"Theory of Mind (ToM) performance in High Functioning Autism (HFA) and Schizotypal-Schizoid Personality Disorders (SSPD) Patients."

Abstract

The similarities between High Functioning Autism (HFA) and Schizotypal-Schizoid Personality Disorder **(**SSPD) in terms of social cognition and interpersonal deficits may lead to confusion in symptom interpretation, and consequently result in misdiagnosis. Thus, this study aims to investigate differences in mentalizing with particular interest on the socio-cognitive and socio-affective dimensions. Three Advanced Theory of Mind (ToM) tests were applied in 35 patients with HFA, 30 patients with SSPD and 36 healthy controls. Individuals with HFA showed greater impairment and no dissociation between affective and cognitive ToM components. Conversely, SSPD individuals displayed less difficulties but greater impairments on the cognitive component. Beyond the replicability of ToM impairment in HFA individuals, these findings suggest more impaired cognitive ToM in SSPD participants which further support the sequence of mentalizing development build upon different chronological stages.

Keywords: Social cognition, High Functioning Autism, Schizotypal-Schizoid Personality Disorder, Advanced theory of mind, Cognitive, Affective

Schizophrenia Spectrum Disorders (SSD) and Autism Spectrum Disorders (ASD) are pervasive neurodevelopmental conditions entailing several social and cognitive deficits (Bailey et al. 1996; Tager-Flusberg et al. 2005; Van Os and Kapur 2009; Stephane et al. 2014). Both disorders share similarities in genetic, neuroanatomical, neuropsychological and behavioural aspects (Tin et al. 2017). However, their deficits lead to impairment of basic cognitive functions, abnormal brain development and wiring paths during growth, which result in distinctive neuro-cognitive profiles (Li et al. 2009; Stefanatos and Baron, 2011; Bakhshi and Chance 2015). Clinical features, such as the presence of autistic traits in patients with schizophrenia (Kästner et al. 2015) and the development of schizophrenia in a significant proportion of children diagnosed with ASD (Larson et al. 2017) support the connection between the two spectra at a clinical level. SSD and ASD has been considered as disorders of the social brain since disturbances of social cognition are central to both of them, including various developmental aspects of eye-contact, language, theory of mind, information processing, and behaviour (Mitelman et al. 2016). King and Lord (2011) pointed to symptoms similarity between Schizotypal Personality Disorder and Autism in terms of unusual preoccupations, unusual perceptual experiences, odd thinking and speech, constricted affect, social anxiety, lack of close friends, and odd or eccentric speech and behaviour. These similarities between the two disorders in terms of social cognition and interpersonal deficits may lead to confusion in symptom interpretation, and consequently result in misdiagnosis (Sheitman 2004; Sasson et al. 2011).

Deficits in Theory of Mind (ToM) which refers to the ability to infer the mental state of other people (Baron-Cohen, 1995), have been well documented in individuals with SSD (Kettle et al., 2008; Koelkebeck et al., 2010; Ziv et al., 2011) as well as in ASD population (Baron-Cohen et al. 1985; Happé 1994; Heavey et al. 2000; Klin 2000; Wellman et al. 2001). Even though ToM deficits are one of ASD and SSD points of overlap, they may reflect different

causal factors for each spectrum (Chung et al. 2014). Most of these studies over this topic treated directly Autism and Schizophrenia samples to examine possible points of overlap. However, the present investigation aims to examine ToM abilities in High Functioning Autism **(**HFA) and Schizotypal-Schizoid Personality Disorder **(**SSPD), two subgroups of the aforementioned spectrum disorders that present similar clinical features, a milder symptoms expression and a lack of consistent empirical evidence findings.

More specifically, individuals with HFA belong to a subtype of the ASD and are characterized by deficits in reciprocal social interaction, subtle impairment of verbal and non-verbal communication and the presence of idiosyncratic isolated interests. In contrast with the diagnostic of Autism, there is no language delay and intelligence is in the normal or near normal range (American Psychiatric Association 2013). Participants with an IQ greater than 70 constitute a high-functioning autism group. Despite their ToM difficulties, patients with normal intellectual functioning, tend to perform better in classical ToM tasks (Baron-Cohen 1989; Happe´ 1994; Grossman et al. 2000). However, these patients continue to mistake social contexts, mainly when processing non-literal speech resources, such as jokes, irony, metaphors or white lies (Happe, 1995).

Schizotypy refers to a set of personality traits encompassing behaviours, cognitions and emotions that resemble the signs and symptoms of schizophrenia. The dimensional approach of schizotypy regards it as a personality trait that is continuously distributed in the general population (Claridge, 1997), ranging from low schizotypy and psychological health to extremely high schizotypy and potential dysfunction in the form of psychosis (Nelson et al., 2013). Schizotypy allows researchers to study the prodrome and at-risk states of schizophrenia and related disorders taking a developmental approach. Even though schizotypal traits constitute a risk factor for psychotic disorders, other risk factors needing to be present before

a transition to psychosis occurs. The difference between schizotypal traits and SSD is therefore determined by the degree of self-recognized impairment to occupational and interpersonal functioning, the frequency, and the severity of symptom presentation. (Walter et al., 2016). The meta-analytic study of Walter et al (2016) supports that family studies demonstrate elevated schizotypal traits with increasing genetic proximity to schizophrenia as well as chromosomal regions association with schizotypy. Under this perspective schizotypal traits might constitute an intermediate phenotype for psychotic disorders which means that they are heritable and underpinned by biological mechanisms, lying mid-distance between the genetic risk and disease.

The autism and schizophrenia spectra are considered in current diagnostic procedures as separate disorders. Their diagnosis relies on the subjective interpretation of symptoms that are supposed to be specific to autism and schizophrenia spectra excluding the shared phenotype. Nevertheless, the number of misdiagnosed cases points out a differential diagnosis problem (Barahona-Correa, 2017) even for experienced clinicians, of the distinction between ASD and certain presentations of the schizophrenia spectrum (Mouridsen et al.,2008).

According to DSM, social interaction, stereotyped behaviours, and interests are impaired in SSPD, however individuals with HFA/AS may have more severe social interaction and communication problems (Lugnegard et al., 2012). Core features of schizoid PD are fundamental in autism: lack of interest in, and active avoidance of social situations both in occupation and daily life, restricted affect and empathy, odd communication, and relationship detachment, as well as rigid pursuit of personal interests (Ford & Crewther, 2014). Also, the sexual indifference and social aloofness, as well as the apparent emotional coldness and the lack of initiative characterize both many young adults with ASD and individuals with schizoid PD (Barahona-Correa,2017). Hurst et. al, (2007) found that social impairment and

communication deficits in ASD overlapped with interpersonal problems and disorganized features in Schizotypal PD respectively.

Objectives

The present study aims to shed light on the relatively unexplored domains of HFA and SSPD overlap, evaluating ToM performance. In the context of empirical evidence supporting the Autism-Schizophrenia continuum, Sheitman et al. (2004) & Bastiaansen et al. (2011) suggests that in the absence of positive symptoms of Schizophrenia, HFA could easily be conflated with SSD. Therefore, by investigating further different aspects of ToM we may contribute to identify specific phenotypic traits for each disorder. ToM impairments may serve as a trait indicator, or they may be a risk factor, which adds to the identification of the Schizotype and Autism distinction. We speculate that there might be disorder specific patterns of mentalizing performance deficits on cognitive versus affective components due to different clinical features and developmental courses for each disorder. Moreover, the purpose of this study was to investigate differences in mentalizing with particular interest on the socio-cognitive and socio-affective dimensions on participants with HFA compared to a group with SSPD and a HC group.

According to Shamay-Tsoory et al. (2002) & Hynes et al. (2006) the study of social cognition supports the affective ToM component to be distinct from the cognitive one. Cognitive ToM reflects the understanding of someone's beliefs, while affective ToM requires the empathic appreciation of someone's emotional state, involving different psychological and neural mechanisms. The results of that study, strongly supported the dissociation between cognitive and affective mentalizing abilities, highlighting the mediating role of ventromedial (VM) frontal lobes in ToM research.

In order to explore these points, we developed the following three hypotheses:

(H1) We expect that, **t**he HC group will perform better in both components of ToM in comparison to HFA and SSPD groups as indicated by the literature of ASD and SSD (Dinsdale et al. 2013) as well as from previous investigations (Kaland et al. 2008; Zalla et al. 2008; Bliksted.et al. 2016; Lugnegard et al. 2013)**. (H2)** Moreover, we hypothesized that the HFA group will perform worse than SSPD group in both aspects of ToM. Even though the findings of Lugnegard et al. (2013) challenged the opinion that social cognition deficits are typically more severe in ASD than in SSD, other studies have demonstrated worse performance in individuals with ASD when compared with SSD samples in advance Theory of Mind tasks (Ozguven et al. 2010; Bolte & Poustka 2003; Tin et al. 2017)

(H3) The third hypothesis, related to differences in mentalizing dimensions, is exploratory in nature since only a few studies have directly addressed these questions and have reported conflicting results. Most of the studies treated ToM as a unitary concept failing to analyse the affective and cognitive subcomponents. Some ASD literature supports findings for greater impairment in cognitive ToM (Rogers et al. 2007; Dziobek et al. 2008) while others for affective ToM (Lockwood et al. 2013). As regards to SSD patients, Shamay-Tsoory et al (2007) and Ho et al (2015) findings support greater impairment in Affective ToM while Okruszek et al (2017) found cognitive ToM to be more impaired, supporting affective ToM to involve more effortful reflective processes. Despite the inconsistency of the previous findings this hypothesis is built upon the rationale of developmental courses. Bottiroli et al (2016) and Dennis et al (2013) suggested that affective ToM is more automatic and less vulnerable to neurodegeneration or brain injury than cognitive ToM. Early ability to understand and infer emotion in others has been found to predict later high-order mentalizing abilities (Brien et al. 2011) relating ASD to a poorer performance in the affective ToM. In contrast, SSD literature

is not suggesting compelling evidence of abnormal precursors of mentalizing (Stannford et al. 2011) potentially providing evidence for greater impairments on cognitive tasks than on emotion recognition. ASD impairments on ToM evolve from deficits starting early in life while ToM impairments in SSD arise later in life (Chung et al. 2014). Given this sequence of mentalizing development build upon different chronological stages we expect differences in ToM components between HFA and SSPD groups.

Methods

Participants:

A total of 101 individuals with clinical diagnoses of HFA (n=35), SSPD (n=30) and a HC group (n=36) were included in the study, as described in Pedreno et al. (2017). Subjects of High Functional Autism (HFA) were selected by convenience from a consecutive sample of patients attending the psychiatric service at the Corporació Sanitària Parc Taulí Hospital in Sabadell (Spain). Patients had to meet DSM-IV-TR (American Psychiatric Association 2002) diagnostic criteria for HFA and be aged between 13 and 40. The diagnosis was confirmed using the instruments detailed in the following section, based on a review of developmental history, current daily functioning and observation by a clinical psychologist.

The Schizotypal Schizoid Personality Disorder (SSPD) sample was recruited among relatives (N=35) of schizophrenia patients and from a group of outpatients (N=4) at the Corporació Sanitària Parc Taulí Hospital in Sabadell (Spain). Additional recruitment of subjects was conducted throughout public advertisements posted on the Autonomous University of Barcelona (Spain). Specifically, in 2010 a total of 1083 subjects answered the Short version of Oxford-Liverpool Inventory of Feelings and Experiences (O-LIFE) test as an initial screening (Mason et al., 2005). Although the O-LIFE evaluates schizotypy, some items evaluate overlapping traits also present in Schizoid Personality Disorder (ScPD) (Mason et al., 2005). The O-LIFE questionnaire was administered online and subjects with the highest scores were further assessed with a semi-structured clinical interview for Axis I and II disorders (First et al., 2002, 1997) conducted by an experienced clinical psychologist (C.P.). Diagnoses of both cluster A and co-morbid disorders were made according to DSM-IV TR criteria (American Psychiatric Association, 2000). Even though some subjects also presented high scores in other personality traits, only those with a main diagnose of SPD, ScPD or both, according to the

clinical interview were selected. The presence of any co-morbid Axis I disorder was considered an exclusion criterion, and particular attention was taken to exclude present or past psychotic disorders. A final group of 30 patients were selected, which fulfilled criteria for SPD, ScPD or both diagnoses. Substance abuse, with the exception of nicotine, and the presence or past history of any neurological or medical condition were additional exclusion criteria.

Finally, 36 individuals formed the HC group and were recruited among high-school and university volunteer students, matched for age and screened in order to exclude any axis I or II psychiatric condition by means of semi-structured interviews. The presence of other medical conditions was also an exclusion criterion. The ethical committee in clinical research of Corporació Sanitària Parc Taulí Hospital and of the Autonomous University of Barcelona approved the study protocol, which was conducted in accordance with the ethical standards of the Declaration of Helsinki. All participants gave written informed consent after a detailed description of the study. Participants of all three groups had to have an IQ within the normal range or higher (IQ > 85) as well as normal verbal skills.

Materials

The "Autism Diagnostic Interview Revised" (ADI-R) (Lord et al. 1994; Rutter et al. 2003).

An evaluation of past and present symptomatology was held in order to diagnose the sample of HFA. One of the participants parents was interviewed with the (ADI-R), a standardized semi-structured clinician-based interview for caregivers of individuals with autistic disorder that provides a useful structure to obtain history and understand a caregiver's perspective on his or her child's symptoms. The diagnosis of autistic disorder according to the ADI-R requires that individuals reach or exceed cut-off scores in all three DSM-IV or ICD-10 symptoms

domains which are Social Interaction (SI), Communication (CO) and Repetitive behaviours and Stereotyped patterns (RB).

The"Autism Diagnostic Observation Schedule Scale test"(ADOS)(Lord et al. 1999).

The second instrument (ADOS) administered directly to the participants, is a semi-structured, standardized assessment of communication, social interaction and play or imagination. It consists of four modules; each module contains a schedule of activities designed for use with children or adults at a particular developmental and language level, ranging from non-verbal to verbally fluent persons. Only one module, lasting about 30 minutes, is administered to any individual at a given point in time. Diagnostic classification is made on the basis of exceeding thresholds on each of two domains, social interaction and communication and exceeding a threshold for a combined social-communication score.

Structured Clinical Interview for DSM-IV-TR Axis II Personality Disorders (SCID-II) (First et al., 2002,1997).

The Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II) is a widely used semi-structured diagnostic instrument for assessing all ten DSM-IV personality disorders. All participants met self-report criteria for any given personality disorder are then administered the corresponding portions of the SCID-II interview in order to assign a formal diagnosis.

The "Strange Stories Test" (Happé 1994)

It was the first of three tests administered examining Theory of Mind (ToM) performance. The particular test mediates the cognitive aspect of ToM, includes 16 stories followed by questions. There are 8 ToM stories and 8 control stories. The ToM stories contain confusions, double

meanings, irony, persuasion, cheating and white lies, and the questions ask subjects to make inferences about the characters thoughts and feelings. In the control stories, participants are required to make global inferences about physical events which go beyond what is explicit in the text. Firstly, a preparatory practice story was read, followed by the control and ToM stories interspersed. The answers to the questions were recorded simultaneously with the test. The standardised score is 2 for an explicitly correct answer, 1 if the answer is partial and 0 if it is incorrect. The higher the score, the higher the functioning.

The "Faux Pas Test" (Stone et al. 1998)

Was administered also to measure cognitive ToM, examine the ability to identify when someone has said something inappropriate which may unintentionally hurt another's feelings. The test is made up of 20 stories about everyday situations, including 10 stories where someone says something wrong or inappropriate and 10 control stories concerning conflicts without "false step", arranged in random order. Each story last about 30 seconds. (see in the Appendix A the compete stories). After reading each story 6 questions assessing social cognition were asked. (1) Firstly, testing detection of the gaffe (*Did anyone say anything awkward, or something they shouldn't have said?*). If the reply is yes and the "faux pas" is identified, the following questions are put, probing (2) the identification of the people (*Who did it?*), (3) the explanation (*Why do you think it was the wrong thing to say?*), (4) the content (*Why do you think s/he said that?*), (5) the false belief involved (*Did they know or remember that…?*—this question is different for each story), and (6) empathy (*How do you think the person who heard it felt?*). There are also two control questions specific to each story to ensure general comprehension of the text, Subjects score 1 point for each correct answer.

The "Reading the Mind in the Eyes Test" (Baron-Cohen et al. 1997)

Measures the affective aspect of ToM, was developed to examine individual differences in recognizing a person's mental states from the expression in their eyes. A revised version for adults was used, containing complex mental states. It consists of 36 black and white photographs of the region of the face around the eyes of men and women (see Appendix B). Participants have to "read the look in the eyes" and decide which of four words around the photograph best describe what the person depicted is thinking or feeling. The terms describing mental states are defined in a glossary provided for consultation. The measure used was the percentage total of participants' correct responses. The mental states of each photograph were classified positive, negative or neutral valence according the classification proposed by Medina-Pradas et al. (2012).

The "Wechsler Adult Intelligence Scale" (Wechsler 1999) and The"Wechsler Intelligence Scale for children" (Wechsler 2005)

All participants were controlled for IQ scores based on the full (WAIS-III) and (WISC-IV) according to the age of the participants. Both tests used as general intelligence tests, were developed to assess cognitive ability. Verbal skills were estimated to be in the normal range based on the verbal subscale of these tests and clinical impression/daily functioning.

Procedure:

The HFA participants were tested individually, in a quiet room, by a trained psychologist. Each session lasted approximately one and a half hour. The HFA group was tested in the hospital. The ADOS was administrated first, followed by the IQ test in the first visit. Previously, their parents completed the ADI-R. The three Theory of Mind tests were administered during the second visit.

The students of the university were summoned in the Department of Clinical Psychology and evaluated in an office, by trained psychologists. SSPD participants with the highest scores in the O-LIFE questionnaire were further assessed with a semi-structured clinical interview for Axis I and II disorders conducted by an experienced clinical psychologist (C.P.). When final group formed, SSPD participants administered with the ToM and the IQ tests.

Finally, the HC group, constituted of high school and university students. Students of the university were tested as described above while high school students were tested at their school (out of lecture hours) or in their homes, completed the IQ test, followed by the three ToM tests. In all three groups, ToM tasks were presented in random order, in their Spanish translation version.

Data Analysis:

Statistical analysis at first comprised a description of all the measures included in the research using IBM SPSS Statistics software for Windows (version 23.0) and a p value of 0.05 was the criterion used to decide statistical significance. The group membership was used as independent variable and the three tests as the dependent variables, each modelled separately of the other. To answer hypothesis about differences in mentalization between groups an analysis of covariance through multiple linear regression with a priori contrasts was conducted. As literature suggest that intelligence is related to group and to mentalization, the intelligence quotient was included in models as an adjusting term. To compare cognitive and affective measures of mentalization in each group, t-test for paired samples were calculated. For each t-test Cohen's d coefficients were calculated (effect size was considered moderate for $|d| > 0.5$ and high for $|d| > 0.8$) (Kelley & Preacher, 2012).

Results

Descriptive information

Characteristics for the participants can be found in Table 1. The groups differ in terms of proportion of males and females (p=0.004). Overall there were more men than women in the sample, each group was formed by an average of (88.2%) male participants. Differences found also with respect to age (p>0.001) and intelligence quotient (p>0.001) so they adjusted statistically prior to the analysis.

As the mean scores of the Table 2. indicate, HFA group scored lower than controls in all theory-of-mind tests, however the differences were not significant in all the measures. As Table 3. shows, the comparison of HFA group with Healthy Controls revealed statistically significant differences in the Strange stories and in the Negative valences of the Reading the Mind in the Eyes Test. After adjustment for age and IQ, the differences between the two groups in the control stories and ToM stories were significant (p<0.001 and p= 0.029 respectively). Furthermore, in the Reading the Mind in the Eyes Test, HFA participants performed significantly worse than HC (p=0.022) in the negative eye test. For significant comparisons effect size coefficients ranged from moderate (0.53) to high (0.83).

As Table 3. presents the comparison of SSPD group with HC did not identified significant differences. In the Faux Pas Stories test the SSPD group obtained the lowest scores in the Faux Pas and Control stories (M 46.0; DE=8.5 and M 8; DE = 1.5 respectively) compared to the other groups. Likewise, in the Reading the Mind in the eyes test, SSPD group scored higher (M 65; DE =12 and M 74.2; DE=16.2) than Healthy controls (M 64; DE =9.1 and M 66.2; DE 14.4) in the total Eyes test and positive valences respectively.

Moreover, the comparison of HFA with SSPD revealed significant difference in Strange stories test ($p< 0.001$), with HFA group (M 11.3; DE =2.5) scoring lower than SSPD group (M 12.2; DE =2.0) in Control stories, while approaching the level of significance in ToM stories ($p=0.063$). All groups had higher scores in the ToM stories than in the control stories. In the Reading the Mind in the Eyes Test, HFA participants performed significantly worse than SSPD participants ($p =0.031$) in the total eye test. When the percentage of accuracy according to the emotional valence of the picture was examined, there were no significant differences between the two groups in the identification of positive and neutral emotional valences ($p= 0.269$ and $p=0.357$ respectively). However, there were differences in the perception of emotions with negative valences, the SSPD group having scored higher percentage of accuracy ($p = 0.022$). Again, effect size values ranged from moderate (0.55) to high (1.03).

We also examined the associations between cognitive and affective Tom in HFA and SSPD groups. As shown is table 4. and 5. after standardized the test scores we conducted t-tests to compare the scores of Tom measures. HFA group showed no significant differences when cognitive and affective components compared. However, the SSPD group scored significantly lower in the Faux Pas stories test ($p=0.058$) and Control stories ($p=0.022$) which measure the cognitive aspect of theory-of-mind. In the Strange stories test, the results were not met statistical significance, but means on the table 5. indicate that SSPD group tend to score generally lower in cognitive versus affective Tom.

Discussion

The main aim of this study was to compare the performance of a group of HFA and SSPD with a matched HC group, on three selected test measuring Advanced Theory of Mind. The HFA group had an overall worse performance and gave significantly more context-

inappropriate mental state explanations in the majority of tasks, compared with the control group. In agreement with our results, Spek et al. (2010) and Kaland et al. (2002) found children and adults with HFA more impaired than controls on the Strange Stories test, while Bora and Pantelis (2016) and Cantio et al. (2016) support also consistently the impairment of HFA patients on ToM tasks.

In the Reading the Mind in the Eyes Test, HFA participants had also significant lower percentage of correct answers in the recognition of negative emotions. Nevertheless, participants with HFA were equally efficient as the control group in positive and neutral emotion recognition. Their overall poor performance on the negative valences of Eyes Test is consistent with previous research. Ashwin et al. (2006) found a deficit in recognition of expressions of negative emotion but not in the other emotions. Furthermore, Salvador et al. (2015) compared typical and HFA children through the use of a humanoid robot (Zeno), supporting no significant impairment in the general emotion prediction but a specific deficit in correctly identifying fear. Moreover, in the study of Enticott et al. (2014), the HFA group showed poorer overall performance in identifying anger, disgust and sad expressions, while Wong et al. (2012) emphasized on the facial expression intensity, supporting with his findings that children with HFA detect mild affective expressions less accurately than their typical peers. Thus, our results suggest that individuals with HFA may need more support in mentalizing processes, particularly on complex emotion recognition, and further highlight that impairments in HFA do not extend to all emotions, but rather seem to be limited to negative emotions.

Contrary to our predictions, the SSPD group did not score significantly lower than controls in none of the measures. This may be due to the absence of clinical severity since this sample consisted of non-clinical individuals, with higher vulnerability to develop

schizophrenia-spectrum disorders, but of milder symptom severity. Moreover, the comparison of the HFA and the SSPD groups identified more differences. The results of the Strange Stories test implying that HFA participants had worse understanding of the implicit meaning. In the Eyes Test individuals with HFA had also more difficulty in the processing of emotional expressions than SSPD participants. The percentage of accurate replies according to the type of emotion was further analysed, classifying them into positive, neutral and negative valences. Participants with HFA were less efficient than SSPD group in negative emotion processing, presenting greater deficits. In line with previous studies (Ozguven et al. 2010; Bolte & Poustka 2003; Tin et al. 2017) our results support worse performance in individuals with HFA when compared with SSPD population in advanced Theory of Mind tasks.

The second objective of this study was to evaluate possible dissociation between the socio-cognitive and socio-perceptive components of ToM in the HFA and SSPD groups. No significant dissociation was observed when we compared the cognitive and affective performance of HFA patients. Conversely, SSPD participants scored significantly lower on cognitive than in affective ToM, further supporting the sequence of mentalizing development build upon different chronological stages which states that ToM impairments in SSD arise later in life (Chung et al. 2014).

One interpretation of these data is that affective ToM is more automatic and less vulnerable to neurodegeneration or brain injury than cognitive ToM (Bottiroli et al 2016; Dennis et al 2013) thus, SSPD individuals whose ToM deficits arise in an older age, may present greater impairments on cognitive tasks than on emotion recognition. One of the most significant difference between the two spectra is that ASD core signs and symptoms are present from birth and tend to improve with age, while SSD develops later, and deficits tend to worsen with age. However, when interpreting these results, it should also be taken into account that

raw scores of the SSPD and the HC groups in the eyes test are very similar. Then, the high standardized scores of the SSPD group in the eyes test are mainly due to the very low scores in this test obtained by the HFA group.

Despite the mixed results found by some groups (Jahshan and Sergi, 2007; Fernyhough et al., 2008; McCleery et al., 2012) a large majority of studies did find a connection between poor ToM and SSPD. Okruszek et al. (2017) support cognitive ToM to be more impaired in patients with Schizophrenia while the meta-analyses of Steffens et al. (2018) investigated the association between Schizotypy and dimensions of cognitive control, revealing subtle cognitive control deficits in high Schizotypy. According to Singer, (2006) individuals with SSD understand other people's emotions earlier than their beliefs. In the same line, results of developmental studies suggest that the abilities to understand other people's thoughts and to share their affects display different ontogenetic trajectories reflecting different developmental paths of their underlying neural structures. More specifically, empathy develops much earlier than cognitive mentalizing abilities, because the former relies on limbic structures which develop early in ontogeny, whereas the latter rely on lateral temporal lobe and pre-frontal structures which are among the last to fully mature (Singer, 2006).

To our knowledge few studies with non-clinical samples have investigated alterations in ToM. Cochrane et al. (2012) suggest that symptoms of schizophrenia and corresponding high schizotypal personality scores in non-clinical samples are associated with similar disruptions in cognitive functioning. Montag et al. (2012) examined first-degree relatives of schizophrenia patients on cognitive versus emotional mentalizing abilities, and their findings confirm impairments in cognitive but not emotional ToM corroborating the assumption of distinct social-cognitive abilities as an intermediate phenotype for schizophrenia. In contrast

Kocsis-Bogar et al., (2017) supports ToM alterations in the emotional state of non-clinical participants with high trait schizotypy.

More research is needed to make the connection of ToM and SSPD clearer, especially whether impaired ToM abilities can be also detected in non-clinical volunteers with high trait schizotypy. In response to our non-clinical SSPD sample, psychotic disorders and psychotic expression can be understood as a continuum, from non-clinical personality manifestations of schizotypy, to severe and chronic schizophrenic psychopathology (Debanee et al, 2016), therefore the value of studying non-clinical population aiming to identify subtle alterations, gives the opportunity to preventive treatment and a better prognosis. In the context of risk for developing psychosis, subclinical research may promote an indicated prevention approach on individuals presenting the first signs of the emerging disorder. The use of subclinical population may be considered as a strength from the point of psychiatric medication absence and illness duration confounds however, it is important to recognise that this particular sample cannot reflect with clarity the higher trait disorder expression.

Several limitations of the current study merit mention. First, the sample size is relatively small, a larger population may have identified more subtle differences. Moreover, the present study was carried out with mainly male youngsters and adults with high average verbal skills. Thus, our results cannot be generalized to populations with average verbal skills or to females. The addition of an equally balanced gender sample would perhaps have revealed greater differences between the groups, extending knowledge for the females on the presentation of HFA and SSPD phenotype. Future research is likely to concentrate on developing a more systematic understanding of the female presentation since mentalizing difficulties may vary across genders.

Compared with previous studies, this study has a number of strengths. First, it contributes to an area which has not received much attention. The direct comparison of cognitive and affective ToM between individuals with HFA and SSPD adds to the previous literature by further establishing the degree of impairment in those two populations and moreover, by screening ToM subcomponents as a multifaceted problem. To our knowledge, this is the first time that those two subgroups are compared directly. Studying ToM in this population permit us to explore whether ToM deficits are present in at-risk individuals prior to, or in the absence of serious functional impairment. In reference to our SSPD sample the absence of potential confounds such as medication or hospitalization can serve as a model system of psychosis, allowing its investigation. Furthermore, in this study was estimated IQ competence, which has proved to be an important confounder of ToM performance (Sasson et al. 2011).

While it is not possible to draw broad conclusions from a single study, our findings suggest differences between the groups, as well as in ToM subcomponents, which need to be replicated by more subtle and detailed instruments on future larger sample studies. In conclusion, individuals with HFA showed more impaired performance compared to healthy controls and SSPD participants at correctly identifying complex emotional states in others while they were equally impaired in both affective and cognitive components. Conversely SSPD individuals displayed a similar profile of difficulties in ToM as healthy controls. However, they present greater impairments on the cognitive component. Future studies that compare the evolution of ToM abilities across the two disorders may help identify and understand subtle differences of mentalizing patterns. It is hoped that a better understanding of social cognition in both disorders will enable us to decrease social disability and capture specific features of these disorders.

Compliance with Ethical Standards

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and /or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

Table 1: Participants Characteristics

	HC (n=36)	**HFA (n=35)**	**SSPD (n=30)**	**P**
Sex (male)	34 (94.4%)	34 (97.1%)	22 (73.3%)	p=0.004
Mean Age (s.d.)	19.4 (6.2)	18.6 (6.4)	28.8 (11.5)	p<0.001
Mean IQ (s.d.)	115.2 (10.7)	100 (15.6)	103.6 (15.4)	p<0.001

***HC* healthy controls, *HFA* high functioning autism, *SSPD* schizotypal schizoid personality disorder, *IQ* intelligent quotient**

Table 2: Descriptives of ToM measures.

ToM tests	HC	HFA	SSPD
	Mean (s.d.)	Mean (s.d.)	Mean (s.d.)
Faux pas stories	52.8 (6.5)	46.7 (12.5)	46.0 (8.5)
Control of Faux pas stories	19.3 (0.9)	19.0 (1.2)	19.4 (0.89)
Control stories without Faux pas	8.9 (1.3)	8.4 (1.3)	8.0 (1.5)
Control questions	19.5 (0.9)	19.3 (1.4)	19.4 (1.0)
Strange Control stories	12.8 (2.0)	11.3 (2.5)	12.2 (2.0)
Strange ToM stories	14.0 (1.2)	12.1 (2.6)	13.2 (2.1)
Eyes test Total	64.0 (9.1)	58.6 (10.4)	65.0 (12)
Eye test Positive	66.2 (14.4)	63.7 (17.2)	74.2 (16.2)
Eye test Neutral	64.0 (21.1)	56.8 (20.0)	63.4 (19.8)
Eye test Negative	62.0 (12.4)	55.0 (12.6)	60.0 (14.5)

HC **healthy controls,** ***HFA*** **high functioning autism,** ***SSPD*** **schizotypal schizoid personality disorder,**

TOM **theory-of-mind**

Table 3: ToM tasks comparison between groups

			HC vs HFA				HC vs SSPD				HFA-SSPD			
	F	**p**	**Mean Diff**	**p**	**CI 95%**	**d**	**Mean Diff**	**p**	**CI 95%**	**d**	**Mean Diff**	**p**	**CI 95%**	**d**
Faux pas stories	4.60	**0.002**	4.76	*0.064*	-0.28 to 9.80	0.45	2.68	0.312	-2.60 to 7.92	0.24	-2.08	0.439	-7.40 to 3.24	0.19
Control of Faux pass stories	2.47	**0.050**	-0.01	0.094	-0.55 to 0.55	0.00	-0.44	0.133	-1.01 to 0.14	0.36	-0.44	0.140	-1.02 to 0.15	0.37
Control stories without Faux Pass	1.98	0.104	-	-	-		-	-	-		-	-	-	
Control questions	2.02	0.098	-	-	-		-	-	-		-	-	-	
Strange ToM stories	5.43	**0.001**	1.25	**0.029**	0.13 to 2.36	0.53	0.11	0.849	-1.06 to 1.30	0.05	-1.13	*0.063*	-2.33 to 0.06	0.47
Strange Control stories	12.67	**0.001**	1.73	**0.001**	0.75 to 2.71	0.83	0.45	0.390	-1.49 to 0.59	0.21	-2.18	**0.001**	-3.24 to -1.13	1.03
Eyes test Total	4.57	**0.002**	2.91	0.300	-2.64 to 8.47	0.25	-3.67	0.220	-9.56 to 2.23	0.29	-6.58	**0.031**	-12.53 to -0.62	0.55
Eye test Positive	5.06	**0.001**	-1.62	0.702	-10.00 to 6.80	0.09	-6.65	0.141	-15.53 to 2.24	0.35	-5.03	0.269	-14.00 to 3.95	0.28
Eye test Neutral	4.43	**0.003**	0.42	0.937	-10.02 to 10.86	0.02	-4.80	0.392	-15.88 to 6.30	0.20	-5.21	0.357	-16.41 to 5.98	0.23
Eye test Negative	4.56	**0.002**	8.17	**0.022**	1.30 to 15.04	0.56	-0.48	0.897	-7.80 to 6.82	0.03	-8.65	**0.022**	-16.02 to -1.28	0.58

***HC* healthy controls, *HFA* high functioning autism, *SSPD* schizotypal schizoid personality disorder, *TOM* theory-of-mind**

In bold: Statistically significant taking alpha = 0.05

***** Differences are adjusted by Age and IQ***

Table 4: Comparison of standardized scores in HFA

Cognitive Tom		Affective Tom		Cognitive Vs Affective		
Test	**Mean**	**Test**	**Mean**	**Mean Diff**	**p**	**CI 95%**
Faux pas stories	-0.203	**Eyes Total**	-0.396	0.193	0.481	-0.358 to 0.744
Control of Faux Pass	-0.219	**Eyes Total**	-0.396	0.177	0.501	-0352 to 0.706
Control stories without Faux pass	-0.430	**Eyes Total**	-0.396	0.353	0.108	-0.081 to 0.788
Control questions	-0.111	**Eyes Total**	-0.396	0.285	0.230	-0.190 to 0.761
Strange ToM stories	-0.361	**Eyes Total**	-0.403	0.041	0.805	-0.295 to 0.378
Strange Control stories	-0.477	**Eyes Total**	-0.403	-0.074	0.718	-0.491 to 0.342

***HFA* high functioning autism, *TOM* theory-of-mind**

Table 5: Comparison of standardized scores in SSPD

Cognitive Tom		Affective Tom		Cognitive Vs Affective		
Test	**Mean**	**Test**	**Mean**	**Mean Diff**	**p**	**CI 95%**
Faux pas stories	-0.284	**Eyes Total**	0.249	-0.533	0.058	-1.086 to 0.019
Control of Faux pas	0.174	**Eyes Total**	0.249	-0.075	0.799	-0.676 to 0.525
Control stories without Faux pass	-0.297	**Eyes Total**	0.249	-0.546	**0.022**	-1.009 to -0.083
Control questions	0.031	**Eyes Total**	0.249	-0.217	0.465	-0.819 to 0.384
Strange ToM stories	0.029	**Eyes Total**	0.249	-0.220	0.387	-0.732 to 0.293
Strange Control stories	0.042	**Eyes Total**	0.249	-0.206	0.410	-0.713 to 0.230

***SSPD* schizotypal-schizoid personality disorder, *TOM* theory-of-mind**

In bold: Statistically significant taking alpha = 0.05

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