a]
Random	Certainty	10.3 (2.03)	10.05 (1.13)	10.25 (0.92)	NS
	Length	7.67 (2.41)	8.58 (2.91)	8.3 (2.28)	NS
Goal-directed	Certainty	9.86 (2.44)	9.95(1.61)	10.57 (1.10)	NS
	Length	8.9 (2.51)	9.39 (2.8)	9.32 (3.09)	NS
ToM	Certainty	10.09 (2.31)	9.93 (1.29)	10.75 (0.92)	NS
	Length	10.68 (2.71)	11.25 (2.36)	11.62 (2.68)	NS

Mean (SD) scores for animated shapes are presented.
[a]One factor ANOVA, [b]Post hoc Tukey test, * p < 0,05, ** p < 0,025 (Bonferroni correction) NS : not significant.

1.1. Correlations between ToM impairment and clinical profiles in SCZ

We did not replicate the associations between ToM impairments and positive or negative symptoms in SCZ, contrasting with other studies (Bliksted et al., 2016; Horan et al., 2009; Koelkebeck et al., 2010). In these previous studies, the association of ToM deficits with negative symptoms could be accounted for by illness chronicity (Pousa et al., 2008). Here, the participants were young and most of them had experienced only one episode. Moreover, they were stabilized and poorly symptomatic, and they constituted a relatively homogeneous group, as reflected by the low level and narrow distribution of PANSS and SANS scores. These features could explain the differences between our observations and previous studies. On the other hand, previous observations could also be driven by the disorganization symptoms embedded in positive and negative subscales of SANS-SAPS and PANSS. Unfortunately, these symptoms were not analyzed in these previous studies.

In SCZ, in the *random* condition, thought disorganization (TLC score) was positively correlated with intentionality and negatively correlated with appropriateness of the response: the more disorganized the thought and language, the more intentionality and inappropriate answers. To our knowledge, no previous studies using Animated Shapes explored the links between disorganization and ToM. We previously found a similar association between disorganization and ToM using another social cognition task: the MASC test (Dziobek et al., 2006; Martinez et al., 2017). Association between disorganization and ToM was already reported with comics tasks in SCZ (Sarfati and Hardy-Baylé, 1999; Sarfati et al., 1999, 1997) and in two meta-analyses (Sprong et al., 2007; Ventura et al., 2013). Disorganization was evaluated using either the TLC scale, which explores specifically thought and language output (Andreasen, 1986), or with PANSS disorganization factor extracted from the scale (Kay et al., 1987). These studies concluded that ToM impairments were more severe in disorganized persons.

Severity of disorganization could be related to the developmental weight in the individuals since it was negatively correlated with age at onset (of prodrome and first episode). We found a positive correlation between age of first episode psychosis and ToM performance in the '*random*' condition, reinforcing the idea that age of onset influences social cognition: the earlier the symptoms, the more disorganization and the more intentionality and inappropriate answers in the *random* condition. These correlations suggest a tendency to overmentalize in persons with early onset of disease.

In SCZ, few studies explored the relationships existing between age of onset and impairments in social cognition. Late age at onset was associated with better performance in an emotion recognition test in 151 persons with SCZ (Linke et al., 2015). In addition, the performance was particularly impaired when the onset occured before 20 years of age, suggesting that development of social skills during adolescence is crucial for future social functioning. Another study compared older persons with either 'early' (before 40 years) or late-onset paranoid SCZ (between 40 and 60 years) and healthy persons, using the Hinting Task (Smeets-Janssen et al., 2013). While the severity of symptoms was comparable in both groups, ToM abilities were better in the late-onset than in the early-onset groups. Disorganization was not explored. The authors suggested that differences in ToM abilities were related to the duration of the disease (Smeets-Janssen et al., 2013). However, the literature is controversial, reporting either gradual decline in social cognition during the disease (Brüne, 2005; Drury et al., 1998; Sarfati et al., 2000), or stability of deficit (Bora and Pantelis, 2013; Green et al., 2012; Mazza et al., 2012). A meta-analysis based on six studies using Animated Shapes (206 participants) reported higher intentionality score in the '*ToM*' condition in persons with a first episode psychosis (duration of the disease between 0.35 and 0.36 years) compared to chronic SCZ (duration of the disease between 5.6 and 17.4 years) (Bliksted et al., 2016).

4.4. Limitations

The first limitation of this study is the rather small size of the ASD group, accounting for possible lack of statistical power. Despite our satisfactory interrater coefficient (alpha coefficient of Cronbach from 0.725 to 0.909), the scoring method of the Animated shapes remains subjective. Some studies, like our, provided two raters to diminish subjectivity (Abell et al., 2000; Castelli et al., 2002; Horan et al., 2009), while others provided only one (Das et al., 2012; Koelkebeck et al., 2013b; Pedersen et al., 2012). Moreover, medications received by participants could influence performances in ToM (Savina and Beninger, 2007). However, here, all SCZ received atypical antipsychotics, with very low dosages (<400 mg Eq chlorpromazine). In addition, the persons were young and most of them had experienced only one episode.

5. Conclusion

Animated shapes showed mental state attribution impairments in young adults with recent onset SCZ and high functioning ASD, as compared with healthy persons. Although persons with SCZ could not be statistically discriminated from those with ASD based on their ToM abilities, the nature of mentalizing impairments seems different, suggesting the existence of distinct pathophysiological mechanisms in both disorders. A trend to overmentalize was found in SCZ, related to thought and language dizorganization, and precocity of the first psychotic episode. On the other hand, undermentalizing was a common feature to both disorders. Noteworthy, both under or overmentalizing can actively be reduced with specific cognitive remediation programs that benefit to persons with schizophrenia as well as persons with autism (Roberts et al., 2014). This suggests at least that the two disorders might share common cognitive abnormalities and mechanisms for rehabilitation.

Funding source

This research was funded by a grant from the Fondation de France (Engt n°. 15142), the Fondation Deniker and ERA-Net NEURON (ANR-2010-002-01), and was promoted by Sainte-Anne Hospital.

Declaration of Competing Interest

The authors declare no competing financial interest.

Acknowledgments

We would like to thank C. Gaillard and Y. Le Nevé ('Centre d'Evaluation et de Recherche Clinique', SHU) for data management, and Dr. F. Lejuste, Dr. L. Pedron, C. Mam-Lam-Fook and C. Alexandre ('Centre Jeune Adulte et Adolescent', SHU) for subject recruitement.

We thank 'Délégation à la Recherche Clinique et à l'Innovation' (DRCI) and 'Clinical Research Center' (CRC) of Sainte-Anne Hospital, and 'URC/CIC Paris Descartes' of Necker-Cochin Hospital for thir help in conducting the study.

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