

PSEUDONEGLECT IN REPRESENTATIONAL SPACE: EFFECTS OF MAGICAL IDEATION

Peter Brugger, Werner Surbeck, Tobias Loetscher

Neuropsychology Unit, Department of Neurology, University Hospital Zurich, Switzerland

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SUMMARY

Background. *Magical thinking, a sign of schizotypy, is accompanied by a decrease in the strength of left hemisphere language dominance and by an inattention towards the right side of space ("pseudoneglect"). We set out to explore whether it is also associated with a pseudoneglect in imagined space.*

Material and methods. *Forty healthy right-handed adults were asked to imagine the contours of the European continent, viewed from a point in outer space directly over Switzerland. After having contemplated this mental map for one minute, they were asked to name as many European countries as they could. All subjects filled in the Magical Ideation (MI) scale, and we split the population at the median scale score into low and high MI groups.*

Results. *The twenty subjects of the high MI group named less countries than those of the low MI group overall, but the difference was only significant for eastern ("right-sided") countries.*

Conclusions. *This study presents preliminary support for an association between magical thinking and right-sided inattention in the evocation of a mental map. We suggest that future studies should make use of tasks that allow a better quantification of left and right in imagined space. The neuropsychiatric significance of lateralized abnormalities in the mental representation of space is emphasized.*

INTRODUCTION

Reports about lateralized abnormalities in sensorimotor and attentional functions abound in the literature on the neurocognitive foundations of schizophrenia (Posner et al. 1988, Park 1999). The predominant pattern is that of a hemi-inattention towards the right side of space (Bracha et al. 1993, Harvey et al. 1993), taken as indicative of a (structural and functional) deficit in the left hemisphere (LH). However, while the finding of an attentional shift away from the right side of space can be interpreted as a neglect-like phenomenon caused by LH dysfunction, it is unlikely that such a dysfunction *per se* would account for delusion formation and the generation of other productive psychotic symptoms. Rather, we should assume that, secondary to LH hypofunction, a functional release of homologous areas in the right hemisphere (RH) is responsible for both disordered thought and a relative hyperattention to the left side of space. Speculations about the nature of such an interhemispheric release effect have been motivated by neuropharmacological considerations, i.e. dopaminergic differences between the two cerebral hemispheres (Bracha 1989).

One way to investigate lateralized attentional abnormalities in relation to disordered thought is to study healthy subjects' lateral biases as a function of their "magical ideation" (MI). MI was introduced as an indicator of "schizotypy," a style of thinking that resembles schizophrenia in the mode of experiencing and reasoning (Eckblad & Chapman 1983). Examples comprise mild forms of paranoia (strangers can read one's mind), fear of alien entities intruding upon human life (e.g., deceased people, aliens from outer space) and the "denial of chance" (e.g., the belief in good luck charms). The advantage of studies with healthy individuals differing in their degree of MI is that task performance is not contaminated by potentially confounding effects of medication or hospitalization. Previous research has unequivocally shown that pronounced schizotypy (high MI) is associated with the same functional deficits and hyperproductions as those described in schizophrenia, albeit in a milder form. Of special interest to the topic of the present study is the converging evidence, from numerous paradigms, that elevated MI in the normal population goes along with increased sensorimotor and attentional biases towards the left half of space, e.g. in a tactile bisection task (Brugger & Graves 1997), in the recognition of chimerical faces (Luh & Gooding 1999), in line bisection and whole body locomotion (Mohr, Bracha & Brugger 2003), and in figure recall (Taylor, Zäch & Brugger 2002).

While recent studies have indicated that patients with schizophrenia show a right-sided neglect not only in physical space, but also in the mental representation of space (Cavezian et al. 2007), unilateral attentional biases in the exploration of mental images have not yet been studied as a function of healthy individuals' magical thinking. We report here a preliminary experiment addressing this issue in a brief task demanding that the subject imag-

ine a map of Europe and then name European countries. We predicted that the subjects high in MI (scoring above the median of the entire group) would name fewer countries located on the right side of the map.

MATERIAL AND METHODS

Subjects

We recruited 40 healthy subjects (20 women) without a relevant psychiatric or neurological history (Campbell 2000), who had never suffered from learning disorders or substance abuse. All subjects were Swiss and had been living in Switzerland for their entire lives. The mean age was 56.0 years (range: 37 to 74 years), and the mean level of education was 13.6 years (SD= 0.9 years). All these subjects were strongly right-handed (Chapman & Chapman 1987). They were recruited by the second author using flyers and personal contacts. All subjects gave written informed consent to participate in the study, which had previously been approved by the local Ethics Committee.

Task and procedure

The participants were instructed to imagine being high up in the sky, looking down at the contours of the European continent (as though the feet were pointing south, the head north). They had further to imagine that Switzerland lay immediately below them, so that the north-south meridian of the visual field would pass through Zurich (see Fig. 1). They had then to name, within 60 seconds, as many countries of Europe as they could think of, in any order. The eyes had to be kept closed, and the subjects were encouraged to keep as vivid an image of the map as they could during the entire task. Afterwards, they were asked to fill in the "magical ideation scale," a 30-item inventory with statements requiring true/false responses. Sample items include: "Some people can make me aware of them just by thinking about me"; "Good luck charms don't work" (reverse scoring). The scale is given in full in rEckblad & Chapman (1987) and Barnett & Corballis (2002), and reliability and validity data can be found in Garety & Wessely (1994).

RESULTS

Overall, the 40 subjects named an average of 19.6 valid countries (SD=3.6). A two-way ANOVA with the factors SIDE (left vs. right of the north-south meridian through Zurich; Fig. 1) and MI group (below or equal vs above the median scale score of 7; 20 subjects in each group) revealed a highly significant main effect of SIDE ($F=153.2$, $p<.001$), a significant main effect of MI group ($F=6.7$, $p=.013$) and a significant interaction ($F=3.0$, $p<.05$, one-tailed). More countries were named that were situated on the right of the meridian; the subjects in the low MI group named more countries than the subjects in the high MI group, and importantly, the subjects in the high MI group named



Figure 1. The map of Europe which the subjects had to imagine. Note that to the right of the meridian through Zurich (Switzerland) there are about three times as many countries as to the left

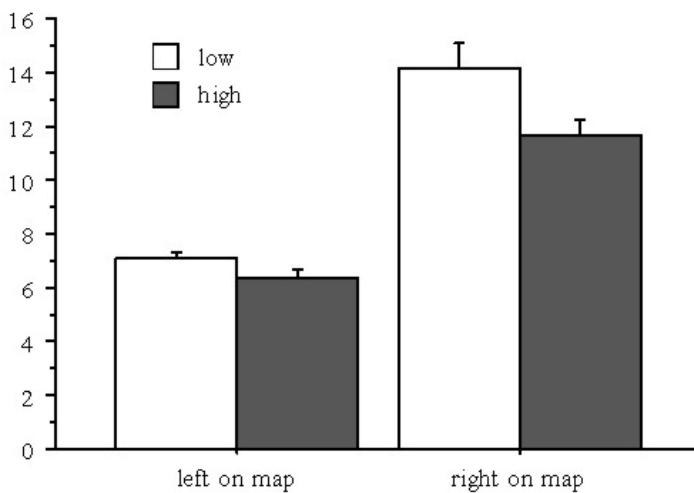


Figure 2. Mean number of countries named within 60 seconds by subjects from the low MI and high MI groups. The vertical bars represent standard errors of the mean

significantly fewer countries on the right side of the meridian than the subjects in the low MI group ($t=2.4$, $p=.01$ one-tailed), while the number of countries named on the left side of the meridian was comparable for the two MI groups ($t=1.8$, $p >.05$, see Fig. 2).

DISCUSSION

In this experiment we assessed healthy subjects' ability to imagine a map of Europe and to name as many countries as came to mind within one

minute. We were specifically interested in the number of countries named from the right side of the map, as we had hypothesized a relative inattention towards this side of representational space for those subjects scoring high in MI. The rationale for this prediction was that MI is a reliable predictor of schizotypy, i.e. a style of perceiving and thinking characterized by hallucination-like experiences and delusion-like beliefs. Both schizotypy and schizophrenia have previously been associated with a relative inattention towards right-sided stimuli ("pseudoneglect", cf. Brugger & Graves 1997, Luh & Gooding 1999, Mohr, Bracha & Brugger 2003). In the present experiment, high scorers on the MI scale (above the median score) named fewer countries than low scorers, but this difference was significant only for the countries on the right side of the map. This result is compatible with an association between magical thinking and an exaggerated pseudoneglect also in representational space. Analogously to previous geographical fluency tasks (Bartolomeo et al. 2005, Morrow 1987, Rode, Perenin & Boisson 1995), which showed a deficit for left-sided items on an imagined map in patients with right parietal damage, our finding of a right-sided deficit in high MI subjects indicates a relative LH hypofunction. As mentioned in the Introduction, in connection with productive symptoms of schizophrenia, the emergence of schizotypal thinking as a productive type in the breakdown of rational thought cannot readily be explained by LH pathology in the first line. We have proposed elsewhere (Brugger & Taylor 2003, Leonhard & Brugger 1998) that a secondary compensation by the RH of a developmentally very early LH dysfunction (Crow 1997) may be responsible for the genesis of magical and "paranormal" thought. Specifically, the preferential processing of the RH semantic system of indirect, oblique and symbolic associations (Nakagawa 1991, Pizzagalli, Lehman & Brugger 2001, Rodet et al. 1992) may favor the emergence of magical ideas. This is particularly evident in the face of everyday coincidences, where a tendency to remote associations may easily produce illusions of causality, whereas a focused LH semantic system will barely detect any meaningful connections.

We note that this model of an over-reliance on RH processing is not easily compatible with our finding that high MI subjects did not produce *more* countries from the *left* side of the map compared to low MI subjects. However, previous work on asymmetries in perceptuomotor space (Mohr, Bracha & Brugger 2003) have also evidenced reduced right-sided spatial attention in high MI subjects without a simultaneously enhanced left-sided orientation bias. Obviously, the most parsimonious explanation of MI that we can provide in neurocognitive terms is that it appears to emerge from an imbalance in functional hemispheric asymmetries (see Crow 1997 for similar reasoning in the context of schizophrenia).

Our method to assess lateral asymmetries in space representation may not have been optimal. The meridian through the center of Switzerland splits Europe into two very unequal parts. A critic could argue that our main finding is not an underrepresentation of specifically right-sided, eastern countries,

but rather a deficit in word fluency (note the highly significant main effect of MI). This would make the spatial interpretation of our result less plausible, but favor an interpretation in terms of a generally reduced verbal-cognitive ability in association with MI (for a recent overview, see Wiseman & Watt 2006). Such a view would not, however, undermine our interpretation of reduced LH functions in people with high MI.

We conclude by pointing out a method to assess asymmetries in representational space, which is potentially more reliable than the evocation of a mental map. This method requires indicating the median number of a numerical interval, and is thus an equivalent of line bisection (note that numbers are aligned along a "number line" that extends from left to right in representational space). Patients with RH lesions and left-sided hemineglect reportedly produce errors that consist of too *large* numbers, that is, they display a "neglect in number space" (Zorzi, Priftis & Umiltà 2002). More importantly, patients with schizophrenia show a deviation towards *small* numbers, which corresponds to a pseudoneglect in number space (Cavezian et al. 2007). An almost mandatory next step in the "cognitive neurology of unsubstantiated beliefs" is thus the exploration of asymmetries in number space as a function of magical and "paranormal" ideation.

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Correspondence: Peter Brugger, Neuropsychology Unit, Department of Neurology, University Hospital Zurich, CH-8091 Zurich; phone ++41 442 555571; FAX: ++41 442 554429; e-mail: peter.brugger@usz.ch

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