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ORIGINAL PAPER

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Cognitive predictors of skill acquisition on social problem solving in patients with schizophrenia

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Abstract The aim of the study was to evaluate the relationship between social problem solving ability, clinical features and cognitive functions, and determine the predictors of benefit from social problem solving training in 63 patients with schizophrenia. We administered Brief Psychiatric Rating Scale (BPRS), Wisconsin Card Sorting Test (WCST), Digit Span Test, Continuous Performance Test (CPT) and the Assessment of Interpersonal Problem Solving Skills (AIPSS). Only BPRS-positive symptoms subscale was negatively related to AIPSS on linear regression analysis. After the completion of the pretest, the patients were randomized to either problem solving training (n = 32) or control groups (n = 31). Patients in training group received 6 weeks problem solving training in-group modality, and those in control group were treated as usual. We readministered AIPSS at the end of 6 weeks. There were significant changes from pretest to posttest on AIPSS-total, AIPSS-receiving skills, and AIPSS-processing skills score in training group but not in control group. The number of correct answers in WCST and CPT hit rate were the predictors of post-training AIPSS scores in training group. Our findings suggest that skill acquisition on social problem solving is related with cognitive flexibility and sustained attention.

Key words schizophrenia · problem solving · cognitive remediation · cognitive functioning · Wisconsin Card Sorting Test · Continuous Performance Test

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Introduction

Cognitive impairment is one of the main symptoms of schizophrenia. Some studies have found widespread cognitive dysfunction, whereas others have provided evidence for the selectivity of cognitive dysfunction of this disorder [1–3]. These studies support the notion that neurocognitive function is an important factor on outcome of the illness and it can be a predictor of social and occupational function in schizophrenia.

By reviewing the existing large body of literature, various cognitive deficits, especially the working memory and attention impairments were determined as core features of the schizophrenia, regardless of the phase and subtypes of the illness [4]. Wide ranging, significant memory impairment were also seem to be the other part of the cognitive findings not affected by age, medication, duration of illness, patient status, severity of psychopathology, or positive symptoms [5]. Heinrichs and Zakzanis [6] showed both of these large deficits in their review paper quantitatively. Green [7] and Green et al. [8] concluded that specific domains of cognition, notably secondary verbal memory, working memory, executive functioning and vigilance are related to functional outcome. But how these cognitive domains affect the functional outcome has still no clear answer. Green [7] highlighted the necessity for additional research to explore cognitive "rate limiting factors", those deficits that restrict the patient's ability to learn, maintain or perform the skills required for everyday functioning. The relations between cognition and outcome on functioning have been explored in terms of three general categories; (1) social problem solving (2) skill acquisition or rehabilitation success, and (3) community functioning or activities of daily living [8, 9]. In a recent study, Chan et al. [1] reported that problem solving capacity of the patients with schizophrenia markedly worse than normal controls, and was very similar to that of the patients with traumatic brain injury. Since the present study addresses social problem solving and skill

acquisition, literature regarding these specific functional domains will be discussed in greater detail.

Assessment of Interpersonal Problem Solving Skills (AIPSS) [9–13], WAIS-R Comprehension Test [14] and Problem Solving subscale of the Independent Living Scale [15, 16] have been used to assess the social problem solving ability of patients with schizophrenia. Significant neurocognitive predictors of social problem solving include vigilance assessed by Continuous Performance Test [9, 11, 13, 17, 18]; verbal memory [19, 20]; and early visual processing, assessed by the Span of Apprehension Test [20]. Addington and Addington [9] reported an association between poor cognitive flexibility, assessed by the Wisconsin Card Sorting Test and social problem solving, but others [12, 17, 20] did not find correlation between them. Negative symptoms were found to be significantly associated with AIPSS scores, but positive symptoms were not [9].

Results of some studies show that it is possible to increase the patient's problem solving skills by using specific cognitive therapies. In their test–retest, treatment-controlled design study, Medalia et al. [16] have reported that inpatients with schizophrenia who received 5 weeks of computer based problem solving remediation showed significant improvement on problem solving skills, which was greater than the patients who received memory training. These authors recently reported that the improvement seen in the problem-solving group persisted for 4 weeks after cessation of problem solving remediation [15].

Medalia et al. [14] also showed the effectiveness of the same computer based remediation program, which consist of six 1-hour sessions in 28 inpatients (4 of them were patients with schizophrenia) in an acute psychiatric care unit. They reported that neither an individual's initial abilities or psychiatric condition, demographic factors, length of interval between assessments nor the degree of their success on the intervention was associated with degree of improvement on the outcome measures. Spalding et al. [10] reported that social problem solving ability measured by AIPSS of 49 psychotic patients (39 of them were diagnosed as schizophrenia) were increased after 6 months of cognitive therapy program.

Predictors of skill acquisition include vigilance [9, 13, 21], immediate verbal memory [12]; and secondary verbal memory [19]. Lysaker et al. [23] association between WCST scores and improvement in social skills. Green et al. [8] and Heinssen et al. [24] reported that positive and negative symptoms do not have any influence on schizophrenia patients' ability to benefit from skills training.

It seems possible that neurocognitive functions are also affected by the type and doses of medicine used in patients with schizophrenia. Corrigan et al. [25] suggested that some atypical antipsychotic medications seem to improve the psychosocial outcomes of some schizophrenia patients compared to conventional neuroleptics. Cassens et al. [26] reported that there was no significant difference in performance in six of seven studies that evaluated the effects of typical antipsychotic medications on working memory. However, Green et al. [27] found that treatment with risperidone exerts a more favorable effect on verbal working memory than treatment with haloperidol. Bowen et al. [13] did not find any association between conventional antipsychotic doses and cognitive test performance. In a recent study, Ehlis et al. [28] reported that atypical antipsychotics may exert a beneficial effect on prefrontal brain functions.

Part of the methodological problems in social problem solving research are small group size of several studies, heterogeneity in diagnosis and inclusion of mixed groups of inpatient/outpatient cases. In this study, we selected diagnostically homogenous, clinically stable outpatients to eliminate these limitations.

One of the aims of this study is to evaluate the relationship between social problem solving ability, clinical features and cognitive functions in patients with schizophrenia. In the second phase of our study, the purpose was to investigate the effects of social problem solving training on social problem solving skills. We hypothesized that both problem solving ability and degree of benefit from problem solving training are related to the cognitive functions of the patients with schizophrenia.

Materials and methods

Subjects

Sixty-three outpatients (34 males and 29 females) with schizophrenia were recruited from outpatients of Psychotic Disorders Research Program. Diagnoses according to Diagnostical and Statistical Manual for Psychiatric Disorders-IV (DSM-IV; [29]) criteria were made by the principal investigator using the Structured Clinical Interview for DSM-IV (SCID; [30]). All subjects also met the following criteria: (a) age between 18 and 45 years old (b) no neurological or medical conditions, such as epilepsy, history of head trauma (c) no diagnosis of alcohol or substance abuse. All the patients were in remission phase of the illness. Mean Clinical Global Impression (CGI; [31]) score was 3.82, (SD = 0.91). The patients had an average age of 28.32 (SD = 6.92), and 11.73 years (SD = 2.12) of education. Mean duration of illness was 7 years (SD = 4.77), and number of previous hospitalizations was 1.83 (SD = 2.24). Two of the patients were married and the rest (96.8%) were single. Ten men and six women were employed (nine as volunteers, seven in paid work), and the rest were supported by their families. All patients were taking antipsychotics (76.1% atypical, 15.8% typical, and 7.9% combination of atypical and low dose typical medication) that were independently selected and titrated on an individual basis by their psychiatrists. Mean dose of typical antipsychotics in chlorpromazine equivalents was 335 mg. Mean dose was 13.4 mg for olanzapine (n = 18), 355 mg for clozapine (n = 16), 4.7 mg for risperidon (n = 10), 600 mg for quetiapine (n = 3), and 600 mg for amisulpride (n = 1). Sixteen percent of the patients were using anticholinergics.

Research design and procedure

The study used a test–retest, treatment controlled design with random assignment of problem solving remediation or standard treatment (control) group. The study was carried out at two

phases. We evaluated the relationship between social problem solving and cognitive and clinical variables of all of the patients in the first phase, and then the predictors of skill acquisition on social problem solving was assessed in the second phase. Pretesting occurred prior to group assignment. After giving informed consent, each of the participants completed a battery of cognitive tests in one session, and in the second session AIPSS were completed. Each of the two testing sessions was conducted by separate researchers, who were blind to performance in other testing sessions. After the completion of the pretesting, the patients were randomized to either problem solving training or control groups. As the characteristics of the whole sample were known in advance, the patients were matched pair wise, as closely as possible for gender, symptom severity, and chronicity. Patients in problem solving training group (n = 32) attended an hour long, weekly training sessions for six weeks. The control group (n = 31) received standard treatment, which did not include cognitive remediation. Since one of the patients in control group had psychotic symptom exacerbation in the fifth week, he was excluded from the posttest assessment.

Social problem solving training was given as group treatment. There were five groups with 6 or 7 patients. The treatment team was consists of a therapist and a co-therapist who were experienced on group treatment and problem solving training in each of the groups (three psychiatrist, one social worker, and one psychiatric nurse). We used social problem solving techniques, which were described by Liberman et al. [32, 33]. After 5–10 min warm up period, therapist described what the interpersonal problem was and then repeated the steps of problem solving methods by writing on board in each session. These steps were: (1) Pinpoint the problem (2) Generate options and alternatives (3) Weigh advantages and disadvantages of each alternative (4) Choose a reasonable option (5) Develop a plan to implement (6) Evaluate and reward progress. Then the patients were asked to repeat the stages of social problem solving. After that two sample interpersonal problems brought by patients or therapists were discussed by using board in each session; then one or two solutions selected by the patients were role-played by them. At the end of the 6-weeks of problem solving training, AIPPS was applied again as posttest to both treatment and control groups, by using different vignettes from the pretest assessment.

We evaluated the psychopathology by using The Brief Psychiatric Research Scale-Expanded (BPRS) [34]. It was administered by the psychiatrist of each patient. Inter-rater reliability for the BPRS score was acceptable (κ = 0.78). Besides the total score of BPRS, positive symptom subscale (items for hallucinations, unusual thought content, and conceptual disorganization) and negative symptom subscale (emotional withdrawal, motor retardation, affective bluntness) were used in statistical analyses. General severity of the illness was assessed with CGI.

Functional outcome measure: The Assessment of Interpersonal Problem Solving Skills (AIPSS; [35]) is a videotaped test used to assess the social skills of patients with schizophrenia. AIPSS presents individuals with 13 videotaped interpersonal scenes, 10 of which portray interpersonal problems defined as one person acting as an obstacle to the achievement of the other's goal, and three of them do not present any problems. After viewing each scene, individuals are asked questions to determine if they recognize presence and nature of the problem ("receiving skills"), generate an effective solution ("processing skills"), and deliver it in the most effective manner by role-playing ("sending skills", terminology from Wallace et al. [36]). Receiving skills are assessed with two questions; "Is there a problem in this scene?" and "Please explain the problem to me as if I have never seen the videotape before". Subjects receive 1 point for each correct answer or 0 for each incorrect answer. Responders who give a false positive answer in a scene without problem are questioned further, but their responses are not scored. Answers to the second-receiving skills question are scored 2 (both obstacle and goal correctly identified), 1 (only obstacle or goal correctly mentioned), or 0 (neither correctly mentioned). These scores are summed up across the scenes to obtain a total for the receiving skills. Processing skills are assessed with the question "If you were in this situation what would you say or do now". Scores for processing skills are based on how likely the described solutions would solve the problem without negative consequences; possible scores are 0, 1, or 2.

For this study five of the thirteen scenes were shown to each patient, four randomly selected with problems and one without. After the patient watched each scene in the videotape he/she answered the above-mentioned questions with paper and pencil, then progressed to the next scene. About half of the patients had attended a supportive group psychotherapy program and gained experience in role-playing, but the others had not. We did not use the third part (sending skills) of the AIPSS because of this inequality in role-playing performance of the patients. Sum of the points of receiving skills and processing skills make up the total score of AIPSS. Maximum point of AIPSS total score was 21. ΔAIPSS was the difference between posttest and pretest assessments of AIPSS. ΔAIPSS-receiving subscore and ΔAIPSS-processing subscores were calculated in same way. Text of videotaped sketches and questions of AIPSS were translated to Turkish and then retranslated to English with comparing the original one by our group and used in patients with schizophrenia in previous studies. All of the AIPSS interviews carried out by principal investigator (A.U.).

Neurocognitive assessment

Executive functioning, visual attention, and short–term auditory recall were assessed at the initial assessment. The computerized WCST was used to measure executive functioning (i.e. generation, execution and changing of concepts). The WCST was administered to all subjects with the standard instructions by Heaton [37]. The WCST computerized version, developed by Wang Laboratories is comparable to the card version for patients with schizophrenia [38]. Performances were automatically scored by the computer. Dependent variables were the number of correct answers, number of sets completed and number of perseverative errors.

CPT was used to measure the sustained attention. CPT-ZA involves a short-term memory component and is a successive discrimination vigilance task. Thus the information process load of the CPT-ZA is higher than that of the CPT-X. Visual stimuli were presented on a 2 inch-square matrix of white light emitting diodes. Letters were randomly presented for 160 ms each, with 800 ms interval. During the session subjects responded to the target stimulus (the letter A preceded by the letter Z) by pressing a button. In a total of 300 trials, 36% of the targets were presented in 8.5 min. Each session began with 1 min of practice, and subjects' responses were recorded automatically on diskette. We used the hit rate (probability of response to target trials) as measure of sustained attention.

The Digit Span, a subtest from Wechsler Adult Intelligence Scale (WAIS-R) [39] measures short-term auditory recall. The Digit Span has two components: Digit Span Forward and Backward. During the Digit Span Forward the patients are asked to repeat immediately an increasing series of numbers read by the tester. During the Digit Span Backward patients are asked to repeat the numbers in a reverse order. There are 14 strings in each set, and the maximum point is 28.

Clinical features and neurocognitive test scores of the patients are presented on Table 1.

Statistics

Since AIPSS scores are sum of ordinal values (0,1,2), Spearman's correlation analyses were used to examine the association between AIPSS scores and clinical and cognitive variables. Student's t-test was used to compare normally distributed, and Mann–Whitney U-test for not normally distributed continuous variables. The difference of changes of AIPSS total scores and subscores between pre- and posttest in two groups were analyzed with repeated measures of ANCOVA. The dependent variables were the changes from baseline on the AIPSS score and subscores. The statistical model

Table 1 Clinical features and neurocognitive test scores of the patients (means ± standard deviations)

	Whole sample (n = 63)	Training group (n = 32)	Control group (n = 30)
Age	28.31 ± 6.91	28.12 ± 5.87	28.51 ± 8.11
Years in education	11.73 ± 2.34	11.92 ± 1.14	11.63 ± 1.91
Duration of illness (years)	7.12 ± 4.74	7 ± 4.14	7.15 ± 5.51
CGI score	3.86 ± 0.94	3.87 ± 1.14	3.92 ± 0.75
BPRS-total	41.44 ± 9.56	42.34 ± 8.56	40.92 ± 7.26
BPRS-positive subscale	6.63 ± 3.12	6.87 ± 3.43	6.53 ± 2.96
BPRS-negative subscale	5.75 ± 2.15	6.34 ± 2.26	5.16 ± 1.97
WCST-correct answers	65 ± 23.16	66.53 ± 23.43	64.91 ± 23
WCST-categories	2.44 ± 2.66	2.5 ± 2.66	2.36 ± 2.64
WCST-perseverative errors	24 ± 11.29	24.84 ± 12.15	23.23 ± 10.22
DST-forward	12.43 ± 3.45	12.53 ± 3.87	12.32 ± 3.14
DST-backward	5.34 ± 1.85	5.54 ± 1.95	5.22 ± 1.74
DST-total	7.16 ± 2.26	7 ± 2.46	7.24 ± 2
CPT-hit rate	93.1 ± 12.7	93.7 ± 13.9	92.3 ± 11.5

included one between groups factor (intervention: Social problem solving training versus treatment as usual) and one within groups factor (pretest–posttest). Baseline score of AIPSS was used as a covariate. The difference between patients receiving atypical (n = 48), and those receiving typical antipsychotics (n = 10) in terms of BPRS, AIPSS, and cognitive test scores were analyzed with Mann–Whitney U-test.

We evaluated possible cognitive and clinical predictors of change in AIPSS scores of patients who underwent training with Spearman's correlation analysis. Since we found a correlation between education status (years) and number of correct answers (r = 0.350, P = 0.007), number of sets completed (r = 0.299, P = 0.02) and perseverative errors (r = −0.256, P = 0.05) in WCST; and counting backwards in Digit Span Test (r = 0.314, P = 0.01) we used years in school as covariate. Multiple linear regression was applied with posttraining AIPSS score as the dependent variable to investigate whether WCST scores independently predicts overall change on social problem solving after the effects of other possible predictors are taken into account. WCST-correct answers, WCST-categories, WCST-percentage of perseverative errors, and CPT scores were the other independent variables in this analysis. Prediction analysis computed only for those actually trained in social skills. All tests of significance were two-tailed. The statistical software used was SPSS for Windows, version 9.0.

Results

We found negative correlation between BPRS positive symptom subscale and total AIPSS scores (r = −0.288, P = 0.02) and AIPSS-receiving skills scores (r = −303, P = 0.01) at initial assessment. There was no correlation between BPRS negative symptom subscale and AIPSS scores. There were no association between AIPSS scores and none of the WCST scores, Digit Span Test, and CPT scores. BPRS psychotic symptoms subscales emerged as the single significant predictor of initial AIPSS score (R = 0.36, R^2 = 0.13, F = 8.36, SE = 0.17, β = −0.36, P = 0.005) after stepwise linear regression analysis. The model excluded WCST-correct answers, WCST-categories, DST-forward, DST backward scores, and CPT scores.

We explored the relations between total BPRS scores and BPRS subscale scores and cognitive measures. We found only a negative correlation between BPRS-positive symptom subscale and CPT scores (r = −0.422, P = 0.001).

Most of the patients were men (65.6%) in training group, and women (58.6%) in control group (x^2 = 3.54, df = 1, P = 0.05). There were no gender effect on clinical variables, cognitive tasks, and AIPSS scores in both training and control groups. Analyses with independent t-test did not show any differences based on groups (i.e. training vs. control) for any of the cognitive tests and social problem solving scores at baseline. With regard to the clinical variables, there was significant group difference only on BPRS negative symptom subscale, so that the patients in training group had higher scores than control group (6.37 ± 2.24 vs. 5.13 ± 1.98, t = 2.29, P = 0.02).

Pretest, and posttest AIPSS scores of patients in training and control groups are presented on Table 2. We analyzed the changes in AIPSS score and subscale scores separately, as different variables. There were significant changes from pretest to posttest on AIPSS scores, receiving skills, and processing skills in training group than control group (F = 15.34, df = 1, P = 0.001; F = 7.84, df = 1, P = 0.007 and F = 9.31, df = 1, P = 0.003, respectively). To explore the relationships between measures of cognitive functioning and change on social problem solving performance in training group, correlation analysis were conducted. There were significant relationships between cognitive flexibility and change on the AIPSS scores, and vigilance and processing skills on the AIPSS, but there were no relation between immediate memory and change on AIPSS scores. The number of correct an-

Table 2 Pretest and posttest scores of the patients in training and control groups

	Training group (n = 32)	Control group (n = 30)
AIPSS (Pretest)		
Total	11.7 ± 4.5	11 ± 4.3
Receiving skills	8.3 ± 2.9	8 ± 2.5
Processing skills	3.2 ± 2.1	3.3 ± 2.2
AIPSS (Posttest)		
Total	14.4 ± 3.7	10.2 ± 4.3
Receiving skills	9.9 ± 2.9	7.9 ± 3
Processing skills	4.2 ± 2	3.1 ± 1.8

Table 3 Parameters that contribute independently to the posttraining AIPSS score in training group (results of the linear regression analysis)

Parameter	*B*	Std. error	*P*	β	*t*
WCST-correct answers	0.120	0.473	0.01	0.747	2.513
CPT-hit rate	12.779	5.387	0.02	0.361	2.372
AIPSS-pretraining	0.216	0.135	0.1	0.264	1.602
WCST-perseverative errors	−0.785	0.059	0.2	0.278	1.262
WCST-number of sets	−0.028	0.413	0.4	−0.207	−0.695

swers of WCST, and hit rate in CPT emerged as the predictors of AIPSS score after training (Table 3).

When compared the patients using atypical antipsychotics to those using typical antipsychotics, we found that BPRS psychotic symptoms score ($Z = -2.3$, $P = 0.02$), and CPT scores ($Z = -2.03$, $P = 0.04$) were significantly higher in the first group.

Discussion

In this study, we examined the correlates of social problem solving and skill acquisition in patients with schizophrenia. The overall hypothesis that cognition would predict problem solving ability and degree of benefit from problem solving training was partially confirmed. We could not find any correlation between cognitive measures and social problem solving before training, but we found that skill acquisition on social problem solving was related with cognitive flexibility and sustained attention in training group. The only clinical variable associated with problem solving was BPRS-psychotic symptom subscale, which effects negatively. This finding is inconsistent with the results of a previous study [9]. We also found that psychotic symptoms has negative effect on sustained attention. It has been reported that formal thought disorder is correlated with CPT variables [40] and positive symptoms are associated with poor attention [41]. The effect of positive symptoms is more prominent on AIPSS receiving skills score in our study. These findings suggest that positive symptoms might have an indirect negative effect on problem solving by interfering with sustained attention, which is necessary to detect what the problem is and how it could be solved.

Addington et al. [12] did not find any relationship between WCST scores and social problem solving capacity in a poor social functioning sample of patients with schizophrenia, where as later they reported a negative correlation in a sample of patients with higher level of functioning [9]. Although we did not use measures of quality of life, most of the patients in our sample were unable to work and had rather long history of schizophrenia. As Addington et al. [12] pointed out, relationship between cognitive flexibility and social problem solving capacity might be overshadowed in patients with lower level of functioning.

We did not replicate the findings of previous studies, which reported that vigilance is related with social problem solving [9, 12, 13, 17, 40]. However, vigilance is appeared as a predictor of problem solving capacity improvement in training group. As reported by Bowen et al. [13] and Bellack et al. [19], we did not find any relationship between immediate memory and social problem solving ability; however others [9, 20, 21] have reported contrary results.

Recent studies show that atypical antipsychotics may improve both social outcome in general [23] and specific cognitive measures [27, 43]. We observed the similar findings in our study, vigilance of patients receiving atypical antipsychotics is better than those receiving conventional antipsychotics. As opposed to previous studies, majority of the patients in our sample were receiving atypical antipsychotics. This difference creates difficulty in comparisons and may account for the discrepancy.

Findings of the second phase of the study showed that it is possible to improve the capacity of social problem solving of patients with schizophrenia by using specific training programs.

Our findings support the reports of previous studies [10, 14]. Patients who assigned to a social problem solving training group successfully progressed through the problem solving tasks compared to the control group. This improvement was independent from duration or severity of illness. We did not found any difference in terms of the type of antipsychotic medication used, all patients on different antipsychotics showed improvement in training group. However, since the number of patients receiving conventional antipsychotics is very small, this finding might be a result of Type II error. Measures of cognitive flexibility was one of the predictor of improvement on social problem solving, as it has been reported elsewhere [8, 23, 44]. Cognitive flexibility is particularly necessary to produce alternative solutions to problems. In our study, patients who had more cognitive flexibility, showed more improvement in processing skills compared to receiving skills after problem solving training. CPT, which is a measure of sustained concentration, might be a sign for capacity of focusing on training, and seems necessary for learning. We found a relationship between CPT score and improvement on processing skills, and this variable also appeared as statistically significant after linear regression analysis.

Although the group modality is more cost-effective than individualized approach, social problem solving training is a sophisticated treatment, and it is

important to predict which patients are most likely to benefit from training. In a recent study, Sergi et al. [42] reported that WCST as a measure of learning potential contributes to the prediction of work skill acquisition. Our results suggest that WCST might be used for selecting suitable patients for problem solving training. This method could be useful for determining different individual approaches according to patients cognitive profile.

This study has several limitations. Our patient sample does not represent the usual characteristic patient with schizophrenia. We included the patients who show high compliance to treatment and regular monthly visits in a specialized unit for treatment of schizophrenia. Our approach can be difficult to apply to common schizophrenic patients who could not have regular psychiatric follow up. Since, we assessed problem solving ability with a structured test, we do not know whether our patients showed any improvement on problem solving in "real world" situations after training. We also do not have any data about the long-term effects of problem solving training (i.e. persistence of improvement on problem solving.). Medalia et al. [16] reported that the gains made by problem solving group persisted for 4 weeks after cessation of training. We are going to analyze the follow up data in the future. Another problem is small number of the patients who undergone to the problem solving training. As almost half of the whole sample attended to training sessions, this limitation reduces statistical power to analyze the predictors of gain from training. And finally, our training groups lasted six weeks. It can be expected that some cognitive variables that were to be insignificant, would appear as statistically significant after a longer period of problem solving training.

The relationship between cognition and performance of the patients with schizophrenia under natural circumstances is complicated. However, the results of studies on this area suggest that it is possible to restore at least some aspects of problem solving deficits of patients with schizophrenia by using cognitive remediation approaches. We believe that to achieve the optimal cognitive improvement, combination of long-lasting and individualized cognitive training modalities and antipsychotic treatments with positive effects on cognition is necessary.

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