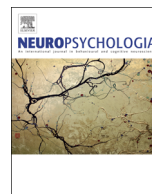




ELSEVIER

Contents lists available at ScienceDirect

Neuropsychologia

journal homepage: www.elsevier.com/locate/neuropsychologia

The effect of rotating random dot motion on visuospatial line orientation in patients with right-sided stroke

A.K. Schaadt^{a,e,*}, S. Reinhart^{a,*}, I. Keller^b, H. Hildebrandt^c, G. Kerkhoff^a, K.S. Utz^d^a Department of Clinical Neuropsychology Unit at Saarland University, Germany^b Department of Neuropsychology, Schön Klinik Bad Aibling, Germany^c Department of Psychology, Oldenburg University and Zentralkrankenhaus Bremen-Ost, Germany^d Department of Neurology, Friedrich-Alexander University Erlangen-Nuremberg, Germany^e Outpatient Neurological Rehabilitation Center, ZANR, Kaiserslautern, Germany

ARTICLE INFO

Article history:

Received 30 November 2015

Received in revised form

23 May 2016

Accepted 26 May 2016

Available online 27 May 2016

Keywords:

Spatial orientation

Line orientation

Visual motion

Brain damage

Treatment

ABSTRACT

Spatial deficits are frequent after brain damage, particularly right hemisphere stroke. Visual judgments of line orientation (LINE) are often impaired after right parietal lesions. Perception of line orientation is an important visuo-perceptual component of visuoconstructive capacities. Yet, little is known about modulating factors in LINE and effective treatments are rare for this disorder. Studies in patients with spatial neglect show that *horizontal* random dot motion (RDM) significantly modulates horizontal spatial disorders, both transiently and permanently after treatment. In the current study, we investigated whether rotational RDM modulates judgements in an oblique LINE task in 20 patients with right-hemispheric first ever stroke (10 of them with a disorder in LINE and 10 without such a disorder), and 10 healthy, age-matched subjects. Subjects were tested under three experimental conditions: (1) with a static background of small white dots, (2) with slow clockwise or (3) counterclockwise circular RDM of these background stimuli, while they performed the LINE task. In the baseline condition with static background, the impaired patient group showed a significant counterclockwise tilt. Clockwise rotating RDM normalized this deficit transiently but completely, while counterclockwise rotating RDM slightly aggravated it, though not significantly. Tilts in the LINE task were significantly correlated with left visuospatial neglect. Similar but much smaller effects were obtained in the spatially unimpaired patients and the normal controls. These results show that rotational RDM modulates deficits of line orientation in patients with right-sided stroke, possibly by influencing higher spatial representations devoted to the perception of oblique lines.

© 2016 Elsevier Ltd. All rights reserved.

1. Introduction

The veridical perception of visual orientations in the environment, i.e. when judging whether two tilted lines are parallel or not, is an important ability for spatial orientation. It is required when reading the hands of a clock face, for understanding arrows on a traffic sign, for drawing a geometrical figure or when matching our hand orientation to the orientation of an object we want to grasp. A frequent sign of spatial disorientation are disturbances in judging

the orientation of oblique lines (LINE, cf. De Renzi et al., 1971; Benton et al., 1975; Kerkhoff, 1999; Gentaz et al., 2002; Hamsher et al., 1992; Treccani et al., 2005). Such deficits are quite often found in patients with right hemisphere stroke (63%, cf. Hamsher et al., 1992; Nichelli, 1999), particularly right parietal lesions (> 90%, cf. Ng et al., 2000). Lesions of the angular gyrus and parietal white matter have been identified as critical (Cramon and Kerkhoff, 1993). Recent lesion mapping studies using the Benton Judgment of Line Orientation test have identified the right dorsal stream, in particular fronto-parieto-occipital areas in acute stroke patients (Biesbroek et al., 2014) and the right occipito-parietal region in chronic stroke patients (Tranel et al., 2009) as crucial for deficits in this task. These sites are often disrupted in patients suffering from stroke of the right middle cerebral artery, many of whom also show left neglect (Kerkhoff, 2001). In fact, impaired LINE performance is significantly correlated with left spatial neglect (Kerkhoff, 1999). LINE deficits are also significantly related to poor ambulation capacity of right hemisphere lesioned stroke patients (Kerkhoff, 1999), impair

Abbreviations: LINE, visual line orientation (45° right oblique orientation); cw, clockwise; ccw, counterclockwise

* Correspondence to: Saarland University, Clinical Neuropsychology Unit, Building A.1.3., D-66123 Saarbruecken, Germany.

E-mail addresses: annakatharina.schaadt@uni-saarland.de (A.K. Schaadt), s.reinhart@mx.uni-saarland.de (S. Reinhart).

¹ Both authors (AKS, SR) have equally contributed to this publication as first authors (Equal first-author contribution).

functional independence (Mercier et al., 2001) and predict poor functional recovery after right hemisphere stroke (Kaplan and Hier, 1982). Finally, perception of line orientation is an important visuo-perceptual component of visuoconstructive capacities (Biesbroek et al., 2014); as a consequence, LINE deficits will impair visuoconstruction.

Rotating visual motion around a fixation point has been shown to influence the perception of verticality in normal subjects (Hughes and Brecher, 1972; Mauritz et al., 1977; Howard and Childerson, 1994; Nishida and Johnston, 1999), and also in patients with a pathological tilt of the subjective visual vertical (see the companion paper in this special issue of Neuropsychologia by Reinhart et al.). The last two decades have shown that horizontal random dot motion (RDM) significantly modulates higher order spatial cognition, such as horizontal line bisection, visual size estimation and perception of the subjective visual straight ahead (Schindler and Kerkhoff, 2004) in patients with right hemispheric lesions. Based on these studies effective rehabilitation techniques with RDM combined with active pursuit eye movements have been developed as a treatment for patients suffering from left spatial neglect (Kerkhoff et al., 2014, 2006, 2013). As horizontal RDM does modulate visuospatial deficits in the left-right dimension in patients with left spatial neglect, rotational RDM (or roll RDM) might act in a similar way on the perception of oblique visual lines. If so, significant modulation effects on LINE would be expected, especially in patients with an impairment in LINE after a right-sided stroke. In the present study, we therefore investigated the modulatory influence of rotating RDM on perceptual judgments of LINE in patients with right hemisphere stroke, either with or without a significant deficit in LINE, as well as age-matched healthy individuals. We predicted that i) clockwise (cw) roll motion normalizes the counterclockwise (ccw) tilt in the LINE task typically found in right hemisphere lesioned patients, whereas ccw roll motion should aggravate this perceptual tilt slightly; ii) normal individuals and unimpaired stroke patients were expected to show only small and more symmetrical shifts in LINE towards the direction of roll motion.

2. Materials and methods

2.1. Participants

Twenty patients with unilateral, right hemisphere lesions (6 male, 4 female) and ten age-matched, healthy individuals (6 male, 4 female) were tested (see Table 1). All participants were right-handed according to the German adaptation of a handedness inventory (Salmaso and Longoni, 1985). Patients were included if they had a) an unilateral, single vascular (hemorrhagic or ischemic) lesion of the right cerebral hemisphere, documented by CT/MRI; b) no evidence for a brain stem lesion and no previous neurological or psychiatric disease; c) corrected binocular visual acuity of at least 0.7 (20/30 Snellen; 0.4 m viewing distance). Patients were classified into the RBD+ patient group when showing a significant spatial deficit in the Judgment of Line Orientation Test (Benton et al., 1983, see Table 1) and in a 45°-oblique LINE task (see below), based on normative values for this task (Kerkhoff and Marquardt, 1998). If patients performed normally in both tasks, they were allocated into the RBD- group. Mean age was 57 years for RBD+ patients, 54 years for RBD- patients and 58 for healthy individuals (One-Way-ANOVA, df 2,27, $F=1.818$, $p>0.05$, not significantly different). Patient groups did not differ significantly according to time since lesion ($t=1.031$, $p>0.05$). Spatial neglect was measured with three conventional screening tests (line bisection, copying, letter cancellation, see Table 1; cf. Kerkhoff, 2000). The CT/MRI scans from the post-acute phase (>1 month post lesion) were analysed with MRICron software (<http://www.sph.sc.edu/comd/rorden/mricron/install.html>) (results see Fig. 1). Lesion volumes are shown in Table 1. Prior to investigation, informed consent was obtained from all subjects. All experiments were performed in accordance with the 1964 declaration of Helsinki.

2.2. Experimental setup

In the LINE task (see Fig. 2) a 45°-tilted 14 × 1.4 cm white bar on a black background was presented on the right side of a computer

Table 1
Clinical and demographic data of 20 patients with right hemisphere stroke, 10 with a deficit in visual line orientation judgments (LINE) and impaired performance in the Judgment of Line Orientation Test (JLOT) vs. 10 patients without a deficit in LINE and normal results in the JLOT.

Pat.	Age Sex	Etiology TSL (months)	Lesion site/volume in mm ³	Visual field sparing (°)	Motor deficit	Line bisection	Neglect copy L/R	Cancell. L/R	Deficit in LINE	JLOT percentile
1	56,f	I,8	T, P, sc/18.9	HH, 2°	Left	-8	-/+	6/1	Yes	< 5
2	44, m	I, 12	F,T,P, I/134.4	HH, 15°	Left	+9	-/+	4/1	Yes	< 10
3	48,f	H, 4	Sc/19.6	HH, 3°	-	+4	-/+	4/1	Yes	< 5
4	70,m	I, 4	F, T, P, T, sc/112.0	HH, 20°	Left	+6	-/+	5/4	Yes	< 5
5	50,f	I, 2	T, P, I, sc/87.5	HH, 15°	Left	+10	-/+	5/0	Yes	< 5
6	50,f	I, 2	T, P/30.8	-	Left	+45	-/+	23/3	Yes	< 10
7	70,m	I, 3	T, P, sc/95.2	HH, 40°	Left	+43	-/+	11/0	Yes	< 5
8	61,m	I, 3	T, sc/27.3	HH, 2°	Left	+20	-/+	16/8	Yes	< 5
9	58,m	H, 4	T, P/96.6	-	Left	+63	-/+	10/4	Yes	< 10
10	63,f	I, 3	T, P/87.5	HH, 17°	Left	+53	-/+	8/4	Yes	< 5
Mean	57.0 yrs	TSL: 4.5	Volume: 80.0	8 impaired	9/10	+26	10 impaired	9.2/2.6	10 impaired	10 impaired
11	57,f	I, 3	O/28.0	HH, 3°	-	-8	+/+	0/0	No	40
12	53,m	I, 2	O/2.8	HH, 3°	-	-12	+/+	0/0	No	57
13	63,m	I, 3	O/0.7	HH, 3°	-	-11	+/+	0/0	No	57
14	50,f	I,15	O/11.2	HH, 2°	-	-10	+/+	0/0	No	57
15	31,f	I, 2	O/28.0	HH, 3°	-	-2	+/+	0/0	No	40
16	45,m	I,3	O/12.6	HH, 3°	-	-8	+/+	0/0	No	57
17	68, m	H,2	T, BG/32.2	-	Left	+4	+/+	0/0	No	57
18	55,m	H,7	BG/30.1	-	Left	+3.5	+/+	0/0	No	57
19	57,m	H,7	BG/17.5	-	Left	+4	+/+	0/0	No	40
20	61,m	I,3	T/9.8	-	Left	+2.5	+/+	0/0	No	57
Mean	54.0yrs	TSL: 4.7	Volume: 17.3	6 impaired	4/10	-3.9	0 impaired	0 impaired	0 impaired	0 impaired

TSL: Time since lesion; I: ischemic; H: hemorrhagic; sc: subcortical; O/P/T/F: occipital, parietal, temporal; frontal; BG: basal ganglia; Neglect Screening Tests: line bisection of a 20 cm horizontal line; the deviation from the true midline is given (in mm; +/- = right/left-sided deviation; normal cut-off: ± 5 mm); Copy: copy of a star; -: left-sided omissions or size distortions, +: normal copy on right side of figure; Cancell.: cancellation of 30 numbers embedded in 200 distractors; L/R: the number of left/right sided omissions is given; normal cut-off: 1 omission per hemifield. JLOT: Judgment of Line Orientation Test; -/+ : impaired/normal

Download English Version:

<https://daneshyari.com/en/article/5045438>

Download Persian Version:

<https://daneshyari.com/article/5045438>

[Daneshyari.com](https://daneshyari.com)