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Impaired Continuous Performance Test and the Go/NoGo Task, but Intact Context Sensitivity, in Patients with Schizophrenia

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Abstract

Difficulty inhibiting context-inappropriate behavior is a common deficit in psychotic disorders. Schizophrenia (SZ) is associated with impaired response inhibition. In SZ, deficit in context processing was suggested as a critical mechanism for impaired response inhibition during the performance, but results of studies are equivocal. In the present study, we investigated the context processing during a switch from Continuous Performance Task (CPT) to Go/NoGo task in patients with SZ. A cross-sectional design was used in order to allow analysis of the means between SZ patients and Healthy Controls subjects (HC). SZ patients (n=180) were compared with HC (n=112) on their performance on CPT and Go/NoGo task as well as during the switch from CPT and Go/NoGo task. Reaction time, variability of reaction time, and accuracy measures were significantly impaired on both CPT and Go/NoGo task in SZ compared to HC. Patients with SZ revealed significantly more impairment on response inhibition performance than HC. However, although SZ patients show impaired response inhibition performance on CPT-Go/NoGo tasks, requiring a different response rate, their ability to create response bias did not differ from HC. Our findings suggest that context sensitivity is intact in SZ patients during the switch from CPT to Go/NoGo task paradigm.

Keywords: Context sensitivity; Response inhibition; Schizophrenia; CPT; Go/NoGo task; Schizophrenia; Response inhibition; Sustained attention; Associative learning

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Introduction

Response inhibition is essential for self-regulation and refers to the capacity to appropriately select actions that are behaviorally advantageous, and to withhold actions that are inappropriate in a given context [1]. The Go/NoGo task is the most widely used laboratory-based assessment of response inhibition [2]. Schizophrenia (SZ) patients show an increased number of commission errors, slower Reaction Time (RT) to both Go and NoGo stimuli during performance in the Go/NoGo task [3-6]. Effective performance is related to the capacity to elicit a Go event within its immediate temporal context. Ability to update a temporal context of past experiences in coping with the upcoming goals has obvious advantages for adaptive and flexible intentional behavior [7]. "If there is response competition and a strong response tendency must be overcome for appropriate behavior, the context module plays an inhibitory role" [8]. Difficulty in inhibiting context-inappropriate behavior is common in psychotic disorders and impairment in response inhibition has been described as a key cognitive endophenotype of SZ [9]. In SZ, deficit in context processing has been suggested as a critical mechanism for impaired capacity to response inhibition during the performance [10,11]. Context processing refers to the adaptive control of behavior through use of prior contextual information that is mentally represented and maintained to support context-appropriate behavior that should serve as a bias in selection of the appropriate behavioral response [12,13]. The context processing deficit is suggested as a model for cognitive dysfunction in SZ [8,14,15]. This dysfunction may account for deficits on a variety of tasks that require selective attention, active memory and prepotent inhibition found that patients with SZ have diminished capacity to create an automatic response bias to a Go stimulus due to abnormal associative context learning [16,10,11]. Thus, SZ patients have an unexpected lower number of commission errors than Healthy Controls (HC) during performance on the Go/NoGo task, because they are less influenced by the visual context of task performance and can thus more accurately perceive characteristics of stimuli than HC [16,17]. However, other researchers failed to replicate these results [18].

Context-dependent processing has been studied using Continuous Performance Tasks (CPTs) in which the representation and maintenance of antecedent contextual information relevant to an immediate goal is required in order to overcome an established automatic or pre-potent response.

The context-dependent processing in the current study was tested by the ability to switch stimulus-to-response associations involving differences in response times or number errors in trials that employ the same stimulus-to-response associations as in previous trials as compared with trials that alternate the frequency of such associations claimed regarding the probability that "information transmitted about any feature at any moment is increased if that feature is predicted by the context and decreased if it is incompatible with that prediction" (p. 659) [19].

An important difference between these two types of task includes:

1. The CPT is a condition with frequent NoGo stimuli (80%) and rare Go stimuli (20%). The high frequency of NoGo stimuli in the CPT provides automatic tendency to withhold response and an expectation that the next stimulus should be a NoGo. Rare exposure to Go signals requires substantial effort for maintenance of adequate alertness and to sustain attention aimed at minimizing distractibility to irrelevant internal or external stimuli for a target (Go) detection.

2. In the Go/NoGo task, in contrast to the CPT, the high frequency of Go (80%) signals provides automatic tendency to repeat response due to an expectation that the next stimulus should be a Go signal, while withholding responses to a pre-defined rare NoGo (20%) that is administered in an unpredictable fashion. The frequent Go stimuli fast response to a Go stimulus increases the likelihood of errors due to buildup of expectancy (a strong prepotent bias) leading to automatic response to the next signal. If automatic response to the next NoGo stimuli can be suppressed successfully, it reflects inhibitory ability to control responses [20,1]. Thus, a commission error (response to NoGo) is considered a measure of failed response inhibition [21].

In the CPT and the Go/NoGo task subjects must learn the associations between a set of stimuli and a set of responses. These fixed associations are typically acquired through a process of trial and error learning [22]. The consistent associations between the stimulus and response, with time, become an automatic processing [23]. Automatic response bias can be an expression of the fact that participants do not respond passively to stimuli, but rather actively use context information to generate a response in a given situation. For present purposes, it will be sufficient to examine whether SZ patients in the two different tasks namely the CPT and Go/NoGo task, show a task-congruent automatic response bias (faster responses to high frequency of Go in the Go/NoGo task as compared with slower responses to low frequency of Go in the CPT task). As a consequence, if SZ patients have impaired contextual processing they are expected to develop lower rates of automatic response bias leading to less commission of errors in the Go/NoGo task compared to HC. However, the direct role of context processing in an ability to develop the automatic response bias to a stimulus is unclear [24]. The present study was designed to investigate the relationship between the sensitivity of contextual processing and response inhibition capacity. We assessed the role of contextual information in mediating CPT and Go/NoGo performance among SZ patients and HC. In the current research, the associative learning ability was measured by comparing the performance during the switch from the CPT to the Go/NoGo task [25]. The CPT differs from Go/NoGo task in the probability of stimulus–response associations that the examinee is required to learn. Thus, the switch from CPT to Go/NoGo task requires a suppression of previously successfully learned associations as well as the learning of new demands. Subjects should be able to discriminate between past correct associations that became incorrect and use new context information to guide successful responses suggested that this reverse stimulus-response mapping paradigm creates a mapping-switch cost which serves as an index of associative memory using this model, found that SZ patients have intact associative learning [26]. In the present study we used a less demanding task design compared to the above-mentioned report [26]. Correct response was purely based on simple perceptual input, which does not include degraded stimuli, overloaded early information extraction and stimulus identification processes, and are not paired with their identical match. Such a task does not require a complex mental operation like arithmetic computation or retrieval of complex memory representations [27]. In our investigation the Go and NoGo stimuli have a different color in order to lessen the demand of the task [28].

Aims of the Study

The primary aim of this study was to characterize the impact of the sensitivity of contextual processing (in terms of both RT and number of errors) assessed by the switch from the CPT to the Go/NoGo task, on the response inhibition capacity in SZ patients as compared to HC. If patients with SZ are assumed to have impaired sensitivity in context processing they should then have diminished ability to create an automatic response bias during performance. They are also expected to express less effort in terms of RT and errors, during the switch from CPT to Go/NoGo task compared to HC. We expected that during the switch from CPT to Go/NoGo task, SZ patients will create an automatic response bias similar to HC. The secondary aim of our study was to compare performance in the two tasks: The CPT and the Go/NoGo using seven measures (RT), intra-individual variability of a RT (RTV), commission error, omission errors, context sensitivity, perceptual sensitivity, and response bias). We expected that performance of the SZ group would be less accurate on both CPT and Go/NoGo task than in HC. To our knowledge, this is the first study to explore neurocognitive assessment using two tasks with different frequencies of Go and NoGo signals for assessing the theoretical concept of impact of prior to exposure to contextual information, that is mentally represented and maintained, on context-appropriate response inhibition behaviors.

Method

Subjects

All 180 male participants in the SZ group were recruited from inpatients at Beer-Ya'akov/Ness-Ziona Mental Health Center and Shaar Menashe Mental Health Center. Psychiatric diagnoses (F20.0, F20.2, F20.5, F25) were established by two senior psychiatrists based on psychiatric interviews, supported by anamnesis, and observations by the hospital staff, medical records, and interviews of family members. Inclusion criteria were:

1. A diagnosis of schizophrenia according to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR);

2. Age between 20 and 65 years; and

3. Capability to participate in the neuropsychological assessment. Exclusion criteria were:

1. Acute psychotic state with agitation, violence and disorganized behavior,

2. Organic brain disorder;

3. Somatic pathology interfering with ability to perform tests,

4. Mental retardation; and

5. Patterns of underperformance on neuropsychological tasks at the time of the examination [29,30].

All SZ patients received antipsychotic medications and were admitted prior to the neuropsychological assessments. SZ patients had abstained from alcohol and illegal drugs for at least one month as validated by appropriate urine examinations. The neuropsychological assessment of the patients was part of the clinical evaluation in the hospitals.

The HC group consisted of 112 male volunteers from the hospital staff. They underwent psychiatric interviews and revealed no evidence for history of psychiatric disorders, substance use disorders or physical and neurological diseases.

Measurement procedure

Response inhibition measures: We used a computerized version of the CPT and the Go/NoGo task (Anima Scan Ltd, Ashdod, Israel, 2000), as described previously [25,31]. During the first phase (the CPT), lasted 5 min, the rare Go stimuli (n=30) were integrated with frequent NoGo noise signals (n=120). In the Go/NoGo stage, that started without pause after CPT ended, the proportion of Go to NoGo stimuli was reversed (120:30). The duration of Go/NoGo task was also 5 min. The software automatically removed responses in which the participants either failed to respond within 2000 msec of a Go signal or made anticipatory responses earlier than 250 msec after a Go signal.

A subject's performance on the CPT and Go/NoGo task must be analyzed using several dimensions of performance including: response time, variability of response time, number of commission errors, number of omission errors, perceptual sensitivity (d' value), response criterion (C value), context processing (as switch from CPT to Go/NoGo and speed-accuracy tradeoff [28,32,33].

Measures:

1. Response Time (RT) is the measure of the interval between the presentation of the Go stimulus and the participant's response.

2. Intra-individual variability of the RT is a measure of consistency in responding and ability to sustain attention over time.

3. Commission error is considered when the participant presses the key when the Go signal does not appear (a false alarm response) and indicates a failure in inhibition capacity.

4. Omission error is the failure to press the key when the Go signal appears, and is considered a measure of inattention (the subject is not paying attention to stimuli).

5. Context processing is a measure of the difference in the average RT and number of both kinds of errors during the switch from CPT to Go/NoGo task [25]. This parameter represents the ability to create a contextually-related bias. A higher difference indicates a greater difficulty in response adaptation when switching one type to another.

6. d' value - perceptual sensitivity, is the ability of a participant to discriminate a signal (Go) from a noise (NoGo). For calculating d' value, the following formula was used: d'= [z (hit rates)-z (commission errors) [34]. As such, d' provides data for assessing an individual's discriminative power. A zero value (0) indicates performance at chance, the higher the d', the better is the discriminative capacity [35].

7. C value is a measure of response bias [a tendency to select one type of response (Go or NoGo) more frequently than another]. For calculating C value, the following formula was used: C= -1[z (hit rates) +z (commission errors)] [34]. Some individuals are so cautious that they avoid responding very often. Conceptually, such individuals want to make sure that they are correct when they respond. Their emphasis is on avoiding commission errors. Higher C value indicates a more conservative response bias toward NoGo responses (i.e., more correct rejections and omissions errors). Other individuals respond more frequently to make sure they respond to most of the targets, and they tend to be less concerned about mistakenly responding to a non-target. A lower C value represents a more liberal, risk-taking response bias toward Go responses (i.e., more target and commission errors). C value of zero (0) indicates the absence of a response bias [36].

8. Speed-accuracy trade-off is the correlation between RT and both kinds of errors. The speed–accuracy trade-off may help to clarify the mechanism of inhibitory impairment. Impulsive participants tend to prefer greater speed at the cost of accuracy, which indicates a fast response to the NoGo stimuli [33].

Statistical analysis

Data was analyzed using the SPSS (v. 23) software for Windows. All analyses used two-tailed levels of significance ($p<0.05$). To evaluate differences between groups in trial-to-trial performance, GLM univariate, multivariate and repeated measures analyses of covariance with performance variables (response time, variability of response time, numbers of commission and omission errors, number of participants with both kinds of errors, D-Prime, C-index as dependent measures, Group (SZ and HC) as between-subject measures, CPT and Go\NoGo condition as within-subject measures were performed. We used Chi-square test to compare the distribution of categorical variables. Two conditions of the performance were examined:

i. CPT as the 'target detection' condition,

ii. 'Go/NoGo' as the 'inhibition ability' condition.

The main goal of the research was the evaluation of 'switch' from CPT to Go\NoGo task as a measure for remapping the strategy of responses (from ability to detect the go event to ability to withhold a response to the no-go event). Task switching especially involves 'task management' processes, i.e. scheduling processes which require switching of focused attention between tasks, and 'attention and inhibition' processes [37]. Spearman's correlation test between response time and numbers of both kinds of errors was performed to compare differences between groups in speed-accuracy trade-off

Table 1: Adjusted means (and standard deviations) in CPT and Go/NoGo conditions.

Variable/Condition	SZ	HC	F*	p
N	180	112		
Age	32.31 (9.62)	36.22 (11.25)	10.03	<0.01
Education	10.55 (3.01)	14.66 (2.37)	122.43	<0.001
RT CPT	447.22 (92.22)	391.52 (77.90)	20.54	<0.001
Go/NoGo	417.05 (116.2)	359.44 (88.41)	20.61	<0.001
Commissions CPT	.972 (1.01)	0.535 (0.85)	8.59	<0.01
Go/NoGo	3.03 (2.02)	2.07 (2.04)	4.39	<0.05
Omissions CPT	0.71 (.55)	0.22 (.50)	13.48	<0.001
Go/NoGo	4.12 (8.12)	1.21 (2.92)	11.75	<0.001
N Participants with Commissions (%)				
CPT	112 (67.22)	58 (51.79)	27.64**	<0.001
Go/NoGo	157 (87.22)	101 (91.18)	0.443**	>0.05
N Participants with Omissions (%)				
CPT	87 (48.33)	23 (25.00)	22.72**	<0.001
Go/NoGo	129 (71.61)	51 (45.54)	19.93**	<0.001
RTV CPT	94.11 (48.90)	58.33 (16.46)	81.58	<0.001
Go/NoGo	142.41 (90.78)	70.28 (24.03)	103.02	<0.001
D' CPT	3.73 (0.56)	4.02 (0.30)	24.53	<0.001
Go/NoGo	2.88 (0.97)	3.40 (0.80)	22.81	<0.001
C-Index CPT	0.264 (0.24)	0.248 (0.13)	0.443	>0.05
Go/NoGo	-0.399 (0.44)	-0.478 (0.30)	2.79	>0.05

characteristics. As age and education differences between participants of 2 studied groups were found, those 2 factors were entered as covariants in all analyses.

Results

Study population

Demographic data of the SZ and HC groups are presented in Table 1. SZ patients were significantly younger [F (1,289) = 10.03, p=0.002; η2=0.033] and less educated [F (1,289) =146.23, p<0.001, η2=0.335] than the HC. Thus, differences in age and educational level were entered as covariates in the further analyses.

Response time

Patients with SZ were slower than HC across performance in both tasks (Figure 1a). RT was slower in the CPT than in the Go/NoGo task in both the SZ and HC groups. During the switch of tasks (from the CPT to the Go/NoGo) participants of both groups were significantly faster [F (1,290) =69.94 p<0.001 η2 =0.174] (Figure 1). In the CPT, the influence of age [F (1,288) =8.451 p=0.004 η2 =0.029] but not education [F (1,288) =0.690 p=0.407] was significant on RT. The same results were obtained regarding the Go/NoGo task: Age [F (1,288) =4.843 p=0.009 η2 =0.017] and education [F (1,288) =1.481 p=0.229]. However, during the task switch from CPT to the Go/NoGo, the influence of age [F (1,288) =0.055 p=0.821] and education [F (1,288) =0.618 p=0.432] was not significant.

Variability of response time

Patients with SZ showed significantly greater standard deviation of RTs than the HC in both CPT and Go/NoGo tasks (Table 1). Variability of RT increased after switch from the CPT to the Go/NoGo task in the two groups [F (1,289)=54.09 p<0.001 η2 =0.157], but in the SZ group the variability of increased RT was significantly greater than among HC participants [F (1,289)=19.69 p<0.001 η^2 =0.064] (Figure 1b). The main effect of the group factor was significant [F (1,288) =19.69 p<0.001 η^2 =0.060]. The effects of age [F (1,288) =0.556 p=0.468] and education [F (1,288) =0.663 p=0.423] were not significant.

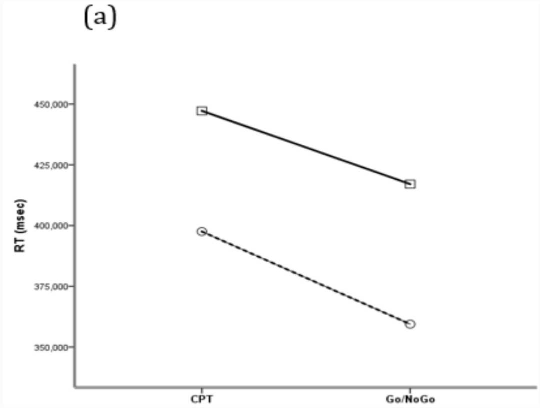

Figure 1a: RT. The SZ patients were significantly slower than HC during CPT and Go/NoGo phases. All subjects (without difference between groups) showed a speeding up of RT during task's switch (after the frequency of go events was increased).

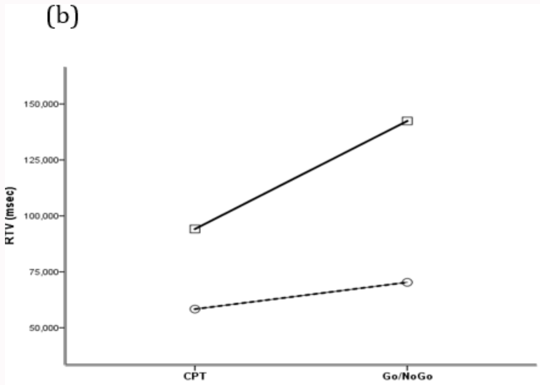

Figure 1b: RTV. The SZ patients showed less consistent performance (larger RTV) than the control group during both tasks, moreover, during transition from CPT to Go/NoGo they demonstrated greater RTV rise than HC.

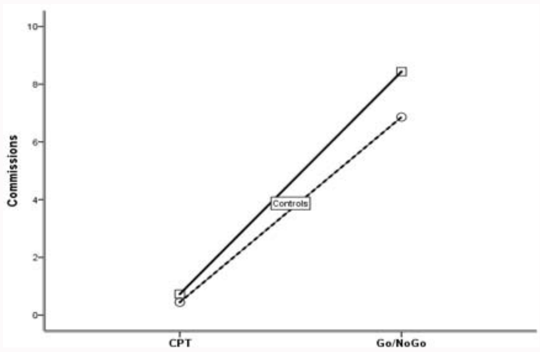

Figure 1c: The SZ patients showed a higher number of commission errors than the control group in both phases of test performance, during task switch the amount of commissions was increased dramatically similarly in both groups.

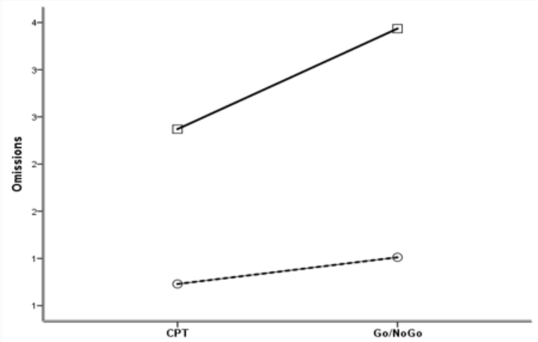

Figure 1d: In both tasks SZ patients made more omissions than HC participants, during condition switch SZ showed the significantly larger rise of errors compared with HC.

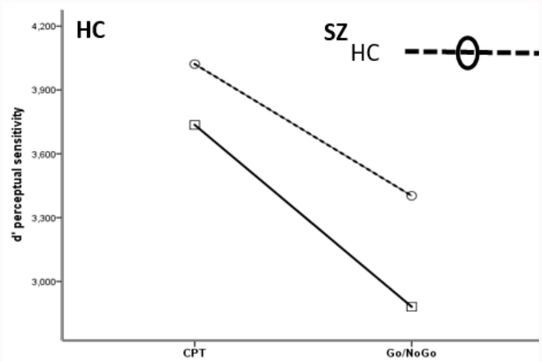

Figure 1e: *d'*, perception sensitivity of SZ patients was significantly lower than HC in both conditions; also they showed the greater decrease of sensitivity during the task switch compared with HC.

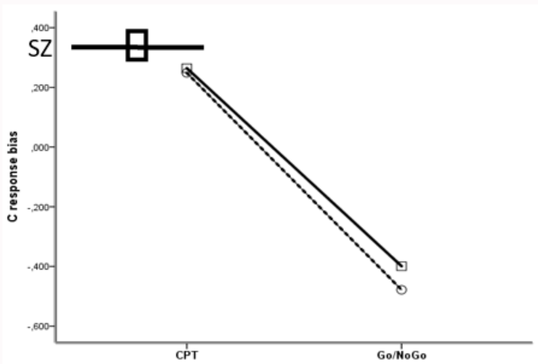

Figure 1f: C-index (response bias), there were no between group differences registered in this measurement during both tasks of test performance.

Commission errors

SZ patients made more commission errors than HC in both the CPT and the Go/NoGo task (Table 1). The number of commission errors significantly increased in both SZ [F (1,179) =115.86, p<0.001 η^2 =0.392] and HC [F (1,111) =115.26, p<0.001 η^2 =0.392] groups during the switch from the CPT to the Go/NoGo task, but the effect of interaction in the Task X Group was not significant [F (1,289)=0.356 p=0.501] (Figure 1c). The results were not affected by age and education.

Omission errors

In CPT and in Go/NoGo tasks SZ patients made more omission errors than HC participants (Table 1). The number of omission errors significantly increased in both groups during the switch from the CPT to the Go/NoGo task [F (1,289) =39.83 p=0.001; η^2 =0.121]. SZ patients revealed a greater increase of omission errors during the switch from CPT to Go/NoGo task than HC participants [F (1,289) =11.68 p=0.001 η^2 =0.040]. The influences of age [F (1,288) =1.18; p=0.278] and education were not significant here [F (1,288) =0.033 p=0.855] (Figure 1d).

Table 2: Spearman correlation between RT and commissions omissions.

RT	Phase	SZ	HC
Commissions	CPT	-0.125	-0.079
Omissions		.314**	.318**
Commissions	Go/NoGo	-.197*	-0.238
Omissions		.373**	.318**

**Correlation is significant at the p<0.01 level (2-tailed)
*Correlation is significant at the p<0.05 level (2-tailed)

Correlation between errors and RT

During performance on the CPT and the Go/NoGo tasks, both groups showed a negative correlation between commission errors and RT as well as a positive correlation between omission errors and RT (Table 2).

Sensitivity for target detection (d')

Compared to controls, the SZ group had lower d' values in both conditions (Table 1). After switch from the CPT to the Go\NoGo performance, participants of both groups showed decreasing of d' values, (F (1,289) =248.61 p=0.001 η^2 =0.496). Also, the effect of the group factor was significant [F (1,289) =20.89 p=0.001 η^2 =0.068], decline of d' in SZ patients was significantly more profound than among control subjects. The influence of age [F (1,288) =0.046 p=0.829] and education here were not significant [F(1,288) =0.494 p=0.483] (Figure 1e).

Response bias (C-Index)

There were no significant between group differences in the C-Index (Table 1). C Index was similar in SZ and HC participants. During the switch from the CPT to the Go/NoGo, C Index decreased remarkably in both groups [F (1,289) =1434.81 p=0.001 η^2 =0.832]. The role of group factor was not significant [F (1,289) =2.985 p=0.085] (Figure 1f).

Discussion

The aim of the present study was to investigate the impact of context sensitivity, as assessed by differences in efficacy of performance (in terms of both RT and number of errors) during the switch from the CPT to the Go/NoGo task, on the response inhibition capacity in SZ patients in the Go/NoGo task.

The results of the current study suggest that patients with SZ are similar to HC in their ability to develop automatic response bias during the shift from the rare frequency of targets in the CPT to the high frequency of targets in the Go/NoGo task as suggested previously by some researchers, but not by others or mixed results [3,15,26,38-41].

While the reason for these conflicting results is not clear, one explanation is that the model used was not sensitive to between-group differences. This task has not been tested extensively among different populations; therefore, its sensitivity is not known. However, our previous study showed statistically significant differences in the switch from CPT to the Go/NoGo model between obsessive compulsive disorder and pathological gamblers [31].

Differences in response speed and in variability of reaction time

In the SZ group Go RT was significantly longer than in the HC group in both the CPT and the Go/NoGo task, in accord with previous reports (Table 1 and Figure 1) suggested that only slowness of RT, but not the number of commission or omission errors, could separate SZ from HC in the CPT. In SZ patients, slowing of RT did not help in preventing commission errors [42-45]. Moreover, this slowness was achieved at the expense of impairment in detection of Go signals. This pattern may be related to an increased number of omission errors and a positive correlation between slowness of RT and the number of omission errors. The slowness of RT may indicate that the achievement of an adequate level of accuracy is required by the SZ patients to invest more mental resources to complete the task. This slowness of RT may be, at least partially, related to motor deficits and to information-processing impairment, as was proposed to be a key factor of cognitive dysfunction in SZ [46]. Reduced processing speed was reported to be the most sensitive indicator for discrimination of subjects with ultra-high risk for psychosis from healthy controls [47]. Slowness in the Go/NoGo task in SZ patients can result from decreased vigilance that requires more time to process the association of a stimulus with a corresponding response, compared to HC [48]. In both the CPT and the Go/NoGo tasks, the SZ patients did not differ from HC in building speed-accuracy tradeoff and showed a similar negative correlation between the number of commission errors and RT (Table 2), consistent with a previous study [49]. Although, the role of antipsychotic treatment in the slowness of response of SZ patients cannot be ignored, previous studies, using CPT, failed to find an influence of daily chlorpromazine dose on performance [50,51]. The SZ patients demonstrated more RT fluctuations (larger RTV values; Table 1) during the task performance than the HC group. This finding is consistent with a report of increased minute-by-minute activity fluctuations in SZ patients [52].

Differences in accuracy in the CPT and the Go/NoGo task

In the CPT, SZ patients responded less accurately to the Go stimuli (less response activation) than HC. Our findings were consistent with those of that SZ patients made significantly more omission than commission errors in the Go/NoGo task, (Table 1 and Figure 1) as was reported previously, in the present study patients with SZ exhibited lower d' values in the CPT compared to HC (Table 1 and Figure 2) [16,53]. Such impairment in attentional processing was suggested as a core cognitive deficit in SZ and associated with higher risk for SZ in families with SZ probands [54]. In the Go/NoGo task, patients with SZ manifested significantly lower accuracy than HC in response to the NoGo stimuli, as reflected in their higher rates of commissions (impaired response inhibition in accord with) the large number of commission errors can be related to attentional lapses, or conflicts in stimulus processing and difficulties in shifting focus of attention to new stimuli [4,20,55]. We found that both SZ and HC show similar decrements of performance in more demanding Go/NoGo conditions relative to the CPT condition. It was not surprising to find that when Go stimuli were presented at a relatively frequent rate, individuals became more alert and prepared for immediate response. The lower accuracy and faster response in the Go/NoGo task, as compared with the CPT, may indicate that SZ patients in demanding conditions are sensitive to changes in the context of the task. All participants in the Go/NoGo task, both SZ patients and HC, were able to optimize stimuli detections in demanding conditions with high frequencies of Go signals and with corresponding faster RT. It is of note that C-value decreased equally in SZ patients and HC during the switch from the CPT to the Go/NoGo task indicating similar adjustment capacity to changes in the context during a task shift.

Limitations

Our current findings are based on retrospective cross-sectional data and thus cannot detect a causal relationship. Furthermore, the studied patients were maintained on antipsychotic agents, and hence the contribution of medications to the slowness of response in the SZ group cannot be disregarded.

Conclusion

It appears that patients with SZ perform less effectively on the CPT and the Go/NoGo task than HC as reflected by slowness of RTs, greater RTV, more commissions and omissions, and smaller d' value. These cognitive measures can be relevant to the cognitive deficits reported in SZ disorder and can discriminate SZ patients from HC. These differences between SZ and HC groups were not attributed to age or to educational levels.

Additionally, the results of the current study suggest that the sensitivity to context during a shift from CPT to Go/NoGo task is similar in patients with SZ and HC indicating apparently intact adjustment capacity to a novel context, as was reported previously. Further research is needed to establish the reliability and validity of the shift from CPT to Go/NoGo paradigm as a tool for evaluating contextual processing in patients with SZ [56]. Future studies should explore the interaction between contextual processing and inhibition impairments in SZ using interruptive, interference, and waiting models of inhibition. Such studies can hopefully delineate the contribution of contextual processing to different inhibition impairments in SZ patients and provide an integrative measurement of mechanisms responsible for a variety of cognitive impairments in patients with SZ.

Ethical Statement

This study was approved by the Institutional Review Boards of the two hospitals: Beer-Yaakov/Ness Ziona/Maban and Shaar Menashe Mental Health Centers. Due to the retrospective nature of the study the need for written informed consent was waived by the two Institutional Review Boards for the participants with SZ. The HC provided signed consent forms prior to participation in the study.

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