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Research report

A study on the independence of egocentric and allocentric neglect



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ABSTRACT

Currently there seems to be consensus that visuospatial neglect may involve egocentric and allocentric symptoms. However, the relation between the two is still discussed and models have been proposed based on the high correlation between allocentric and egocentric neglect symptoms. To analyze the relation between these two kinds of symptoms we developed a new paradigm. In contrast to previous paradigms, we varied the extension of the search field and we added centered reference targets to evaluate egocentric effects independent from allocentric effects. Patients with exclusively left-sided neglect ($n = 15$) and left-sided visual field deficit (VFD) ($n = 9$) were included. Right brain damaged patients ($n = 15$) and a healthy control ($n = 15$) acted as control groups. The results revealed egocentric inattention in VFD patients. Neglect patients suffered from egocentric and allocentric neglect, but we found no interaction between both kinds of impairments in the sense of a monotonous additive or multiplicative increase going from right to left in terms of egocentric and allocentric coordinates. On the contrary, at the outmost left allocentric and egocentric positions, the number of omissions did not increase, unlike in outmost right and centered positions. In conclusion, our experiment shows that egocentric and allocentric neglect can be clearly dissociated in neglect patients and do not interact. Inclusion of neglect patients with a VFD may lead to an artificial interaction between egocentric and allocentric symptoms and this may explain the differences with results of previous studies.

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Abbreviation: VFD, visual field deficit.

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1. Introduction

Spatial neglect may be defined as an inability of a patient to respond to stimuli on the contralesional side. It is a rather complex syndrome and various distinct forms have been described (Robertson & Marshall, 1993). Currently there seems to be consensus that visuospatial neglect may be described in at least two major frameworks: a near/egocentric framework which is related to grasping and manipulating of objects, and a far/allocentric framework, which codes spatial information in relation to the perceived object independent from the own body position. The near/egocentric framework seems to be associated with inferior-parietal and frontal areas, whereas the far/allocentric framework involves anterior-parietal, insular, frontal and temporal areas (Chechlacz et al., 2010). Recent functional neuroimaging data have indicated that near and egocentric spatial frameworks can be differentiated even further in four near and far, ego- and allocentric frameworks and that these four components of attention interact (Chen, Weidner, Weiss, Marshall, & Fink, 2012; Vossel, Geng, & Fink, 2014). However, most clinical studies do not distinguish these four dimensions and mainly focus on the dissociation between egocentric and allocentric neglect.

Recently, the dichotomy between egocentric and allocentric symptoms has been scrutinized. Rorden et al. (2012), for example, assume there is only one spotlight-like attentional mechanism that adapts in width according to focus of interest and to spatial extension. Their model assumes that searching for targets in clinical tests, used for assessing egocentric and allocentric neglect, would lead first to an inattention on the left side of the search array and, after having focused to the right half, this subsequently leads to an inattention of the left side of the target. They propose that most existing clinical data arguing for independent egocentric and allocentric neglect actually may be explained with such a single mechanism. Rorden et al. (2012) used the paradigm developed by Ota, Fujii, Suzuki, Fukatsu, and Yamadori (2001) in which a patient was advised to look for targets while concurrently ignoring non-targets in a single continuously presented search array on a horizontally oriented DIN A4 page which enables a continuous measurement of allocentric neglect. This task was applied for a second time with a new instruction: now the patient had to focus on opened circles and ignore closed circles. Further, the letter cancellation task (Weintraub & Mesulam, 1985) was used to measure egocentric neglect. Rorden et al. (2012) showed that allocentric neglect was highly correlated with egocentric neglect, and that the severity of egocentric neglect was a strong predictor for the existence of allocentric neglect. According to their results, there was no reason to assume independent mechanisms for these two attentional reference frames and consequently for two dissociable kinds of neglect. Similar results were found by Yue, Song, Huo, and Wang (2012), relying on a relatively large sample of 47 neglect patients with acute right hemisphere stroke. About 64% of the patients showed egocentric and allocentric symptoms and there was no case with pure allocentric neglect. Moreover, there was no evidence for an anatomical dissociation between allocentric and egocentric neglect.

Both studies, Rorden et al. (2012) and Yue et al. (2012), argue for a common mechanism for egocentric and allocentric neglect. However, there is some concern about the methods used by these studies to measure egocentric and allocentric neglect.

The procedure for assessing egocentric and allocentric neglect can be criticized for at least three reasons: First, there is only one non-changing spatial frame, the DIN A 4 page, for orienting attention, and all targets can be found within this frame. In other words, no systematic variation of egocentric attention in terms of the size of the search frame was applied. Second, due to the use of a constant spatial frame, egocentric and allocentric attention were not measured at exactly the same spatial location. Consequently, this procedure does not allow a precise assessment of a possible interaction between egocentric and allocentric aspects of neglect. Targets of the Ota Test were located at different positions. This problem becomes even more evident when comparing the letter cancellation task (as indication for egocentric neglect) with the Ota test (as indication for allocentric neglect) as it was done in the study of Rorden et al. (2012). In the letter cancellation task the test sheet was densely filled with small letters while the Ota test was not so crowded with targets and non-targets. Consequently, no spatial mapping of egocentric and allocentric targets was possible with respect to their location on the two test sheets.

The third methodological problem concerns the three different instructions for the Ota Test (looking for closed versus opened circles versus looking for specific letters). Perhaps these task differences do not have any effect, but one cannot be sure about that.

In our view, apart from clinical routine, where the Ota test is a fast and excellent screening method for allo- and egocentric neglect, a methodological sound measure of egocentric and allocentric aspects of hemi-inattention has to fulfill the following conditions: (1) The extension of the search array has to be varied as an independent factor for egocentric neglect. (2) A centered target feature should be used for measuring egocentric hemi-inattention independent of allocentric target position. (3) There should be no differences in instructions and physical task structure for measuring egocentric and allocentric aspects of hemi-inattention.

Several years ago, we developed an experimental paradigm, which was designed to assess whether allocentric and egocentric attention are independent or whether they interact (Grimsen, Hildebrandt, & Fehle, 2008). An interaction arises due to a combination of egocentric and allocentric impairments shown in additively or multiplicatively higher functional limitations (i.e., omissions) of the neglect patient. The experimental paradigm consisted of the presentation of three figures, looking like three fences, located at different egocentric positions on the screen (left, middle, right). Half of the trials included critical target features that were located at the allocentric left or right side of a fence. Patients had to react when targets were present by a button press. As a result it was possible to measure the performance of neglect patients on allocentric and egocentric targets in one experimental run, avoiding different instructions and physical task structures for measuring both aspects of neglect (Grimsen et al., 2008).

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