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Free Viewing Perceptual Asymmetry for Distance Judgments: Objects in Right Hemispace are Closer than They Appear

Daniel Brian Krupp,[1] Brent M. Robinson,[2] and Lorin J. Elias[1]

[1]*Department of Psychology, Neuroscience & Behaviour, McMaster University, Hamilton, Ontario, Canada*

[2]*Department of Psychology, University of Saskatchewan, Saskatoon, Saskatchewan, Canada*

Neurologically normal individuals demonstrate leftward biases in tasks of line bisection and judgments of brightness, numerosity, and size. Normals also report and demonstrate a right-sided bias when bumping into objects. Collectively, these results suggest that normals relatively neglect the right hemispace. The present experiment investigated the possibility that normals will also demonstrate leftward biases for judgments of distance. Participants viewed two equivalent but mirror-reversed three-dimensional shapes (“boxes” and “pyramids”) of various orientations, sizes, and angles, making judgments about the perceived closeness of the stimuli. Significant leftward biases were exhibited for judgments of the closeness of boxes, but not for pyramids. The findings of the current study support the hypothesis that the normal tendency to bump into objects with the right side of one’s body might be due to a perceptual asymmetry for distance judgments.

KEYWORDS: Pseudoneglect, laterality, perceptual asymmetry, distance judgment, driving

Individuals suffering from visuospatial neglect exhibit significant problems in responding to stimuli within specific areas of the visual field, and this neglect is not attributable to either motor or sensory failure (Kim et al., 1999). Neurologically normal individuals bisect lines to the left of true center (Jewell & McCourt, 2000), a phenomenon now referred to as “pseudoneglect.” Other tasks also reveal strong and reliable leftward biases in normals. Nicholls, Bradshaw, and Mattingley (1999) presented left/right reversed greyscales, gradients of small stars, or shapes changing in size from one side to another. For the greyscales task, Nicholls et al. (1999) asked the participants to indicate which side was darker or lighter. For the gradients of small stars, participants were to indicate which side contained more or less stars. For the shape task, participants were asked to indicate which shape was larger or smaller. Regardless of the type of stimulus presented or the type of assessment being made, participants exhibited large leftward biases in their responding. Collectively, these results suggest that normals neglect the right hemispace.

Analyses of self-report data reveal that normals show a lateral bias when bumping into objects. Most of these minor collisions involved the right side of the body, suggesting that objects on the right side of space are relatively neglected (Turnbull & McGeorge, 1998). Furthermore, this lateral bias was related to the strength of the leftward bias in a line-bisection task, suggesting that the two effects could rely on a common mechanism. However, while Nicholls, Loftus, Mayer, and Mattingley (2007) find a significant lateral bias in bumping behavior observed in the laboratory, the extent of the bias is not associated with performance on the line-bisection task or with dextrality. Rather, they show that the use of the left hand in a shooting task increases the rightward bias, whereas shooting with the right hand decreases the bias.

Several phenomena might explain the rightward bias in lateralized bumping: (1) asymmetries in choosing the right versus the left side of a path; (2) asymmetries in motor coordination; or (3) asymmetries in perception of the distance of objects in space. As bumping into objects generally necessitates a choice between one of several paths, individuals may be encouraged or

Address correspondence to: Lorin J. Elias, Department of Psychology, Neuroscience & Behaviour, McMaster University, 1280 Main St. W., Hamilton, Ontario, L8S 4K1, Canada. E-mail: kruppdb@mcmaster.ca

obliged to asymmetrically choose the rightmost path, increasing the likelihood of bumping into objects on the right side. For instance, social norms might dictate that individuals walk on the right side of hallways to avoid colliding with other walkers. However, this explanation does not account for the putative relationship between asymmetries in line bisection and lateralized bumping (Turnbull & McGeorge, 1998) or between hand movement and lateralized bumping (Nicholls et al., 2007). Alternatively, individuals may be less skilled in motor tasks on their right sides than on their left. Again, this explanation seems unlikely, as most individuals are *more* skilled on their right sides, being typically right-handed and right-footed, and Nicholls et al. (2007) failed to find an effect of dextrality on lateralized bumping. Finally, as discussed above, individuals tend to show a leftward bias in a variety of judgments relating to objects in space. When asked to make judgments of brightness, numerosity, size, or color, normal individuals exhibit leftward biases (Elias, Saucier, Sheerin, & Burton, 2002; Nicholls et al., 1999). Similarly, individuals may judge the distance of an object in the left hemispace as closer than a same-distanced object in the right hemispace, thus better avoiding objects on the left and increasing the likelihood of bumping into objects on the right.

The current study investigated whether individuals manifest a lateral bias in the perceived closeness of objects. If lateralized bumping is due to a perceptual asymmetry in the judgment of distance, individuals should perceive objects with the relevant feature (i.e., the nearest part, or "front," of the object) on the left side of hemispace as closer than the same objects with the relevant feature on the right side. A free viewing task employing simple geometric shapes was used to determine whether the perceptual asymmetry that exists foxr judgments of brightness, size, and numerosity generalizes to distance judgments.

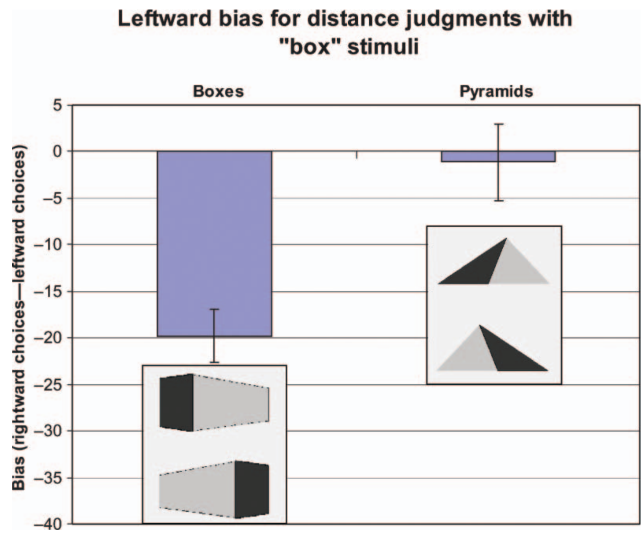

FIGURE 1. Participants exhibited a significant leftward bias for judgments of proximity with box stimuli, but no such bias was found for the pyramid stimuli. Values are means +/− SEM.

METHOD

The data were collected from 21 participants, but the data from one individual were removed because of a failure to understand the instructions for the experiment. The data from the remaining 20 individuals (9 men and 11 women, mean age = 23.15 years, range = 18 to 30 years) were included. All participants were blind to the hypothesis until after the experiment was completed. Participants completed a demographic and laterality questionnaire and reported to the experimenter having normal or corrected-to-normal vision. The task was administered on a computer (PIII 450) interfaced with a 19-in. SVGA monitor running at 1024 × 768 resolution. Responses were made on a computer keyboard on one of two buttons marked as "top" or "bottom."

Participants were seated and placed their chins on a rest, situated 60 cm from the computer monitor. The stimuli were simple, three-dimensional geometric forms consisting of two shapes ("boxes" and "pyramids") of two sizes, in two orientations (i.e., the top shape was either oriented to the left or to the right), and three displayed angles (see Figure 1). All stimuli had a black surface (the "front" of the object) and a gray surface (the "side" of the object). Stimuli were presented centrally, one above the other (mirror-reversed but equivalent), with the horizontal midline of each stimulus aligned with the middle of the computer screen. For each trial, participants were asked to select the object that was closest to them, by choosing the "top" or "bottom" buttons, and bearing in mind that the black surface was the front of the object. Stimuli were presented under free-viewing conditions, during which time the participant could foveate across the stimuli. Following each response, a new trial would begin, for a total of 96 trials. Each participant received a different randomized order of trial presentation.

RESULTS

Response bias scores were calculated by subtracting "leftward" responses (choosing the object with the "front" of the object on the left side) from rightward responses. The bias scores for the box stimuli were significantly leftward, t (19) = −6.867, p <.001, but pyramids were not, t (19) $= -0.268$, $p = .792$, (see Figure 1). To examine whether the lateral biases for the box stimuli varied with the specific parameters of the stimuli, we used a repeated-measures ANOVA, with the within-subjects factors of orientation (top shape oriented to left or right), size (small or large), and angle (three horizontal angles). None of these factors significantly influenced the bias scores, nor did they interact.

DISCUSSION

The current study investigated whether a sample of neurologically normal individuals would exhibit a perceptual asymmetry in the judgment of distance between two equidistant objects. It was hypothesized that individuals show a leftward bias for the closeness of objects, thus accounting for the finding that there is a rightward bias in bumping behavior (Nicholls et al., 2007; Turnbull & McGeorge, 1998). In support of this hypothesis, participants judged the box stimuli with the front on the left side as closer to them than the boxes with the front on the right side, although they did not show a statistically significant leftward bias with the pyramid stimuli. However, several participants made it known during debriefing that they did not find the pyramid stimuli to be believable in terms of providing the illusion of depth, thus making interpretation of the pyramids less tenable.

In the future, relating individual differences in the degree of perceptual asymmetry in distance judgments to differences in lateralized bumping behavior would be an important test of the hypothesis. Furthermore, if lateralized bumping is indeed a robust phenomenon, an understanding of the mechanisms underlying it may provide fruitful avenues of research for understanding the development and evolution of brain lateralization.

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