Autism and schizophrenia in high functioning adults: Behavioral differences and overlap

Annelies A. Spek *, Saskia G.M. Wouters

Mental Health Institution (GGZ) Eindhoven, Boschdijk 625, 5626 AB Eindhoven, The Netherlands

A B S T R A C T

Several recent studies have demonstrated a genetical overlap between autism and schizophrenia. However, at a behavioral level it remains unclear which features can validly distinguish adults with autism from an adult schizophrenia group. To this end, the present study compared 21 individuals with the autistic disorder and 21 individuals with schizophrenia in self-reported features of autism and schizophrenia, as measured by the Autism-Spectrum Quotient (AQ) and the Schizotypal Personality Questionnaire (SPQ).

The schizophrenia group was more likely to report positive symptoms and the adults with autism were more likely to report impairments in social skill. Overlap was found between the two groups in negative symptoms, disorganization, attention to detail and imagination.

Thus, when discriminating between the two disorders, especially social skill and the presence of positive symptoms are relevant, whereas the presence of negative symptoms is not indicative.

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1. Introduction

Recently, research demonstrated that autism and schizophrenia are genetically linked (Burbach & van der Zwaag, 2009). Apparently, the two disorders share common genotypical features, therefore phenotypical (cognitive) and endophenotypical (behavioral) overlap can be expected (Braff, freedman, Schork, & Gottesman, 2007; Happé & Frith, 1996). In order to classify the two disorders correctly in adults and to choose appropriate interventions, it is important to know their precise behavioral overlap and differences. The present study aims to examine this.

1.1. Autism and schizophrenia

Originally, autism and schizophrenia were thought to be closely linked and the DSM-II made no distinction between the two disorders (APA, 1968). However, research in the 1970s demonstrated that the two disorders could be reliably differentiated (Kolvin, 1971; Rutter, 1972). Throughout the years, various differences have been reported between the two disorders, for example in age of onset, sex distribution, family history and long-term outcome (Konstantareas & Hewitt, 2001; Tantam, 1991; Watkins, Asarnow, & Tanguary, 1988; Werry, 1992). Furthermore, Volkmar and Cohen (1991) reported that the prevalence of schizophrenia in an autistic sample is not higher than in the general population, which at that time confirmed the hypothesis that autism and schizophrenia should be regarded as separate disorders.

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* Corresponding author. Tel.: +31 0402613900; fax: +31 0402613909.
E-mail address: aa.spek@ggze.nl (A.A. Spek).

However, research continued to report some degree of overlap between autism and schizophrenia (Dykens, Volkmar, & Glick, 1991; Konstantareas & Hewitt, 2001). Currently, the growing body of genetic studies in autism and schizophrenia enabled a more fundamental examination of the overlap and differences between the two disorders. Results indicated that similar chromosomal rearrangements and several single genes emerge as genetic risks both in autism and schizophrenia (Burbach & van der Zwaag, 2009; Rapoport, Chavez, Greenstein, Addington, & Gogtay, 2009; Tabares-Seisdedos & Rubenstein, 2009). These findings gave rise to the hypothesis that the two disorders may arise from similar neurodevelopmental vulnerability, or actually share defects in biological pathways of brain development (Burbach & van der Zwaag, 2009; Rapoport et al., 2009). This confirms previous ideas that autism and schizophrenia are related (APA, 1968), although the overlap may be smaller than originally thought. Genotypical overlap between autism and schizophrenia is expected to reflect in similarities on neurocognitive (phenotypic) and behavioral (endophenotypic) levels (Nylander, Lugnegard, & Hallerback, 2008).

1.2. Cognitive and behavioral differences and overlap between autism and schizophrenia

At the cognitive level, research indicated various similarities between autism and schizophrenia. For example, impairment in theory of mind (Baron-Cohen, Leslie, & Frith, 1985; Corcoran, 2000; Pilowsky, Yirmia, Arbelle, & Mozes, 2000), central coherence (Happé & Frith, 2006; John & Hemsley, 1992; Uhlhaas & Silverstein, 2005) and executive function (Kerns, Nuechterlein, Braver, & Barch, 2008; Ozonoff, South, & Provencal, 2005) have been found both in autism and schizophrenia. However, only cognitive flexibility and theory of mind have been actually compared between the two groups. Individuals with autism appeared more impaired in cognitive flexibility (Schneider & Asarnow, 1987), for theory of mind, results are mixed, whereas children with autism were found more impaired than children with schizophrenia (Pilowsky et al., 2000), no differences have been reported for adult groups (Craig, Hatton, Craig, & Bentall, 2004). In other cognitive areas, the two groups have not yet been compared.

At the behavioral level, research showed which features that are associated with negative symptoms, as described in schizophrenia, are also present in autism (Dykens et al., 1991; Konstantareas & Hewitt, 2001; Petty, Ornitz, Michelman, & Zimmerman, 1984; Sheitman, Bodfish, & Carmel, 2004). Furthermore, behavioral differences between the two groups have been reported in face orientation and recognition (Bölte, Rudolf, & Poustka, 2002; Sasson et al., 2007). Individuals with autism performed poorer in face orientation and recognition tasks compared to individuals with schizophrenia. No studies were found in which other behavioral characteristics were compared between the two disorders. For this reason, the precise behavioral overlap and differences between the two disorders are still not clear.

Furthermore, the abovementioned studies regarding behavioral differences and overlap between autism and schizophrenia were predominantly executed in children or adolescents. To our knowledge, only three studies addressed adolescent or adult groups. In two of these studies, the average full scale IQ of the majority of the participants was below 80, which indicates mild intellectual impairment (Bölte et al., 2002; Konstantareas & Hewitt, 2001). One study examined adults with average intelligence (Sasson et al., 2007). However, this study encompassed small research groups, with 10 individuals each. Moreover, the aim of this particular study was limited to face orientation and recognition in the two groups. Therefore, there is only little knowledge about which behavioral features can validly differentiate between high functioning adults with autism and schizophrenia. It is important to be aware of the behavioral overlap and differences between the two disorders for different reasons. Firstly, it increases the fundamental knowledge about the two disorders and how they may be related. Secondly, an increase of knowledge in this area can help clinicians to distinguish between the two disorders in adults, which facilitates the diagnostic process in these chronic psychiatric disorders and which enables recommending appropriate treatment and guidance.

Therefore, the present study aims to examine behavioral differences and overlap in high functioning adults with autism and schizophrenia. Furthermore, the relationship between behavioral characteristics of autism and schizophrenia will be investigated.

2. Method

2.1. Procedure

The participants of autism and the schizophrenia groups were recruited from GGZ (mental health institution) in Eindhoven and in Oss and the study was approved by the regional Ethics Committees of both centers. The individuals were randomly selected from a larger group of patients in treatment programs for autism or schizophrenia. Participants with genetic conditions or relevant neurodevelopmental conditions other than schizophrenia or autism (e.g. ADHD, Tourette syndrome) were excluded, as were participants who were institutionalized. Only men who ranged in age from 18 to 65 and who met the inclusion criteria were asked to participate. In total, 42 participants agreed to take part and signed informed consent forms prior to their inclusion in the present study. The group comprised 21 adults with autism and 21 adults with schizophrenia. Participants were only included when the Verbal Comprehension score of the WAIS-III (Wechsler, 1997) was at least 80 in order to ensure adequate understanding and interpretation of the items in the questionnaires. The lowest Verbal Comprehension score in the participant groups was 84.

To examine whether characteristics of autism or schizophrenia are present in the participants, the Autism-Spectrum Quotient (AQ) and the Schizotypal Personality Questionnaire (SPQ) have been used. Although the use of self-reports is controversial in individuals with autism, research has shown that adults with average verbal ability and a relatively high level of functioning are to a certain degree able to describe their strengths and weaknesses adequately (Happé, 1991; Frith &

Happé, 1999; Spek, Scholte, & Van Berckelaer-Onnes, in press). In the present study, the level of education was relatively high. 90.4% of the individuals with autism have finished a middle or high level of education (see Table 1). Therefore adequate insight might be expected.

In schizophrenia, insight into the symptoms of the disorders has also been questioned (for an overview, see Osatuke, Ciesla, Kasckow, Zisook, & Mohamed, 2008). However, research also pointed out that insight into the disorder is positively related to consent and compliance to treatment (Capdevielle et al., 2009; Lincoln, Lüllmann, & Rief, 2007) and to the absence of substance abuse (Kamali et al., 2001). Therefore, we only included participants in the schizophrenia group if they had high treatment compliance and we warranted that there was no substance abuse in the participants.

2.2. Assessment of disorders

The diagnosis in autism group was established preliminary through evaluation of history and current symptomatology. To gather developmental information, parents or an older brother or sister were interviewed using the Dutch version of autism Diagnostic Interview, revised version (ADI-R, Lord, Rutter, & Le Couteur, 1994). The ADI-R was administered by psychologists who were officially trained in the administration and scoring of this instrument. The ADI-R yields excellent reliability and validity when used by trained examiners (Lord et al., 1994). To gather information of current symptomatology, a semi-structured interview was administrated. This interview assessed the DSM-IV-TR criteria of autism by asking the participant standard questions (APA, 2000). Only those participants who met the DSM-IV-TR criteria of the autistic disorder were included in the present study.

The diagnoses of the participants with Schizophrenia were established preliminary to the present study, by psychiatric assessment following standard protocols. To verify and confirm the diagnoses, the Structured Clinical Interview Schedule for the DSM-IV has been examined (SCID-I/P; First, Spitzer, Gibbon, & Williams, 1997). The reliability of the SCID-I in diagnosing specifically schizophrenia is high (Skre, Onstad, Torgersen, & Kringlen, 1991). Based on SCID-I criteria, all participants met criteria for schizophrenia, paranoid type.

2.3. Assessment of symptoms of autism and schizophrenia

2.3.1. Autism-Spectrum Quotient (AQ)

The AQ is a 50 item self-administered questionnaire that assesses the degree to which an adult has features of the core autistic phenotype (Baron-Cohen, Weelwright, Skinner, Martin, & Clubley, 2001). The five subscales of the AQ assess the following areas: Social skill, Attention switching, Attention to detail, Communication and Imagination.

The internal consistency and test–retest reliability are satisfactory (Hoekstra, Bartels, Cath, & Boomsma, 2008). In the present study, a Dutch translation of the AQ has been used (Ponnet, Roeyers, Buysse, De Clerck, & Van der Heyden, 2004). The internal consistency for the two groups in the present study is high for autism group (standardized Crohnbach's α = .89) and sufficient for the schizophrenia group (standardized Crohnbach's α = .73).

2.3.2. Schizotypal Personality Questionnaire

The SPQ is a self-report questionnaire that measures the presence and severity of positive symptoms, negative symptoms and symptoms of disorganization, as they appear in individuals with a Schizotypal Personality (Raine, 1991). Research demonstrated that the SPQ is a valid and reliable instrument to examine similar symptoms in individuals with schizophrenia (Vollema & Hoijtink, 2000). The SPQ comprises 74 items and has been translated and standardized in Dutch for both a schizotypal and a schizophrenia group (Vollema & Hoijtink, 2000). The internal consistency for the autism group (Cronbach's α = .93) and the schizophrenia group (Cronbach's α = .88) is high.

2.4. Matching procedure

The two groups were matched according to age, level of education and Verbal Comprehension as measured by the WAIS-III factor scale 'Verbal Comprehension Index' (VCI). The subject characteristics for the two groups are presented in Table 1. T-tests showed that the two groups did not differ in VCI and mean age, a Kolmogorov–Smirnov test revealed no significant differences in level of education between the two groups.

Table 1
Matching variables.

	Autism	Schizophrenia	Statistic	p-Value
Mean age	44.1 (11.7)	40.9 (8.1)	$t(40) = 1.04$	$p = .306$
VCI[a]	110.5 (13.6)	107.2 (11.4)	$t(40) = 0.85$	$p = .400$
Level of education			$Z = 1.080$	$p = .194$
Low	2 (9.5%)	7 (33.3%)		
Middle	7 (33.3%)	4 (19.0%)		
High	12 (57.1%)	10 (46.6%)		

[a] Verbal Comprehension Index, measured by the WAIS-III.

Table 2
Means and standard deviations for Autism-Spectrum Quotient.

	Autism	Schizophrenia	p-Value
Social skill	30.1 (4.5)	23.6 (4.9)	.000
Attention switching	28.4 (4.8)	24.5 (4.0)	.007
Attention to detail	24.5 (5.3)	22.9 (4.4)	.289
Communication	25.2 (4.3)	20.7 (3.3)	.000
Imagination	25.3 (4.5)	24.0 (3.9)	.314

3. Results

3.1. Differences in the AQ subscales

The mean scores and standard deviations of the AQ for the two groups are presented in Table 2.

To test the hypotheses of differences in the AQ subscales between the two groups, a multivariate analysis of variance (MANOVA) was performed. The diagnosis was used as the independent variable and the AQ subscales as the dependent variables. The assumptions of univariate normality were met for each dependent variable, and the assumption of equality of variances between the groups were met.

Significantly higher scores in autism group in comparison with the schizophrenia groups were found the Social skill subscale ($F(1, 40) = 20.005$, $p < .01$, partial eta squared = .33), the Attention switching subscale ($F(1, 40) = 8.229$, $p < .001$, partial eta squared = .17) and the Communication subscale ($F(1, 40) = 14.720$, $p < .001$, partial eta squared = .27). The effect sizes of each of the three variables can be described as large (Cohen, 1988). For the subscales Attention to detail ($F(1, 40) = 1.155$, $p = .289$) and Imagination ($F(1, 40) = 1.038$, $p = .314$), no significant differences between the groups were found.

3.2. Differences in the SPQ subscales

The mean scores and standard deviations of the SPQ subscales for the autism group and the schizophrenia group are presented in Table 3.

To examine whether differences are present in the three subscales of the SPQ, multivariate analysis of variance was performed with the diagnosis as the independent variable and the SPQ subscales as the dependent variables. The analyses showed that the assumptions of homogeneity and equality of variance were met. Wilks' Lambda was used to measure group differences. For the subscale Positive schizotypy, the individuals with schizophrenia reached significantly higher scores compared to the participants with autism ($F(1, 40) = 6.314$, $p < .05$, partial eta squared = .14), with an effect size that can be interpreted as large (Cohen, 1988). The analyses revealed no differences between the two groups in the subscale Negative schizotypy ($F(1, 40) = 3.104$, $p = .086$) and Disorganization schizotypy ($F(1, 40) = .066$, $p = .799$).

3.3. The association between the AQ and the SPQ subscales

To examine the relationship between the AQ and SPQ subscales for autism and schizophrenia, Pearson product-moment correlation coefficients were calculated for each group. Preliminary analyses showed that assumptions of normality, linearity and homoscedasticity were met. Only medium or high correlations that reached significance will be described. Table 4 shows the correlation matrix for these results.

For the schizophrenia group, strong correlations were found between the SPQ subscale Negative symptoms and two AQ subscales, namely the AQ subscale Social skill ($r = .74$, $p < .001$) and Communication ($r = .66$, $p = .001$). A medium-sized negative correlation was found between the SPQ subscale Negative symptoms and the AQ subscale Attention to detail ($r = -.47$, $p = .030$).

No significant correlations were found between the SPQ subscale Positive schizotypy and the AQ subscales. For the SPQ subscale Disorganization, a strong correlation was found with the AQ subscale Social skill ($r = .56$, $p = .008$) and medium-sized correlations with Disorganization schizotypy and the AQ subscales Attention switching ($r = .48$, $p = .029$) and Communication ($r = .46$, $p = .036$) appeared.

Table 3
Means and standard deviations for the Schizotypal Personality Questionnaire.

	Autism	Schizophrenia	p-Value
Negative schizotypy	23.4 (8.7)	18.9 (7.9)	.086
Positive schizotypy	10.3 (8.0)	16.1 (6.8)	.016
Disorganization schizotypy	7.8 (4.9)	7.4 (4.7)	.799

Table 4
Correlation coefficients.

	Negative schizotypy	Positive schizotypy	Disorganization
Autism			
1. AQ Social skill	.462[*]	.008	.095
2. AQ Attention switching	.437[*]	.198	.430
3. AQ Attention to detail	.283	.267	.030
4. AQ Communication	.465[*]	.105	.285
5. AQ Imagination	.232	−.049	−.164
Schizophrenia			
1. AQ Social skill	.743[**]	.161	.563[**]
2. AQ Attention switching	.404	.253	.477[*]
3. AQ Attention to detail	−.474[*]	−.072	−.295
4. AQ Communication	.666[**]	.161	.461[*]
5. AQ Imagination	.343	.153	−.010

[*] $p < .05$.
[**] $p < .01$.

In autism group, no significant correlations were found between the AQ subscales and the two subscales Positive symptoms and Disorganization. Medium correlations appeared between the SPQ subscale Negative symptoms and the AQ subscales Social skill ($r = .46$, $p = .035$), Attention switching ($r = .437$, $p = .048$) and Communication ($r = .465$, $p = .034$).

3.4. The ability of the questionnaires to predict whether a diagnosis is present

Hierarchical (backward) multiple regression was used to assess the ability of the subscales for which the two groups differed significantly to predict the diagnosis (Social skill, Attention switching, Communication and Positive schizotypy). Preliminary analyses showed that the assumption of normality, lineairity, multicollinearity and homoscedasticity were met. The results of the multiple regression analysis are presented in Table 5.

The total variance explained by the model as a whole was 43.3% ($F(4, 1.136) = 7.056$, $p < .001$). The total variance explained by the final model (as a result of backward analyses) was 41.4% ($F(2, 2.176) = 13.799$, $p < .01$). This final model contained the subscales Social skill (which individually explained 28% of the variance) and Positive schizotypy (which individually explained 8% of the variance). We further examined the sensitivity of the Social skill scale and the Positive schizotypy scale in making a correct group classification by calculating two Receiver Operating Characteristic analyses (ROC-analysis; Fawcett, 2006). The ROC curves are illustrated in Figs. 1 and 2.

In the ROC-analysis for the Social Skill subscale of the AQ, the area under the curve was .838, which means that in almost 84% of all possible pairs of subjects in which one has autism and the other schizophrenia, this model will assign a higher probability to the subject with autism.

In the second ROC-analysis for the subscale Positive schizotypy of the SPQ, the area under the curve is .737, which means that in almost 74% of all possible pairs of subjects in which one has autism and the other schizophrenia, this model will assign a higher probability to the subject with schizophrenia.

Table 5
Summary of multiple regression analysis (backward) for variables predicting diagnosis ($N = 42$).

Variable	B	SE B	β	p
Model 1				
Social skill (AQ)	−.03	.02	−.36	.086
Attention switching (AQ)	−.01	.02	−.07	.730
Communication (AQ)	−.02	.03	−.17	.438
Positive symptoms (SPQ)	.02	.01	.30	.023[*]
Model 2				
Social skill (AQ)	−.03	.02	−.39	.058
Communication (AQ)	−.02	.02	−.20	.301
Positive symptoms (SPQ)	.02	.01	.29	.023[*]
Model 3				
Social skill (AQ)	−.05	.01	−.53	.000[**]
Positive symptoms (SPQ)	.02	.01	.29	.026[*]

Note: $R^2 = .43$ for Model 1; $\Delta R^2 = −.002$ for Model 2; $\Delta R^2 = −.02$ for Model 3.
[*] $p < .05$, two-tailed.
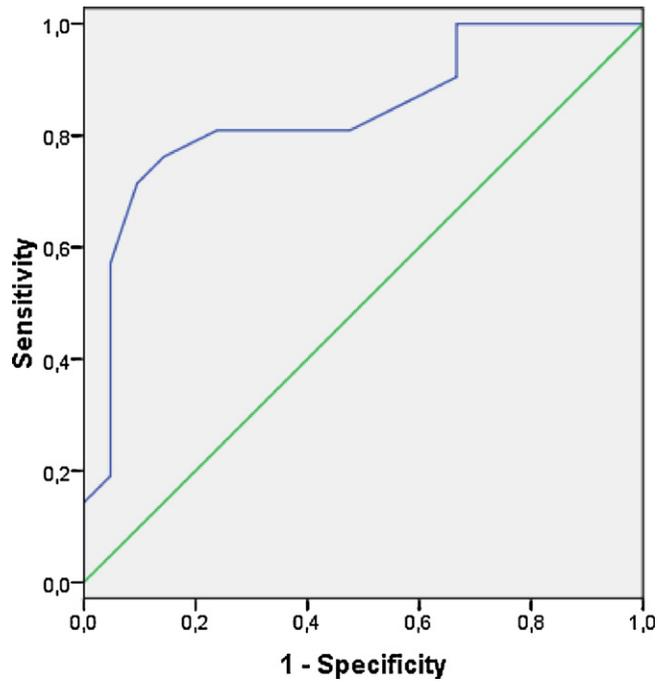[**] $p < .01$, two-tailed.

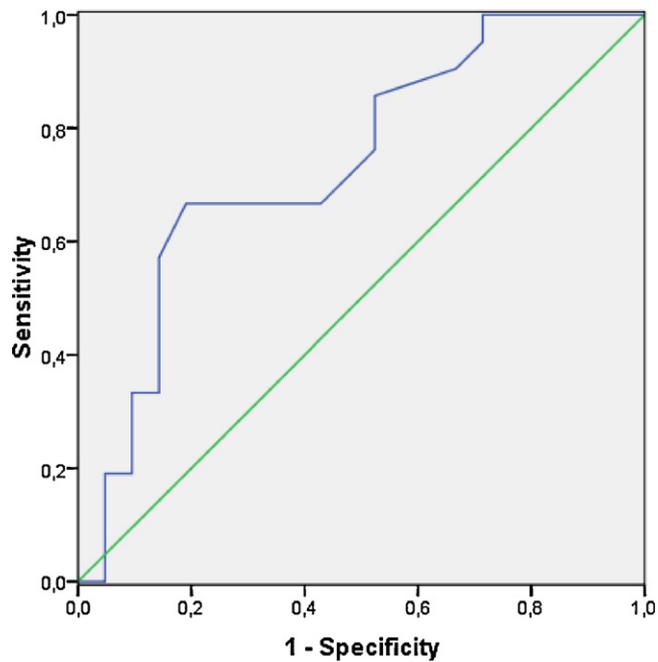Fig. 1. Roc curve Social skill subscale in autism.

Fig. 2. Roc curve Positive schizotypy subscale in schizophrenia.

4. Discussion

In the present study, we assessed differences and overlap in autism and schizophrenia. The results showed that the autism group reported more problems in Social skill, Attention switching and Communication compared to the individuals with schizophrenia. Furthermore, the individuals with schizophrenia reported more characteristics of Positive schizotypy compared to the autism group. However, of these four subscales, only Social skill (as measured by the AQ) and Positive

schizotypy (as measured by the SPQ) were relevant in differentiating between the two groups. Results in the Social skills subscale were most important for predicting the presence of autism and Positive schizotypy results were most predictive for the presence of schizophrenia. The larger impairment in social skill for the autism group is in line with previous findings in face orientation and recognition (Bölte and Poustka, 2003; Sasson et al., 2007). Furthermore, our results have a broader scope, suggesting overall poorer social skill and social behavior in adults with autism. This is in accordance with the notion that in autism, impairment in this area is regarded a primary deficit (Carter, Davis, Klin, & Volkmar, 2005), while in schizophrenia this is still unclear (Brüne, 2005). However, in schizophrenia most evidence points to a strong relationship between acute psychosis and theory of mind impairment. In 'remitted' patients, theory of mind impairment appeared reduced or in some cases even absent (Bora, Yucal, & Pantelis, 2009).

The differences in the SPQ subscale Positive schizotypy between the two groups are generally in line with previous findings of Volkmar and Cohen (1991), who indicated that the prevalence of schizophrenia was similar in individuals with autism compared to the general population. Moreover, no correlation was found between the subscale Positive schizotypy and the AQ subscales. This gives rise to the hypothesis that the presence of autistic features does not increase the risk of developing positive symptoms as are characteristic of schizophrenia.

Our results further showed that the individuals with autism reported more negative symptoms compared to the schizophrenia group, although this difference was not significant.

An overlap in negative symptoms between the two disorders has been reported previously (Dykens et al., 1991; Konstantareas & Hewitt, 2001; Petty et al., 1984; Sheitman et al., 2004). Apparently, autism and schizophrenia in adults cannot be distinguished based on the presence or absence of negative symptoms. In the two disorder groups, the negative symptoms were related to impairment in social skills and communication as measured by the AQ, which replicates earlier findings (Tordjman, 2008). This may indicate that the overlap in negative symptoms between autism and schizophrenia is due to similarities in social and communicational features. Interestingly, in the autism group the negative symptoms were also related to attention switching, while in the adults with schizophrenia, an inversed relation with attention to detail was found. This raises the possibility that performance in the subscale Negative schizotypy may reflect slightly different features in the two disorder groups. In individuals with schizophrenia, negative symptoms co-occur with relatively little attention to details, while in the adult autism group negative symptoms are even slightly positively related to a detailed information processing style. In autism withdrawal from the (social) environment, as characteristic for negative symptoms, can co-occur with an increased attention to detail in the environment, while this is not the case in schizophrenia. This is consistent with two of the three cognitive frameworks of autism, namely those that describe impaired theory of mind and enhanced detailed information processing.

In the present study, no group differences were found for the Disorganization subscale of the SPQ, which encompasses odd speech and odd or eccentric behavior. This suggests that individuals with autism also recognize these features. From this perspective, the presence of symptoms of Disorganization can be indicative for both schizophrenia and autism. In the autism group, performance in the Disorganization subscale was not related to any of the AQ subscales, whereas relationships with the Communication and the Social skill subscales might have been expected. This may be due to differences in the specific content of the items. Whereas the Disorganization items of the SPQ are mainly focussed on the oddity of speech and behavior, the emphasis in the AQ Communication items has been put on initiating and maintaining a conversation, as well as understanding non-verbal communication. For the schizophrenia group, these two communicational problems appear related, as opposed to the individuals with the autistic disorder. Similarly, whereas the SPQ Disorganization subscale refers to odd and eccentric behavior, the Social skill items in the AQ seem more centered around enjoying and seeking social situations.

The AQ results showed no differences in self-perceived detailed information processing between the autism and schizophrenia groups. This finding is not surprising, since a detailed information processing style, as characteristic for autism (Frith, 2003; Happé & Frith, 2006) has also been proposed for schizophrenia (John & Hemsley, 1992; Johnston, Lowery, Kohler, & Turetsky, 2005; Uhlhaas & Silverstein, 2005). Furthermore, similarities were found in the AQ subscale Imagination. This findings may be somewhat surprising, since imagination is thought to be limited in individuals with autism, while over-developed in schizophrenia (Crespi & Badcock, 2008). However, in the AQ subscale most items refer to 'active and purposeful' imagination, like: 'I find it difficult to imagine what it would be like to be someone else'. Despite the over-developed imagination in schizophrenia, active control in this respect has been found limited (Brébion, Ohlsen, Pilowsky, & David, 2008).

Concluding, only self-reported positive symptoms and social skill can validly distinguish between adults with autism and schizophrenia. Thus, when discriminating between the autistic disorder and schizophrenia, these subscales of the SPQ and the AQ can provide useful information. Overlap was found between the two disorders in negative symptoms, disorganization, detailed information processing and imagination. These findings may give further direction to future studies that investigate genetic overlap between autism and schizophrenia.

4.1. Limitations

The present study used two self-report questionnaires. Although the two disorder groups were carefully selected on level of education and the absence of substance abuse, deficiencies in insight may have influenced the performance in the two questionnaires.

Further, our sample size was rather small, which limits the power of the present study and precludes any definite conclusions. Therefore, replication with larger samples is required in order to draw final conclusions.

Another limitation of the present study concerns the generalizability of the results. The individuals with schizophrenia were all of the paranoid subtype and in the autism group we only included individuals with the autistic disorder. Therefore, our findings cannot be generalized to other subtypes within the schizophrenia and autism spectrum. In general, the results are limited to male adult groups with a relatively high level of functioning.

Acknowledgements

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