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Social problem-solving in high-functioning schizophrenia: Specific deficits in sending skills

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Abstract

This study examined social problem-solving performance in high-functioning schizophrenia ($n=26$) and its relation to neurocognition. Ten healthy controls were used as a comparison group. Social problem-solving was assessed with the Assessment of Interpersonal Problem Solving Skills (AIPSS) method. The schizophrenia group was outperformed by healthy controls on all AIPSS measures, reaching statistical significance for sending skills. Exploration of the internal relationship between different aspects of social problem-solving showed that identification of an interpersonal problem (a receiving skill) was not correlated with formulating solutions to the problem (processing skills) or successfully role-playing solutions (interpersonal sending skills). Nonverbal performance in the role-play (an interpersonal sending skill) was not significantly correlated with identification of an interpersonal problem or the generation of solutions. This suggests a dissociation of social problem-solving processes. Social problem-solving was significantly associated with psychomotor speed, verbal learning, semantic fluency and cognitive flexibility. Clinical implications are that remediation of social problem-solving skills should focus on role-playing (nonverbal) interpersonal behaviors, rather than on verbally analyzing an interpersonal problem and clarifying alternative solutions.

Keywords: Social functioning; Neurocognition; Social problem-solving; AIPSS

1. Introduction

Reduced social functioning is a diagnostic criterion for schizophrenia (DSM-IV, American Psychiatric Association, 1994), and difficulties in social interactions are clinically salient features of the disorder (Couture et al., 2006). Schizophrenia is also characterized by impaired neurocognition, which has been shown to be related to functional outcome (Green et al., 2004). Especially verbal memory, executive functioning and vigilance show associations with social and community functioning, the ability to solve interpersonal problems in a role-play situation and the ability to require psychosocial skills through rehabilitation programs (Green et al., 2000). Hence, individuals with schizophrenia are

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possibly less competent in everyday social interactions due to difficulties in concentration, remembering old and learning new information, or handle new situations. These findings need to be translated into clinical practice in order to identify clinically meaningful treatment targets. Therefore, it is necessary to move beyond overall test scores and search for underlying mechanisms. By disentangling these relations, new clinical interventions can be developed.

Challenging situations involving other people occur on a regular basis in everyone's life. It is difficult to measure someone's ability to master such situations *in vivo*, and laboratory based social problem-solving tests have been developed, such as the Assessment of Interpersonal Problem-Solving Skills (AIPSS; Donahoe et al., 1990). The test is based on an information processing paradigm and posits that social problem-solving occurs in several sequential stages. First, a problem has to be discovered (the *receiving stage* where the problem is identified and described), then pondered upon and possible solutions listed (the *processing stage*), and finally responded to (in a verbal and non-verbal manner through a role-play in the *sending stage*). The AIPSS produces six scores, which usually are grouped into three scales or stages (*Receiving, Processing* and *Sending Skills*). Since these stages are closely related theoretically, high intracorrelations are expected. This was shown by Donahoe et al. (1990) and later replicated by Toomey et al. (1997), but to our knowledge no studies have later confirmed this finding.

Social problem-solving as assessed with the AIPSS has been shown to be associated cross-sectionally with measures of neurocognition, such as vigilance (Bowen et al., 1994; Addington and Addington, 1999), verbal ability (Addington and Addington, 1999) and verbal memory (Addington and Addington, 1999; Corrigan and Toomey 1995). Also, in a longitudinal study (Addington and Addington, 2000) these neurocognitive measures predicted AIPSS performance 2.5 years later. A cross-sectional relationship between social-problem solving and visual ability and cognitive flexibility (Addington and Addington, 1999) and general intellectual functioning (Zanello et al., 2006) has also been found. Two studies have failed to find a relationship with visual memory (Addington and Addington, 1999; Zanello et al., 2006). Hence, problem-solving difficulties may partly be explained by neurocognitive impairments, but the relationship between neurocognition and specific social problem-solving domains needs to be studied further.

From the literature it seems that 20–40% of individuals with schizophrenia have little cognitive impairment when compared with normative data (Weickert et al., 2000; Rund et al., 2006). However, some studies have pointed out that when impairment classification is done differently, schizophrenia subjects with normal IQ are not so "neuropsychologically normal". Allen et al. (2003) showed that such a sample has deficits on specific neuropsychological tests when compared to normal IQ subjects with milder psychiatric diagnoses or a medical condition not involving the central nervous system. Wilk et al. (2005) found that a similar schizophrenia sample arrived at a normal IQ through high scores on verbal comprehension and perceptual organization and lower scores on tests loading on working memory or speeded processing. A disease-related fall from a higher-than-normal premorbid IQ-level can be hypothesized to have taken place.

Research on high-functioning schizophrenia samples makes it possible to focus on what the specific problems of schizophrenia might be, since they have fewer deficits when compared to healthy samples, but still fulfill the diagnostic criterion of reduced social functioning. Most research on social problem-solving skills in schizophrenia is based on samples with longer illness duration and more severe impairments than our sample. With its high IQ it is suitable for searching for explanatory models for why some persons with schizophrenia are socially disabled in spite of a high IQ.

In the current study we aim to explore the characteristics of social problem-solving skills. We have three research questions: 1) What are the social problem-solving deficits in schizophrenia? A group of healthy subjects is used to contrast the findings of our well-functioning schizophrenia group. We ask which parts of the social problem-solving process are affected, and more specifically whether impairment is observed across all social problem-solving domains or within some in particular. If the latter holds true the multi-process nature of the AIPSS is supported, and the impaired score(s) may indicate a specific vulnerability measure of reduced problem-solving in schizophrenia, which could be a treatment target. 2) Does social problem-solving as measured by the AIPSS constitute a single-module skill or should it be considered a multi-module operation? High intracorrelations between the six measures will indicate that the stages are closely connected. This is in line with the theoretical basis for the test. Low intracorrelations suggest a dissociation of the social problem-solving processes. In line with previous research (Donahoe et al., 1990; Toomey et al., 1997), we expect significant correlations between the various AIPSS scores. 3) How is AIPSS related to measures of neurocognition in the schizophrenia sample? In line

with earlier studies, a varied pattern of correlations with neuropsychological measures is expected since social problem-solving skills have been shown to be associated with vigilance, verbal memory and executive functioning, but not with visual memory. The association with psychomotor speed and motor function has not been examined earlier.

2. Methods

2.1. Participants

Twenty-six Norwegian-speaking, Caucasian subjects (17 males, 9 females) aged 22 to 55 years with a DSM-IV diagnosis of schizophrenia were included in the study. All are participants in the Norwegian Thematic Organized Psychosis Research (TOP) study and were recruited mostly from out-patient clinics at the Division of Psychiatry at Ullevål University Hospital in Oslo by way of contact with their primary clinician. We included ten control participants (5 males, 5 females) from the large healthy TOP control sample. TOP controls are randomly selected from official population records and invited through letters to participate. The ten healthy controls in the current study came from a subsample ($n=31$) that was matched on age, gender and education on an individual basis to the schizophrenia group (Vaskinn et al., 2007). Informed consent was signed by

Table 1
Comparison of demographic characteristics, neurocognitive and social problem-solving performance in subjects with schizophrenia (SZ) and healthy controls (HC)

	SZ ($n=26$)	HC ($n=10$)			
Demographics					
				x^2	*P*
Gender (males/females)	17/9	5/5		0.72	0.396
	M (S.D.)	*M* (S.D.)	*d*	*Z*	*P*
Age	32.3 (9.3)	32.5 (10.5)	0.02	−0.05	0.958
Education (years)	13.0 (2.4)	12.9 (2.0)	0.05	−0.09	0.929
NART	16.2 (7.3)	13.4 (7.7)	0.37	−0.87	0.386
WASI FIQ	107.5 (11.6)	113.2 (9.4)	0.21	−1.36	0.173
Neurocognition					
Motor function	79.5 (18.0)	67.5 (8.8)	0.90	−2.07	0.039
Psychomotor speed	59.4 (15.2)	73.5 (18.5)	0.83	−2.10	0.036
Verbal learning	50.5 (11.7)	57.9 (11.9)	0.63	−1.24	0.216
Verbal memory	11.4 (3.8)	13.2 (2.4)	0.58	−1.17	0.241
Visual memory	1.65 (0.57)	2.08 (0.70)	0.20	−1.91	0.056
Vigilance	0.82 (0.35)	1.24 (0.47)	1.02	−2.38	0.017
Semantic fluency	40.2 (10.5)	43.2 (10.6)	0.28	−0.87	0.386
Cognitive flexibility	64.6 (15.7)	54.9 (13.6)	0.66	−1.96	0.050
Social problem-solving (AIPSS)					
Receiving skills (%)	81.6 (10.7)	88.2 (8.1)	0.70	−1.80	0.072
Identification (range 0–13)	11.1 (1.3)	12.1 (1.0)	0.83	−2.17	0.030
Description (range 0–20)	15.9 (2.5)	17.0 (1.9)	0.50	−1.38	0.167
Processing skills (%)	52.9 (12.1)	61.5 (12.7)	0.69	−1.61	0.107
Processing (range 0–20)	10.6 (2.4)	12.3 (2.5)	0.68	−1.61	0.107
Sending skills (%)	47.1 (13.3)	81.3 (10.8)	2.83	−4.26	<0.001
Content (range 0–20)	9.9 (2.9)	15.3 (2.6)	1.93	−3.73	<0.001
Performance (range 0–20)	9.1 (3.0)	17.5 (2.3)	3.11	−4.40	<0.001
Overall (range 0–20)	9.3 (2.7)	16.0 (2.1)	2.79	−4.32	<0.001

d: effect size.
Motor function: Grooved Pegboard (composite score).
Psychomotor speed: Digit Symbol (WAIS-III).
Verbal learning: CVLT-II total recall list A, trials 1–5.
Verbal memory: CVLT-II delayed free recall.
Visual memory: Continuous Visual Memory Test *d′*.
Vigilance: CPT (Conners' version) *d′*.
Semantic fluency: Animals and Boys' names (D–KEFS).
Cognitive flexibility: Color–Word Interference: inhibition/switching (D–KEFS).

all participants. The TOP study has been approved by the Regional Committee for Medical Research Ethics and the Norwegian Data Inspectorate.

Exclusion criteria were traumatic brain injury or neurological disease, as well as IQ below 70. In addition, control participants were excluded if they had a history of drug use within the last three months. The schizophrenia group constitute a high-functioning schizophrenia sample, based on their mean current IQ as measured by *Wechsler Abbreviated Scale of Intelligence* (WASI; Psychological Cooperation, 1999) of 107.5 (S.D.=11.6, minimum=87, maximum=137). They were not recruited specifically for being high-functioning, but are representative of the larger TOP sample. Premorbid IQ was assessed with a Norwegian research version of the National Adult Reading Test (NART; Vaskinn and Sundet, 2001), where number of errors is reported. See Table 1 for demographic background information. All were clinically stable with a mean PANSS (Kay et al., 1987) total score of 55.0 (S.D.=11.1), a positive score of 11.7 (S.D.=3.9) and a negative score of 15.4 (S.D.=5.5). Mean duration of illness was 6.4 years (S.D.=5.4) years. Global functioning was measured by the GAF (split-version; American Psychiatric Association, 1994), with a mean function score (GAF-f) of 49.0 (S.D.=9.3), and a mean symptom score (GAF-s) of 47.5 (S.D.=10.9). All participants in the schizophrenia group used antipsychotic medication with a mean dose in chlorpromazine equivalents of 390 mg/day. One person used a first generation antipsychotic medication as monotherapy, whereas twelve used a second generation antipsychotic medication as the only drug. The rest was using different combinations of first and second generation antipsychotic medication, antidepressants or antiepileptic drugs. One person received anticholinergic medication. None had experienced a change in medication immediately prior to inclusion in the study.

Mean WASI IQ for the ten healthy controls was 113.2 (S.D.=9.4, minimum=98, maximum=127). Like for the schizophrenia sample, the high IQ-level amongst controls is comparable to that of our total control sample, indicating that subjects with higher IQ in general were more likely to agree to participate in the TOP study. The groups did not differ on any demographic characteristic (see Table 1).

2.2. Social problem solving

Social problem-solving was assessed with the Assessment of Interpersonal Problem Solving Skills (AIPSS) (Donahoe et al., 1990). This test consists of thirteen videotaped social situations of which ten present a problem, defined as one person preventing another person from reaching a desired goal. The subject is asked to identify herself with one of the characters in the situation and then probed for receiving, processing and sending skills, yielding in total six scores. These six scores can be organized into three scales. *Receiving Skills* (scale # 1) consists of *Identification* ("Is there a problem in this situation?") and *Description* ("Please explain the problem to me"). *Processing Skills* (scale # 2) refers to the subject's suggestions on how he or she would solve the problem ("If you were in this situation what would you say or do now?"). *Sending skills* (scale # 3) is scored from the role-play with the test administrator as the partner and is made up of three scores. *Content* is the rating of the exact wording of the subject's response (verbal) in terms of the likelihood of this solving the problem. *Performance* is the rating of the subject's non-verbal behavior, whereas *Overall* is a composite score of how likely it is that what the person says and does in the role-play will lead to successful solving of the interpersonal problem. 20 points is the maximum given for each score, except for *Identification* where 13 points is the highest possible score. Percentage correct responses are computed for each scale. In this study we use both the six scores and the three scales and indicate which AIPSS measure we use for the issue in question.

The AIPSS has been translated to Swedish with good psychometric properties (Stålberg et al., 2008). We used the Swedish version, but added dubbed-over Norwegian voices. In order to check the reliability of the Norwegian version we had one Swedish expert (CMH), who was blind to the subject's group status, rate ten videotaped recordings and compared her scores with that of the Norwegian administrator (AV). According to the AIPSS manual, two raters are in agreement if their ratings are within 0.5 points of one another. This was the case for 99% of the scored items, whereas the corresponding number for total agreement was 88%. In addition, an intra class correlation coefficient (3,1; Shrout and Fleiss, 1979) was calculated. It corresponded to a value of ICC=0.96 ($P<0.001$, CI: 0.95–0.96). Hence, the inter-rater reliability of the Norwegian AIPSS is satisfactory.

2.3. Neuropsychological tests

In addition to the WASI and the NART, assessments of neurocognitive functioning included measures of visual and verbal memory, vigilance and executive functioning. These cognitive domains were chosen because they have been included in previous studies using the AIPSS instrument. In addition, tests of psychomotor speed and

motor function were administered to broaden the scope of cognitive characteristics.

2.3.1. Motor function

The *Grooved Pegboard* test (Matthews and Kløve, 1964) measures manual dexterity and complex motor coordination. Pegs are placed into little holes, first with the dominant hand, then with the non-dominant hand. The pegs have a ridge along one side and must be rotated to fit the hole. The score is time to completion. We report the average number of seconds for the two hands.

2.3.2. Psychomotor speed

The *Digit Symbol* test from the WAIS-III (Wechsler, 1997) was administered as a measure of speed of processing. This paper-and-pencil test consists of several rows with double spaces, the space on top having a number from one to nine. A key is given where every number is paired with a symbol. The task is to fill in the blank spaces with the correct symbol. The score is the number of spaces correctly filled within the time limit of 120 s.

2.3.3. Memory

Visual recognition memory was assessed with the *Continuous Visual Memory Test* (CVMT; Trahan and Larrabee, 1998). One hundred and twelve line drawings of abstract objects are shown consecutively, each with an exposure time of 2 s. In all there are seven target figures, each appearing seven times. The subject is asked to indicate whether a drawing has been shown previously or not. Discriminability (d') is a calculation of the relationship between hits and false alarms and was considered the main variable. Verbal memory was measured with *California Verbal Learning Test-II* (CVLT-II; Delis et al., 2000). It consists of a 16-word list (list A) which is presented five times with immediate recall, and a second 16-word list (list B) read once, also with immediate recall. After this the subject is asked to recall the first list, immediately and again after a delay of 30 min. Data is reported for total words recalled on list A during the five presentations (verbal learning), and on the delayed free recall variable (verbal memory).

2.3.4. Vigilance

The *Continuous Performance Test* (CPT-II; Conners' version; Conners and MHS Staff, 2000) was used. In this computerized test, participants are instructed to respond by pressing the spacebar every time a letter appears on the screen, except the letter "X". Stimuli are displayed for 250 ms and inter-stimulus intervals are 1, 2 or 4 s. The duration of the test is 14 min. Discriminability (d') was considered the main variable. This is a measure of attentiveness, i.e. how well a person discriminates between targets and nontargets.

2.3.5. Executive functioning

Executive function was assessed with two tasks from the Delis–Kaplan Executive Function System (D–KEFS; Delis et al., 2001). Verbal semantic fluency was measured with the categories subtest from the *Verbal Fluency* test. The person is given 2×60 s to name first as many animals, then as many boys' names as possible. Cognitive flexibility was assessed with the inhibition/switching subtest of the *Color–Word Interference* test. Color names are presented in ink of a different color on a piece of paper. Some of the color names are framed. The task is one of set shifting and requires the person to name the ink color of words that are not framed and to read the words that are framed. Score is time to completion in seconds.

2.4. Procedure

Diagnostic interviews and symptom ratings were done by a group of trained psychiatrists with good inter-rater reliability. For the diagnostic categories the overall agreement was 88% with a Kappa of 0.77 (95% CI: 0.60–0.94). The neuropsychological tests and the social problem-solving task are part of a larger test battery. The neuropsychological testing was done within two weeks of the clinical interview. The test battery was administered on two separate occasions, not more than a week apart. If the clinical state of a participant with schizophrenia changed during those up to three weeks that had passed since the symptom assessment, it was redone. The AIPSS was always administered by the first author, as were most of the neuropsychological tests. Only one of the participants that were asked refused to participate in the videotaped AIPSS session.

2.5. Statistical analyses

The Statistical Package for the Social Sciences (SPSS for Windows, version 14.0; SPSS Inc., Chicago, IL, USA) was used. Because of small sample sizes and data that were not always normally distributed, non-parametric tests were used. Demographics, neurocognition and social problem-solving performance in participants with schizophrenia were compared to that of healthy controls using Mann–Whitney U tests. Additionally, effect sizes (Cohen's d) were calculated based on the mean standard deviation for both groups. Then, the internal relationships between the six different AIPSS scores were explored

through Spearman's *rho* for bivariate correlations in the schizophrenia group. Finally, the association between demographic and clinical characteristics, neurocognition and social problem solving skills in the schizophrenia group was examined, also using Spearman's *rho* for bivariate correlations.

3. Results

Participants with schizophrenia were outperformed on all neuropsychological tests, reaching statistical significance for motor function, psychomotor speed and vigilance. Effect sizes indicated that the groups differed on all neurocognitive measures, except visual memory and semantic fluency. For all aspects of social problem-solving, healthy controls performed better than the schizophrenia group. This reached statistical significance for *Identification*, *Content*, *Performance* and *Overall*. For the three AIPSS scales only performance on the *Sending skills* scale differed significantly between the groups (see Table 1). Effect sizes for AIPSS measures ranged from medium to very large.

There were significant associations between many of the AIPSS scores in the schizophrenia group (see Table 2). All scores were significantly associated with scores from other scales, with two exceptions. *Identification* correlated significantly only with *Description* (belonging to the same *Receiving Skills* scale) and *Performance* showed significant associations only with *Content* and *Overall* (all three from the *Sending skills* scale).

Table 3 shows correlations between the three AIPSS scales and demographic, clinical and neurocognitive characteristics in the schizophrenia group. Among the demographic variables only gender was significantly associated with the AIPSS (*Processing Skills*). IQ was not significantly associated with social problem-solving, and neither were any of the clinical characteristics. Psychomotor speed and cognitive flexibility correlated significantly with *Processing Skills* and *Sending Skills*, and verbal learning and semantic fluency were significantly associated with *Sending Skills*. All these associations were in the expected direction, in that better neurocognitive score was associated with better social problem-solving performance.

Table 2
AIPSS intracorrelations (Spearman's rho) in subjects with schizophrenia

	Description	Processing	Content	Performance	Overall
Identification	0.629**	0.297	0.383	0.033	0.341
Description		0.491**	0.499**	0.179	0.477*
Processing			0.688**	0.255	0.631**
Content				0.553**	0.941**
Performance					0.740**

*$P<0.05$, without correction for multiple comparisons.
**$P<0.01$, without correction for multiple comparisons.

Table 3
Correlations (Spearman's rho and *P*-value) between demographic and clinical characteristics, and neuropsychological test scores and social problem solving skills in subjects with schizophrenia

	AIPSS		
	Receiving skills	Processing skills	Sending Skills
Demographics			
Gender	−0.08 (0.712)	**0.43 (0.030)***	0.36 (0.074)
Age	−0.01 (0.971)	−0.16 (0.444)	−0.35 (0.076)
Education	0.31 (0.123)	0.12 (0.566)	−0.02 (0.919)
NART	0.02 (0.908)	−0.31 (0.128)	−0.24 (0.247)
WASI VIQ	0.04 (0.861)	0.03 (0.869)	0.13 (0.525)
WASI PIQ	−0.08 (0.693)	−0.04 (0.867)	−0.23 (0.263)
Clinical characteristics			
PANSS total	0.07 (0.729)	0.11 (0.581)	−0.08 (0.684)
PANSS positive	−0.24 (0.241)	−0.07 (0.734)	−0.29 (0.155)
PANSS negative	0.22 (0.277)	<0.01 (0.995)	−0.16 (0.423)
GAF-f	0.02 (0.915)	<0.01 (0.989)	−0.01 (0.969)
GAF-s	0.13 (0.521)	−0.17 (0.411)	0.04 (0.834)
Illness duration	−0.12 (0.567)	−0.05 (0.816)	−0.10 (0.627)
Neurocognition			
Motor function	0.30 (0.131)	0.37 (0.07)	0.06 (0.776)
Psychomotor speed	0.10 (0.644)	**0.42 (0.033)***	**0.54 (0.005)****
Verbal learning	−0.05 (0.798)	0.09 (0.681)	**0.41 (0.040)***
Verbal memory	0.07 (0.729)	0.07 (0.741)	0.29 (0.154)
Visual memory	−0.31 (0.128)	0.01 (0.976)	−0.32 (0.107)
Vigilance	−0.31 (0.119)	0.12 (0.568)	−0.09 (0.647)
Semantic fluency	0.01 (0.953)	0.38 (0.055)	**0.52 (0.006)****
Cognitive flexibility	0.13 (0.531)	**−0.48 (0.013)***	**−0.43 (0.030)***

*$P<0.05$, without correction for multiple comparisons.
**$P<0.01$, without correction for multiple comparisons.

4. Discussion

This study confirmed that high-functioning participants with schizophrenia perform poorer than healthy controls on the AIPSS. This replicates findings from previous studies (Donahoe et al., 1990; Bowen et al., 1994; Toomey et al., 1997; Zanello et al., 2006). Even though the group performed above mean on measures of intelligence and not significantly different from the healthy control group, they demonstrated major problems enacting solutions to correctly perceived social problems. In line with the Zanello et al. (2006) study, individuals with schizophrenia had a more severe deficit on the more complex social problem-solving tasks, as

shown by their markedly reduced performance on the *Sending Skills* scale compared to the healthy controls.

Another main finding of our study is the weaker than expected association between the different AIPSS scores in the schizophrenia group. Several intracorrelations were significant, but interestingly, *Identification* of an interpersonal problem was not significantly associated with AIPSS scores from later in the sequential social information processing paradigm. And likewise, *Performance*, the non-verbal aspects of social interaction, was not correlated with AIPSS scores from earlier in the process. This indicates that although AIPSS skills are interrelated, they seem to be more separable than earlier studies have shown. This implies a possible dissociation of the processes of identifying a social problem and the enacting of a solution to such a problem. One could speculate that the AIPSS assesses several phenomena when applied to subjects with high-functioning schizophrenia. Receiving, processing and sending skills of social problem-solving seem to be three slightly different phenomena. This could have large clinical implications, and needs to be studied further.

The intracorrelations between the AIPSS scores in the present study were lower than in earlier studies (Donahoe et al., 1990; Toomey et al., 1997). This could be due to different characteristics of the schizophrenia groups. The Donahoe et al. (1990) study only included older males (mean age 42 years), and the sample in the Toomey et al. (1997) study had a chronic illness course (an average of 14 years of illness duration). Our sample seems to have a better level of functioning compared to others in the general schizophrenia literature. They have intact visual emotion perception compared to healthy controls (Vaskinn et al., 2007) and their general cognitive level also indicates high-functioning. It seems like individuals with a high-functioning type of schizophrenia have a different pattern of AIPSS intracorrelations. It is possible that although they are high-functioning and perform rather well on many measures, the disorder manifests itself on other measures. Both *Identification* and *Performance* show significant associations only with scores from the scale they belong to, and individuals with schizophrenia are markedly impaired on *Sending Skills* compared to healthy controls. We therefore propose that the problem of social problem-solving in schizophrenia is how to behave non-verbally in a difficult interpersonal situation. Hence, we put forward the hypothesis that the disability caused by schizophrenia manifests itself in the role-play situation of the AIPSS, especially on the non-verbal *Performance* score. This is in line with a study that showed that siblings of persons with schizophrenia performed worse than healthy controls only on *Performance* among the AIPSS measures (Stålberg et al., 2008). Thus, one speculation is that problems in non-verbal social interaction are a vulnerability marker of the disorder, manifesting itself in family members and in individuals with high-functioning schizophrenia. In other words, people with schizophrenia may have an idea of what an interpersonal problem is and how to solve it, but they are not able to translate this knowledge into real life (or here; the role-play situation with the test administrator). If this is the case, low correlations will be expected among the different variables. This hypothesis is further supported by the increased deficit in the schizophrenia group for the *Sending skills* scale as compared to the *Receiving Skills* and *Processing Skills* scales when compared with healthy controls. Thus, a person with schizophrenia can be able to generate suitable solutions to a problem, but still be unable to "practice what they preach" in the actual situation where the problem has to be handled.

Following this argument it seems that the AIPSS is a very sensitive instrument, disclosing the problems of schizophrenia where other instruments cannot. In line with WHO terms (World Health Organization, 1980), one could say that whereas neuropsychological tests measure performance at the impairment level, the AIPSS refers to a social context and is thus a measure at the disability level. Since our sample is young and has not been hospitalized for an extended period of time, we do not believe that this is caused by social deprivation or the negative effects of institutionalization.

The identified difficulty of taking advantage of the knowledge of *how* to solve a social problem during the actual *solving* of this problem can lead to more targeted treatment interventions. The clinical implications of the low intracorrelations and the large impairment for *Sending Skills* are that remediation efforts of social problem-solving deficits should focus mostly on role-played solutions, especially training of non-verbal expressions. Results so far are promising. Kern et al. (2005) showed that errorless learning improved all three AIPSS problem-solving skills. In a recent study by Ücok et al. (2006), AIPSS *Receiving Skills* and *Processing Skills* improved after training. Unfortunately, *Sending Skills* were not included in this study.

The third main finding was fewer associations than expected between neurocognition and social problem-solving in the schizophrenia group. AIPSS *Sending Skills* correlated significantly with psychomotor speed, verbal learning, semantic fluency and cognitive flexibility; and AIPSS *Processing Skills* correlated with psychomotor speed and cognitive flexibility. This indicates that social problem-solving is related not only to neurocognition, but depends on other processes, too. Social cognition seems

to be a promising candidate. Recently, Pinkham and Penn (2006) showed that social cognition contributes uniquely to social problem-solving performance, and Addington et al. (2006) found that social cognition mediates the relationship between neurocognition and AIPSS performance. In our study, the *Sending Skills* scale showed the strongest associations with neurocognition. This supports our hypothesis that this is a particularly problematic area for individuals with schizophrenia.

It has been speculated that general intellectual ability determines social competence in schizophrenia (Zanello et al., 2006), and in several studies the AIPSS has been associated with different measures of IQ (Donahoe et al., 1990; Addington and Addington, 1999). Our data does not support this position. AIPSS was not significantly associated with any IQ-measure. Instead, our data indicate that specific neurocognitive abilities are more important, especially executive functioning. In addition to the significant associations between AIPSS scores and semantic fluency and cognitive flexibility, this is supported by a stronger correlation between AIPSS *Sending Skills* and verbal learning (CVLT-II list A) than with verbal memory (CVLT-II delayed recall). Verbal learning depends more on executive or strategic planning skills than verbal memory which can be considered a "purer" measure of memory. *Sending skills* are also of a more executive nature than *Receiving Skills* and *Processing Skills*, and therefore social problem-solving difficulties in high-functioning schizophrenia appear to be more of an executive than a reasoning impairment. Initiating behavior and responding in a timed and flexible manner to a partner in a conversation (semantic fluency and cognitive flexibility), and remembering what has recently been said (verbal learning) seem to be plausible prerequisites for successful solving of an interpersonal challenge, as does being able to respond quickly (psychomotor speed). Symptom load does not seem to have an impact on social competence in our sample, whereas we found gender to be significantly related to *Processing Skills*. In another study we have shown that the females in this sample outperformed men for auditory emotion perception (Vaskinn et al., 2007). The same gender effect may exist for social problem-solving, but an investigation of this is beyond the scope of this study.

Our study has several limitations. First, our sample is small, and performing group comparisons with only ten subjects in one group is not recommended. The results of this study must therefore be considered preliminary, and replications are needed. However, the inclusion of the ten healthy controls served primarily the purpose of confirming that controls in general master the AIPSS, which was developed for individuals with schizophrenia. Healthy controls often approach ceiling effects with less variability in scores (Donahoe et al., 1990; Stålberg et al., in press). Another limitation is that we did not construct a Norwegian version of the AIPSS from scratch, but instead added dubbed-over voices to the Swedish version. This may have changed the psychometric characteristics of the test. However, good inter-rater reliability was demonstrated and replications of previous findings of a relation with neurocognition lend support to the validity of the test. Therefore, we argue that the Norwegian AIPSS has satisfactory psychometric properties. Ideally, both raters should have been blind to diagnostic status when rating the AIPSS recordings, but unfortunately this was not possible. On the other hand, in some instances group membership is easily determined from the subject's behavior in the video-taped role-play, so that raters in reality are not always completely blind.

In conclusion, our study of high-functioning schizophrenia showed a weaker than expected association between the different AIPSS scores. This has lead to the hypothesis that the problem of social problem-solving in schizophrenia is the ability to respond in an appropriate manner, especially non-verbally, in a challenging interpersonal situation. This indicates that remediation of social problem-solving skills should focus on role-playing interpersonal behaviors, rather than on verbally analyzing an interpersonal problem and clarifying alternative solutions.

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