

Brief article**Title:** Neurocognitive insight and executive functioning in schizophrenia**Running head:** Neurocognitive insight in schizophrenia**Author's name and affiliations:**

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Abstract

Introduction: This study was aimed at exploring whether integrity of executive functioning is required to have a good neurocognitive insight in persons with schizophrenia.

Method: Neurocognitive insight was measured by subtracting executive difficulties (errors in the Modified Card Sorting Task) to executive cognitive complaints (Subjective Scale To Investigate Cognition in Schizophrenia) in forty persons with schizophrenia and forty-two normal controls. The schizophrenia sample was a priori divided into two subgroups on the basis of executive level. Multivariate analyses were conducted to compare groups and to control for potential confounding factors.

Results: Only the schizophrenia dysexecutive subgroup had a poorer neurocognitive insight compared to normal controls. Group differences remained significant after adjustment for potential confounding factors (education, depression, anxiety, self-esteem).

Conclusion: These results provide support for the hypothesis that executive dysfunctioning is a limiting factor for neurocognitive insight, independently from depressive and anxiety symptoms.

Key words: cognition, cognitive complaint, self-awareness, mental flexibility

Introduction

Neurocognitive deficits in schizophrenia, occurring in several domains of neurocognition (Fioravanti, Carlone, Vitale, Cinti, & Clare, 2005), have been consistently linked to functional outcomes (Prouteau et al., 2005). In this perspective, awareness of neurocognitive difficulties, i.e. neurocognitive insight (NI), is of particular importance for optimizing efficacy of cognitive remediation aimed at enhancing neurocognitive functioning. For instance, self-perception of cognitive dysfunction, has been reported to be a strong predictor of long-term occupational outcome (Verdoux, Monello, Goumilloux, Cougnard, & Prouteau, 2010).

In the first study dealing explicitly with NI in schizophrenia, Medalia and Lim (2004) reported that outpatients are poor at accurately classify their cognitive status (impaired or not) in memory and attention. In subsequent studies, 28% to 52 % of cognitively impaired participants are considered to have no NI, depending on the used tools (self-reports versus clinician ratings) (Medalia & Thysen, 2008; Medalia, Thysen, & Freilich, 2008). Additionally, even if a majority of people with schizophrenia underestimates their impairment, some overestimate it (Gilleen, Greenwood, & David, 2011; González-Suárez et al., 2011). Hence, several subprofiles of NI could co-exist within included samples.

In the domain of NI, two theoretical levels of analyses and interpretation have to be differentiated. Indeed, cognitive complaints reflect difficulties relevant from the subject's viewpoint, but also reflect the efficiency of underlying mechanisms allowing the subjects to become aware of their difficulties. Brekke et al (2001) suggested that a lower executive functioning level would prevent persons with schizophrenia from making sophisticated judgments about themselves, taking into account their past history and the others. Executive functions such as mental flexibility are critical for

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3 having access to mnemonic representations, which constitute the pool of information on
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5 which judgments about one's own cognitive functioning are based. To date, the few
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7 studies dealing with this issue failed to find any association between NI and
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9 executive functioning (Donohoe et al., 2009; Gilleen, et al., 2011; Medalia & Thysen,
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11 2008). However, associations were explored at the whole group level, potentially
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13 masking associations restricted to specific subprofiles.
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16 This study was aimed at exploring in persons with schizophrenia whether integrity of
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18 executive functioning is required to have a good NI.
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21 22 23 24 **Method**

25 26 27 *Participants*

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30 Forty participants with schizophrenia (clinical group) were consecutively recruited
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32 during ambulatory treatment in the rehabilitation unit of a public psychiatric hospital.
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34 Included participants fulfilled the following criteria: 1) diagnosis of schizophrenia or
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36 schizoaffective disorder according to the DSM-IV criteria (APA, 2000); 2) age range
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38 between 18 and 65 years; 4) fluency in French; 5) no substance or alcohol
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40 dependence according to the DSM-IV criteria; 6) no history of neurological disease or
41
42 brain injury; 7) medication and clinical status stable for at least one month. All the
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44 participants were receiving antipsychotic medication at the time of assessment.
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49 To explore whether NI depends on executive functioning level, we split the
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51 schizophrenia group into two subgroups on the basis of executive performance. As
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53 we used the MCST score for measuring NI, we used another executive test, i.e. the
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55 TMT B-A score, as an independent indicator of executive functioning. The TMT B-A
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57 5th percentile (Godefroy & GREFEX, 2008) was a priori used as a cut-off score to
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3 split the schizophrenia group into two subgroups. The first one was considered as
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5 “schizophrenia executively normal”, containing participants with TMT B-A scores
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7 strictly inferior to 96 seconds. The second one was the “schizophrenia dysexecutive
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9 group”, with scores ranging from 96 seconds to highest. The 5th percentile was
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11 chosen in accordance with consideration about pathological threshold in
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13 neuropsychology, and was selected according to schizophrenia group’s mean level
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15 of education.
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19 Forty two control participants (control group) were recruited through announcement in
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21 medical centers. Their psychiatric status was assessed using the Mini International
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23 Neuropsychiatric Interview (MINI), to exclude subjects with DSM-IV diagnoses of
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25 mental disorders (Lecrubier et al., 1997). The other inclusion criteria were the same
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27 as for patients.
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31 The investigation was conformed to the French bioethics and clinical research
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33 legislation and all participants provided written informed consent to participate. Local
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35 ethical committee approved the procedures.
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38 *Assessments*

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41 A trained psychologist conducted all assessments. Executive functioning was
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43 assessed with the French validated versions (Godefroy & GREFEX, 2008) of the
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45 Modified Card Sorting Test (MCST) (Nelson, 1976) and the Trail Making Test (TMT)
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47 (Reitan, 1958). Cognitive complaints were measured using the French validated
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49 version of the Subjective Scale To Investigate Cognition in Schizophrenia (SSTICS,
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51 Stip, Caron, Renaud, Pampoulova, & Lecomte, 2003). The SSTICS is 21-items self-
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53 report questionnaire providing cognitive complaints scores in several domains:
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55 memory, attention, executive function, praxia and language. Subjects have to rate
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3 each item on a 5-point Likert-type scale (from 0: « never » to 4: « very often »). The
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5 SSTICS sustained executive function score (max = 16) was considered in the
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7 present study.
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10 The participants completed French validated versions of self-administered
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12 questionnaires to assess depressive symptoms with the Beck Depression Inventory-II
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14 (Beck, Steer, & Brown, 1998), anxiety symptoms with the State-Trait Anxiety
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16 Inventory (Spielberger, 1983), and self-esteem with the Rosenberg Self-Esteem
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18 Inventory (Rosenberg, 1965).
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20 21 22 *Neurocognitive insight calculation* 23

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25 A NI variable was created for the present study to reflect adequacy between self-
26
27 perceived executive functioning and real executive performance. A discrepancy score
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29 was thus calculated by subtracting executive performance (error percentage in
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31 MCST) to executive complaint (complaint percentage in the SSTICS 'sustained
32
33 executive functioning' factor). A value close to zero reflects a good NI, whereas
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35 values far from zero indicate either lack of awareness of difficulties (negative values),
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37 or overestimation of difficulties (positive values).
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41 42 *Statistical analyses* 43

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45 Analyses were carried out with the Statistical Package for Social Science®. In order
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47 to explore differences between groups, the Chi-square test was used to compare
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49 categorical qualitative data, whereas *t*-test for independent samples and one-way
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51 analysis of variance (ANOVA) were used to compare quantitative continuous
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53 variables. Degrees of freedom for the independent samples *t*-tests were corrected for
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55 unequal variances based off of a Levene's test for equality of variances. Post-hoc
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3 analyses were performed using Tukey HSD (Honestly Significant Difference) test for
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5 pairwise comparisons.
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8 Comparisons between the three groups (control, schizophrenia executively normal
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10 and schizophrenia dysexecutive groups) were made using one-way ANOVA on the
11
12 NI score. Finally, multiple regression analyses were performed in order to control for
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14 sociodemographic characteristics, depression, anxiety and self-esteem. For all tests,
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16 significance was set at $p < .05$, two-tailed.
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22 23 **Results**

24 25 *Participants' characteristics*

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27 The "schizophrenia executively normal" group contained $N=29$ (72.5%) participants
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29 with TMT B-A scores strictly inferior to 96 seconds. There was $N=11$ (27.5%)
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31 participants the "schizophrenia dysexecutive" group, with scores ranging from 96
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33 seconds to highest.
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37 Participants' characteristics are described in Table 1. Group comparisons revealed
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39 that groups were not different on gender ($\chi^2=3.53$, $df=2$, $P=0.17$) or age ($F_{(2, 79)}=1.54$,
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41 $P=0.22$), but were different in education level ($\chi^2=41.76$, $df=2$, $P<0.001$),
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43 SSTICS' executive complaint score ($F_{(2, 79)}=16.50$, $P<0.001$), executive performance
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45 (MCST : $F_{(2, 79)}=19.80$, $P<0.001$; TMT B-A: $F_{(2, 78)}=82.47$, $P<0.001$), depression score
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47 ($F_{(2, 77)}=18.57$, $P<0.001$), state-anxiety score ($F_{(2, 78)}=4.71$, $P<0.05$) and self-esteem
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49 score ($F_{(2, 64)}=5.12$, $P<0.01$). The schizophrenia groups were not different in terms of
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51 duration of illness ($F_{(1, 35)}=1.15$, $P=0.29$).
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6 *Neurocognitive Insight differences*

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9 The Table 1 presents scores in the three groups (control, schizophrenia executively
10 normal, schizophrenia dysexecutive). In the schizophrenia dysexecutive group, there
11 was a majority of high positive NI scores (63% had scores superior to 6.25),
12 contrasting with the two other groups (24% in the schizophrenia executively normal
13 group, 9.5% in the control group). One way ANOVA on the NI score showed a
14 significant effect of group ($F_{(2, 79)}=5.45$; $P<0.01$, $\eta^2=.12$). Post hoc analyses revealed
15 that only the schizophrenia dysexecutive group significantly differed from the control
16 group ($P<0.05$, $d=1.31$). There was no difference between the two schizophrenia
17 groups ($P=0.064$, $d=.63$), nor between the control group and the schizophrenia
18 executively normal group ($P=0.42$, $d=.33$). Finally, multiple regression analysis
19 showed that the effect of group remained significant when controlled for education,
20 anxiety, depression and self-esteem variables.
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40 **Discussion**

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42 Our results show that only the schizophrenia dysexecutive group has a poorer NI
43 compared to normal controls, independently from education, anxiety, depression and
44 self-esteem. This result provides support for the hypothesis of Brekke et al (2001), as
45 executively impaired participants were less able than controls to evaluate accurately
46 their cognitive abilities. Our results apparently contrast with those of previous studies
47 that failed to find any correlation between awareness of cognitive impairment and
48 executive functioning (Donohoe, et al., 2009; Gilleen, et al., 2011; Medalia & Thysen,
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3 2008). This inconsistency might be related to discrepancies in the used methods of
4 analyses. Indeed, in previous studies, correlations were explored at the whole group
5 level, thus potentially masking different profiles among participants. Our results
6 suggest that exploring awareness of cognitive impairment among groups of cognitive
7 functioning (for instance severe executive impairment versus no or mild impairment)
8 could be a more sensitive method. Moreover, the link between executive functioning
9 and judgments about one's neurocognitive abilities has also been underscored in the
10 domain of metamemory and aging. In elderly participants, metamemory control may
11 be largely the result of executive limitations associated with aging (Souchay &
12 Isingrini, 2004). Altogether, these results suggest that the integrity of executive
13 functioning has an impact on metacognition (i.e. cognition about one's cognition),
14 whether during one particular cognitive task (i.e. metacognitive judgment and
15 control), or more generally on what a subject knows about her/his everyday
16 functioning (metacognitive knowledge or neurocognitive insight). Further research are
17 necessary to understand these relationships in normal controls, as well as their
18 specificities in schizophrenia, in which executive dysfunctions are known to be
19 frequent (Fioravanti, et al., 2005).

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40 Our results also show that problems for evaluating neurocognitive difficulties do not
41 always appear in the sense of a 'lack of awareness'. Indeed, 63% of the
42 dysexecutive participants tend to overestimate their difficulties. This result is
43 consistent with previous studies, showing that subjects with schizophrenia could
44 either underestimate or overestimate their difficulties (Donohoe, et al., 2009;
45 González-Suárez, et al., 2011; Medalia & Thysen, 2008). González-Suárez et al
46 (2011) argued that this phenomenon could be a manifestation of low self-esteem or
47 depression. In our study however, it seems unlikely that self-esteem, depression and
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3 anxiety could have played a major role, as these factors do not explain differences in
4 neurocognitive insight between groups. The great amount of participants presenting
5 with an overestimation of difficulties is at first sight surprising, given the classical
6 consideration on unawareness of difficulties (lack of insight) in schizophrenia.
7
8 However, it has already been shown that in schizophrenia, several components of
9 self-awareness should be differentiated, such as clinical insight, cognitive insight and
10 cognitive complaints (Tastet, Verdoux, Bergua, Destailats, & Prouteau, 2012).
11
12 Furthermore, this finding also suggests that, in some dysexecutive patients,
13 neurocognitive deficits can be clearly perceivable. In practice, overestimation of
14 difficulties constitutes a privileged way for including these patients in remediation
15 programs. Considering cognitive complaints may contribute to enhance intrinsic
16 motivation. Indeed, self-reported cognitive difficulties are perceivable in daily life and
17 could reflect some relevant limitations for an individual project (i.e. education, work,
18 social relationships).

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35 This study has several methodological limitations. First, our sample was composed of
36 persons with schizophrenia treated in a rehabilitation unit; hence results may not be
37 generalizable to the entire population of persons suffering from schizophrenia. The
38 limited size of our sample prevented us from studying NI in some moderate or mild
39 executive impairment groups. We thus cannot exclude that subtle NI impairments
40 could exist in such groups. Another potential limitation is that our cut-off score for
41 isolating a subgroup of dysexecutive subjects is severe (percentile 5). Executive
42 difficulties, though milder, may exist for other subjects of the entire sample. Finally,
43 the present study design was limited to mental flexibility. Further studies are needed
44 to know whether the same phenomenon can be described in other executive
45 dimensions.

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3 In conclusion, our findings suggest that executive dysfunctioning is a limiting factor
4 for NI in schizophrenia. Interventions aimed at enhancing NI, and more globally self-
5 awareness, should first consider the availability of cognitive processes within each
6 subject, particularly in the domain of executive functioning.
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14 15 16 **Acknowledgements**

17
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34 35 **References**

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Tables

Table 1: score differences between groups

	Schizophrenia dysexecutive ¹ (N=11)	Schizophrenia executively normal ² (N=29)	Control (N=42)
	Mean SD N (%)	Mean SD N (%)	Mean SD N (%)
• Age	40.00 (10.96)	36.93 (9.07)	33.86 (12.56)
• Gender	7 (63.6%)	15 (51.7%)	15 (35.7%)
• Education level			
• < 6 years	2 (18.2%)	1 (3.4%)	0 (0%)
• 6 to 12 years	9 (81.8%)	23 (79.3%)	9 (21.4%)
• > 12 years	0 (0%)	5 (17.2%)	33 (78.6%)
• Duration of illness ³	16.81 (13.95)	12.88 (8.20)	-
• MCST ⁴ : errors	11.45 (7.15)	6.79 (6.29)	2.02 (2.33)
• SSTICS ⁵ : Sustained executive complaints score	6.27 (2.69)	6.07 (2.83)	2.98 (2.16)
• TMT B-A ⁶	161.60 (63.76)	42.11 (25.39)	34.26 (16.94)
• Neurocognitive insight ⁷ score	8.10 (12.57)	1.13 (10.52)	-1.49 (5,34)
• BDI-II ⁸ : total score	15.27 (12.30)	15.03 (8.52)	4.65 (5.03)

• STAI ⁹ : state score	31.55 (12.48)	38.79 (13.93)	30.21 (9.58)
• RSE ¹⁰ : total score	6.86 (2.54)	6.71 (2.34)	8.40 (1.84)

*: p<.01; **: p<.001

¹ Subjects with a Trail Making B-A score $\leq 5^{\text{th}}$ percentile

² Subjects with a Trail Making B-A score $> 5^{\text{th}}$ percentile

³ defined as the number of years since the first hospitalization

⁴ MCST: Modified Card Sorting Task

⁵ SSTICS: Subjective Scale To Investigate Cognition in Schizophrenia

⁶ TMT B-A: Trail Making Test : time B-time A (s)

⁷ defined as 'sustained executive complaint percentage – executive errors percentage'

⁸ BDI-II: Beck Depression Inventory-II

⁹ STAI: State-Trait Anxiety Inventory

¹⁰ RSE: Rosenberg Self-Esteem inventory