



Hemispatial neglect evaluated by visual line bisection task in schizophrenic patients and their unaffected siblings

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ABSTRACT

Visuospatial attentional asymmetry has been investigated by the line bisection task in patients with schizophrenia, however, those studies are in small number and the results are controversial. The present study aimed to investigate hemispatial neglect in patients with schizophrenia ($n=30$), their healthy siblings ($n=30$) and healthy individuals ($n=24$) by a computerized version of the line bisection task. Deviation from the midline for both hemispaces (mean bisection error—MBE) were calculated and the effects of both hand and line length were controlled. Repeated measures ANOVA yielded a significant hemisphere effect for the MBE scores, but no group or group $\times$ hemisphere interaction effect, i.e., all three groups were inclined to a leftward bias in the left and a rightward bias in the right hemisphere. MBEs were significantly different from “zero” only for the right hemisphere in siblings and for the left hemisphere in controls. Negative symptoms were significantly correlated with the bisection errors in the right hemisphere. The results of the present study do not support aberrant hemispheric asymmetry, but bigger bisection errors in schizophrenia.

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1. Introduction

Patients with right parietal lesions ignore left sided stimuli and this phenomenon is called “neglect” or “left hemispatial neglect”. These patients bisect horizontal lines toward the right of the veridical center (Mesulam, 1982). Although right-hemispheric lesions resulted with greater visuospatial processing deficit, left-hemispheric lesions also led to bisection errors (Mennemeier et al., 1997). “Pseudoneglect” refers to the tendency of neurologically intact individuals to misbisect horizontal lines (Bowers and Heilman, 1980). Tasks of visual bisection, midsagittal-pointing and tactile bisection usually reveal leftward bias in healthy subjects (i.e., right hemispatial neglect), while kinesthetic tasks result in rightward errors. Pseudoneglect is explained by the predominance of the right side of the brain in visuospatial functions. Although it is not a consistent finding, the meta-analyses indicate a significant leftward bisection error with an overall effect size between 0.37 and 0.44 (depending on the integration method), which is significantly modulated to varying degrees by a number of task or subject variables (Reuter-Lorenz et al., 1990; Milner et al., 1992; Jewell and McCourt, 2000; McCourt et al., 2000).

Visual pseudoneglect in line bisection task has been investigated in patients with schizophrenia, and many studies have indicated that the tendency to leftward bias (i.e., right pseudoneglect) observed in healthy individuals, is pronounced in patient groups (Mather et al., 1990; Cavérian et al., 2007; Michels et al., 2007; Tian et al., 2011). This aberrant visuospatial attention (increased visuospatial attentional asymmetry) in schizophrenia has been explained by possible left hemispheric dysfunction or right hemispheric overactivity or impaired callosal transfer. However, variability in patient groups are even higher, controversial results (either a tendency in patient groups to a rightward bias or no significant difference from “zero-the midpoint” or control groups) have been reported (Barnett, 2006; Rao et al., 2010; Cavérian et al., 2007; Michels et al., 2007; Tian et al., 2011; McCourt et al., 2008; Zivotofsky et al., 2007). Although the inconsistency might suggest lack of any association between schizophrenia and pseudoneglect, small sample sizes and use of different tasks across studies as well as the fact that most studies did find differences, albeit small or in different directions, suggests that the possibility of aberrant visuospatial attention in schizophrenia deserves further exploration with more precise methods of measurement.

The present study was carried out to investigate hemispatial neglect in Diagnostic and Statistical Manual of Mental Disorders IV-Text Revised (DSM-IV-TR) schizophrenia patients and their healthy siblings by using a computerized line bisection task (LBT)

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and to compare the results with healthy controls. Both phenomena of hemispheric asymmetry (neglect and pseudoneglect) are modulated by the quality of stimuli like the line length, line position, etc. (Marshall and Halligan, 1989). Previous studies reported an increased error with increasing line length and an increased error accompanying increasing leftward placement (McCourt and Jewell, 1999). Therefore, lines which are presented in different lengths from both left and right hemispaces and testing the performance of both hands are considerably needed to evaluate validity of the line bisection task for measuring hemispheric visuospatial asymmetry in patients with schizophrenia. Additionally, evaluation of hemispheric asymmetry in healthy siblings as well as in patients, may contribute to understand whether it is related to a possible endophenotype of schizophrenia or not.

2. Method

The study sample consisted of DSM-IV-TR schizophrenia patients ($n=30$), their healthy siblings ($n=30$) and healthy individuals without any psychiatric disorder ($n=24$). All subjects were identified as right-handed as assessed by Chapman and Chapman's Hand Preference Questionnaire (Nalçacı et al., 2002). Participants with any neurological, ophthalmological or any other psychiatric disease were not included. Schizophrenia patients only without or with mild involuntary movements were included. The study procedure was approved by the Ethics Committee of the university and all of the subjects provided written informed consent prior to their participation in the study. Scale for the Assessment of Positive Symptoms (SAPS) and Scale for the Assessment of Negative Symptoms (SANS) were administered to schizophrenic patients by two trained psychiatrists for the assessment of psychopathology. All schizophrenia patients were taking antipsychotic medication during the task performance.

Turkish version of the Magical Ideation Scale (MIS) was used as an indicator of mild schizotypal symptoms in siblings and controls (Atbaşoğlu et al., 2003). Hemispatial neglect was evaluated by a computerized version of the Line Bisection Task that was developed by Çiçek et al. and used in several studies (Çiçek et al., 2003, 2007, 2009). Validity and reliability study of the classical pencil and paper version of the LBT task was carried out by Güneş et al. (2002).

The LBT included presentation of 10 horizontal lines with different sizes (80, 90, 100, 110, 120 mm) on the right and the left sides of the computer screen which was 40 cm (16 in.). Head of the subject was fixated during the task and the monitor-head distance was adjusted as 40 cm. Participants were expected to bisect the lines from the middle as quickly and precisely as possible by using the computer mouse. They were able to move the cursor with vertical line shape (1 cm in height) and they clicked the left mouse button to mark the transection point. When the line was presented, the cursor appeared on the left or right end of the line and the side of appearance was balanced to compensate eye scanning direction. The delivery of the lines were not cued in any manner. Lines were

presented on the screen till the subjects responded. The lines disappeared at each response and next line was presented one second later. The test program computed the distances of the bisection marks to the left end of the lines with 0.1 mm precision. The procedure was repeated with the left hand, yielding a total of 20 scores for each subject. A pretest was applied to each subject in order to teach the task. Same task was applied in two different serials for both hands, each consisting of 10 lines. Therefore, deviation from the midline (mean bisection error) for both hemi-spatial areas were obtained and the effects of the hand and the line length were controlled. Mean bisection errors (MBE) were calculated for three groups. Negative scores indicated a leftward deviation in mm, while positive scores indicated a rightward deviation. One sample *t*-test was used to evaluate whether MBE scores were different from zero (the midline). Also, mean absolute bisection error (MABE), which is the total deviation from midline, independent of the direction, was calculated. Finally, MBE and MABE scores were calculated in terms of the percentage of the half-line, since the length of the lines were different. MBE and MABE scores of the groups were compared by repeated measures ANOVA. When the *p* value from the ANOVA was statistically significant, pair-wise comparisons were used to assess specific differences and a Bonferroni adjustment was applied for multiple comparisons. MIS scores of the siblings and the controls were compared by using Independent Samples *t*-test. Pearson's Correlation Test was used to examine the correlations between SANS, SAPS, MIS scores and MABE scores.

3. Results

Sociodemographic features of the subjects are presented in Table 1. The three groups were similar in terms of age ($F=1.19$, $d.f.=2$, $p=0.31$), total years of education ($F=2.15$, $d.f.=2$, $p=0.12$) and sex distribution ($\chi^2=0.308$, $p=0.86$). Mean MIS scores of the siblings ($M=4.47 \pm 3.22$) were higher than the mean MIS scores of the healthy controls ($M=2.89 \pm 2.45$; $t=2.09$, $p=0.04$). Mean total SAPS and SANS scores of the patients were 20.14 ± 20.19 and 36.57 ± 12.45 , respectively. Table 2 shows the MBE and the MABE scores of the groups. Results are presented separately for each hemisphere. In patients with schizophrenia the MBE scores were not different from zero in either hemisphere ($p > 0.05$). In healthy siblings, the MBE scores were different from zero only in the left hemisphere ($t=-2.92$, $d.f.=29$, $p=0.0035$) and in controls the MBE scores were different from zero only in the right hemisphere ($t=1.784$, $d.f.=23$, $p=0.044$).

Repeated measures ANOVA yielded a significant hemisphere effect for the MBE scores ($F=10.5$, $d.f.=1$, $p=0.002$), but no group or group $\times$ hemisphere interaction, i.e., all three groups were inclined to a leftward bias in the left and a rightward bias in the right hemisphere (Fig. 1).

For the MABE scores, group effect approached statistical significance ($F=2.9$, $d.f.=2$, $p=0.06$), however hemisphere and group $\times$ hemisphere interaction were not significant (Fig. 2). When the MABE scores of the patients with schizophrenia patients ($n=30$) and non-schizophrenics ($n=54$) were compared; a significant difference in the MABE scores for the left hemisphere was found ($n=2.52$, $d.f.=82$, $p=0.01$). This result indicated greater misbisection in the left hemisphere for patients with schizophrenia compared to healthy subjects.

When the correlations between the MABE scores and total SANS and SAPS scores of the patients were examined, only total SANS scores were significantly correlated with the MABE scores in

Table 1
Sociodemographic features of the groups.

	Patients with schizophrenia ($n=30$)	Healthy siblings ($n=30$)	Controls ($n=24$)
Mean age	32.6 ± 8.9	36.4 ± 10.4	35.5 ± 10.4
Mean total years of education	11.9 ± 2.3	12 ± 2.4	13.2 ± 2.6
Sex (M/F)	17/13	17/13	12/12

Table 2
Mean bisection errors and mean absolute bisection errors.

	Mean bisection error		Mean absolute bisection error	
	Left hemisphere	Right hemisphere	Left hemisphere	Right hemisphere
Patients with schizophrenia	-0.31 ± 2.27	0.43 ± 3.19	4.58 ± 3.54	4.49 ± 3.18
Healthy siblings	$-0.98 \pm 1.83^*$	0.08 ± 2.60	3.30 ± 1.07	3.43 ± 1.10
Controls	-0.53 ± 2.73	$0.94 \pm 2.59^*$	3.17 ± 2.40	3.73 ± 1.51

* Significantly different from zero by one-sample *t*-test.

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