University of St Andrews

NHS Fife

NHS Tayside

Disease mechanisms in Spatial Neglect: Displaced locus of attention in response to salient objects

Daniela Balslev[1], Alexandra G. Mitchell[1], Harinath Chandrashekar[2], Matthew Lambert[2], Vera Cvoro[3]

[1]School of Psychology and Neuroscience, University of St Andrews, UK

[2] Acute Stroke Unit, NHS Tayside and University of Dundee, UK

[3]Acute Stroke Unit, NHS Fife and University of Edinburgh, UK

Annual Meeting of the Society for Neuroscience, 2025

Is the locus of attention in patients with left spatial neglect displaced rightward relative to salient objects?

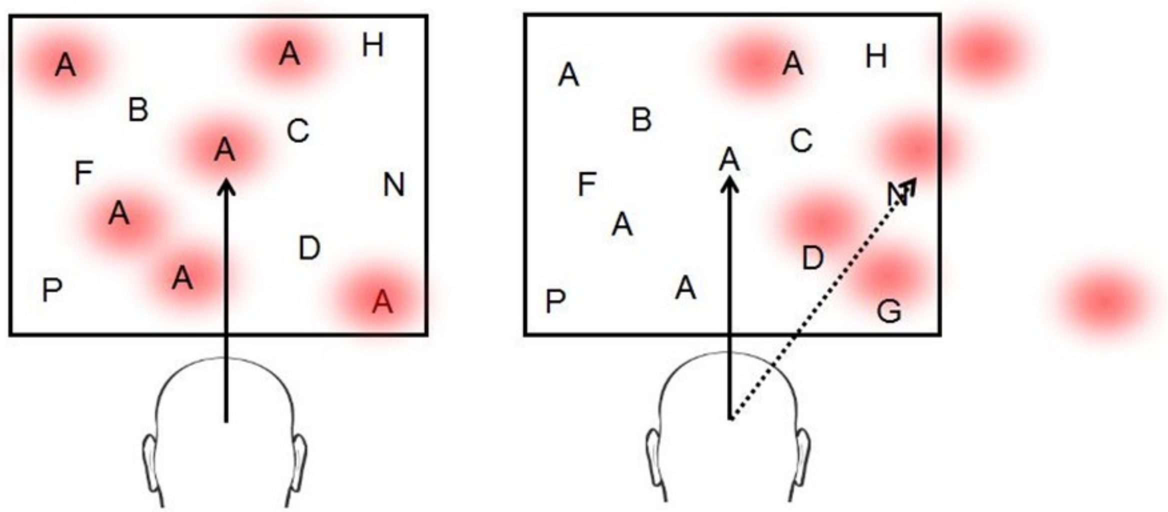

Figure 1. The hypothesis. The attentional priority map (red) codes the location of behaviourally important objects (letter A) relative to the centre of gaze. This retinotopic location is combined with information about the rotation of the eyes in the orbits to compute the location of salient objects relative to the head. If the gaze is perceived as being more rightwards than it actually is (dashed vs. solid line), the spotlights of attention will be displaced rightwards relative to the location of the salient objects. Overall, attention would be biased rightwards, in the direction of perceived gaze. This presents a novel attention-related mechanism that could cause spatial neglect. From Balslev and Odoj, 2019 https://doi.org/10.1016/j.neuropsychologia.2019.05.017

Participants with a right-hemisphere stroke, with and without spatial neglect

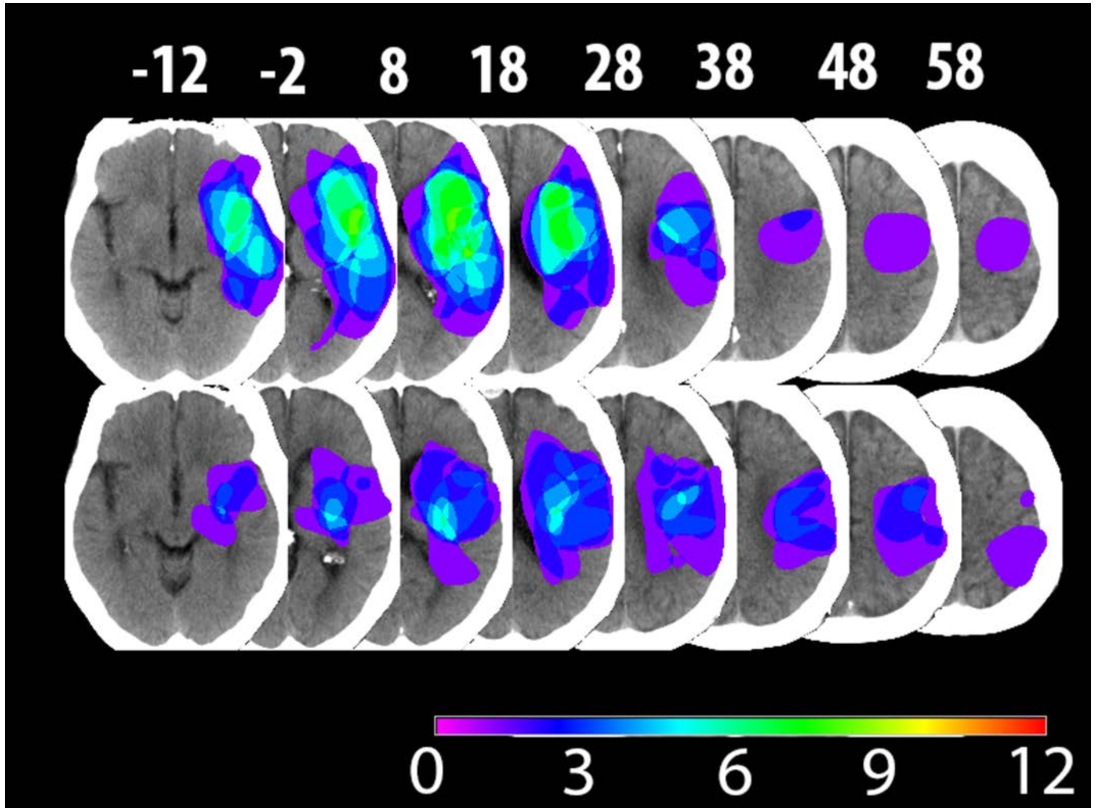

Figure 2. Simple lesion overlap for the two groups: spatial neglect (N=12, upper panel) and stroke control (N=11, lower panel)*. The color bar indicates the number of patients who had a lesion at each voxel. The lesion map is overlaid on the average structural image for each group, after coregistration of each individual CT/MRI with the standard MNI152 space (ICBM). The z coordinate of each transversal slice is shown at the top of the image. The right side of the brain is shown to the right.*

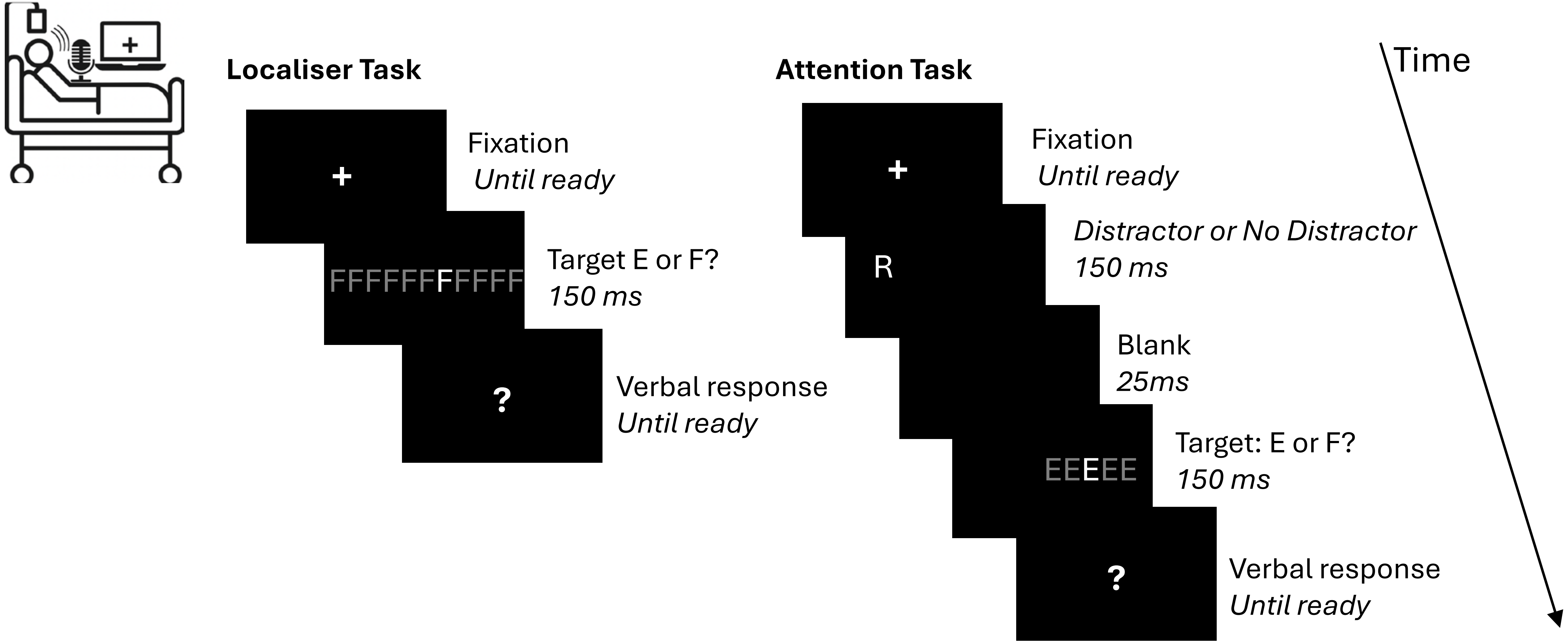

Figure 3. The Localiser Task mapped the neglected visual field. Each trial started with the onset of a white target letter (E/F, 2°x2°) for 150 milliseconds. The target was presented at one out of 20 possible locations along the mid-screen x-axis, from -14° (left) to 14.5° (right), in 1.5° increments. The edge of the neglected field was defined in each participant as the first location on a left-to-right horizontal axis where discrimination accuracy dropped to 50% or below. The distractor for the exogenous attention task was placed at that location. If the edge of the neglected field could not be determined the distractor was placed at -9.5°. ***The Attention Task*** identified the locus of attention in response to a salient, but task irrelevant distractor. The target was presented at one of several possible locations, from 6° to the right of the distractor to 14.5° in 1.5° increments.

Estimating the locus of attention in response to the distractor in each participant

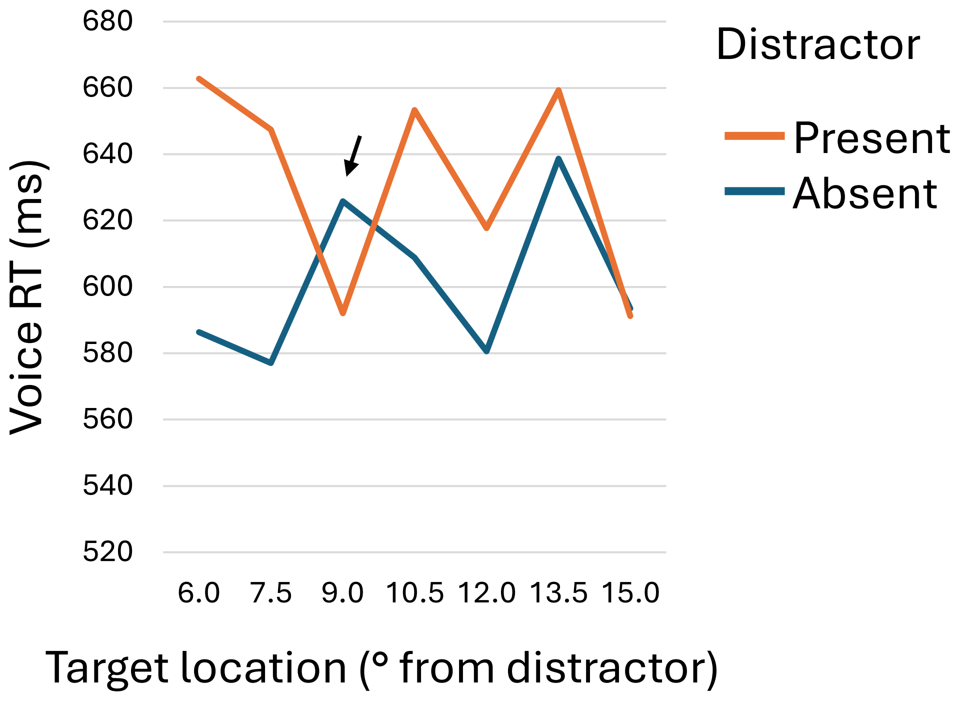

Figure 4. Example data in a participant with spatial neglect. The arrow indicates the locus of attention, calculated as the peak positive distractor effect (RT Distractor Absent minus RT Distractor Present).
We focused on this measure because a previous study reported a reverse (positive) distractor effect in patients with spatial neglect (Vossel, 2016 https://doi.org/10.1016/j.cortex.2016.02.010)
Accuracy at ceiling in all participants, so the estimate is based on RT only.

In spatial neglect, a distractor in the left visual hemifield speeds up target detection in the right visual hemifield

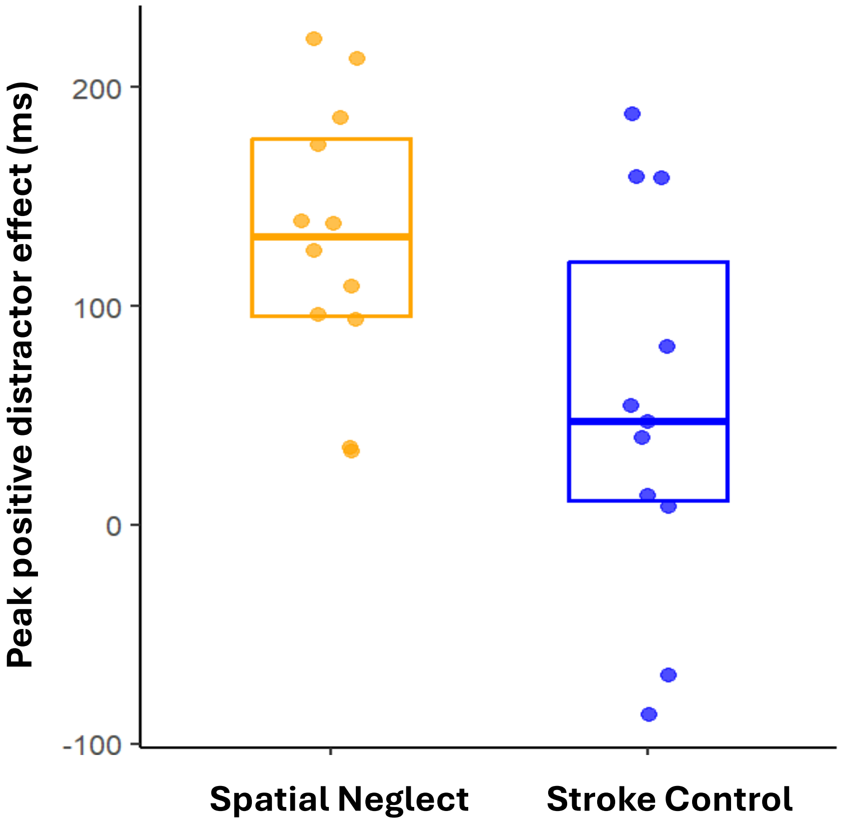

Figure 5. A reverse distractor effect in the spatial neglect group.
The positive distractor effect was calculated as
RT Distractor Absent minus RT Distractor Present. The peak positive distractor effect shown here was the maximum of this value across target locations, calculated in each individual patient.
This measure was significantly larger in the Spatial Neglect vs. Stroke Control group (two-sided independent samples t-test, unequal variances t (17.6) =2.4, p<0.03)

In spatial neglect, the locus of attention in response to the distractor was spatially consistent

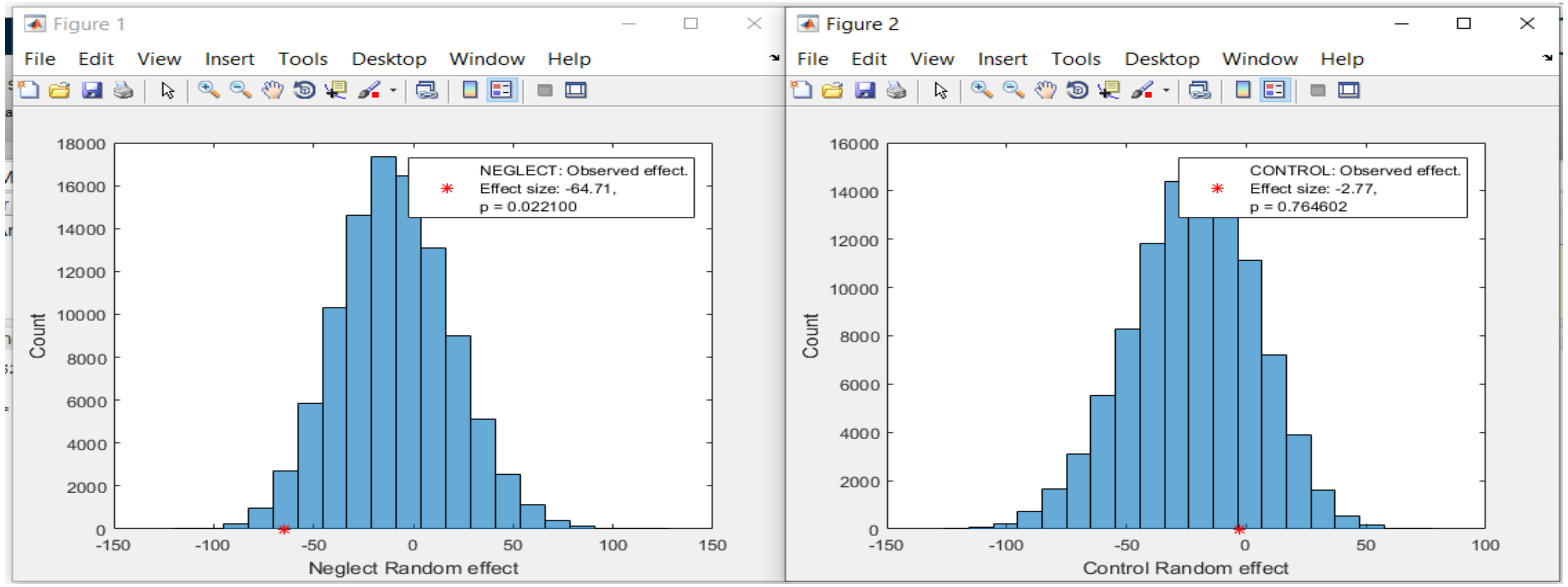

Figure 6. Test-retest reliability of the locus of attention in response to the distractor. To assess the test-retest reliability of peak positive distractor effect location in each participant, we split individual data into two halves: a training set (session one), to identify PPDE location, and an independent, test set (session two) to extract the value of the distractor effect at that location. After averaging this value across the two possible ways to split the dataset (training set: session 1, test set: session 2 and vice-versa) we conducted permutation test to assess the likelihood of finding a larger positive distractor effect in the test set at a random location vs. the PPDE location indicated by the training set). The permutation test showed a reliable PPDE location within participant in the neglect group ($p<0.022$) but not in the stroke control group ($p>0.76$).

In spatial neglect a lesion of the internal capsule and superior longitudinal fasciculus correlate with a displaced locus of attention

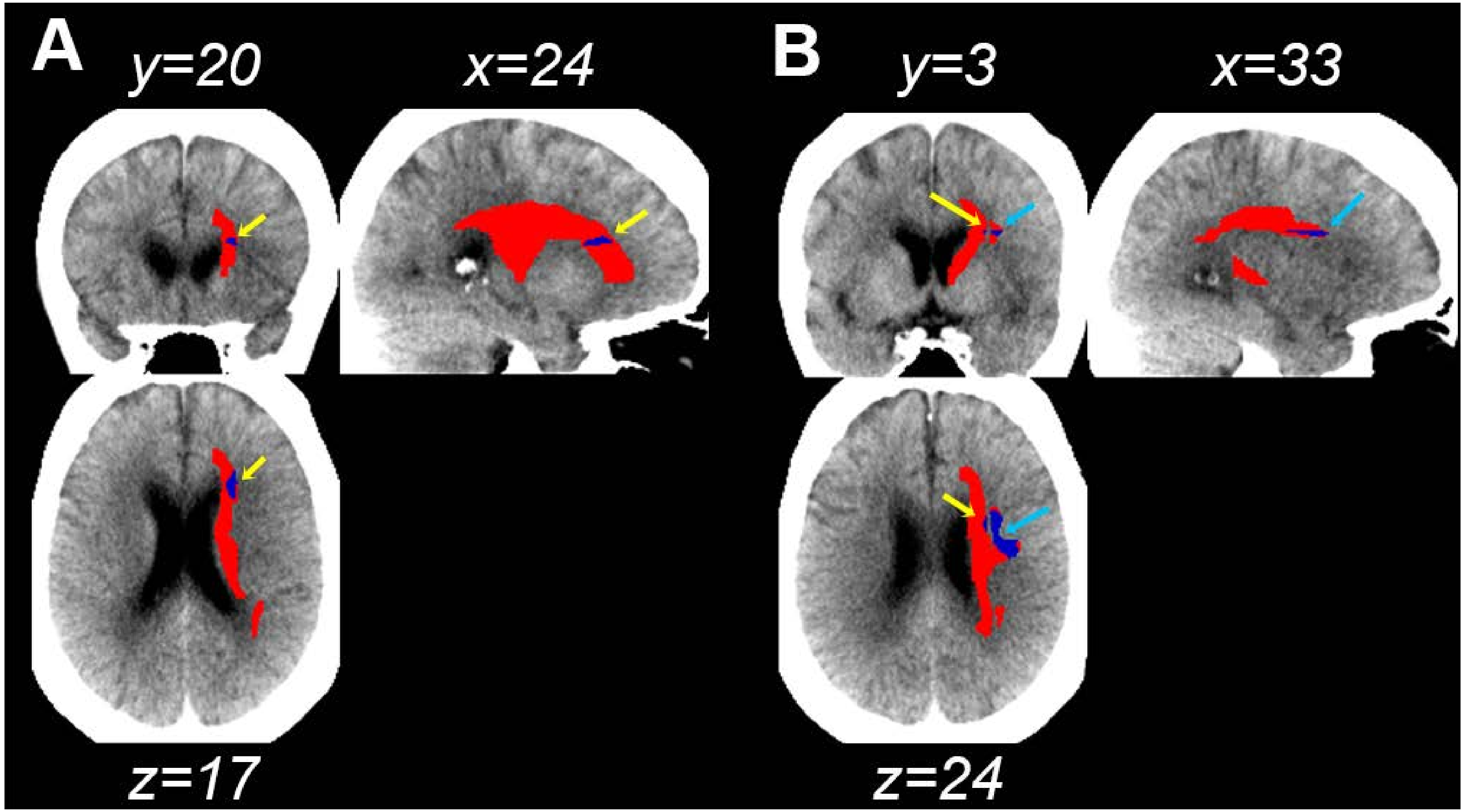

Figure 7. Voxel-wise lesion behaviour mapping (VLBM) analysis in the spatial neglect group. The analysis identified brain areas whose lesion correlated with the magnitude of the peak positive distractor effect (**A**) or the distance between the distractor and the location of the peak positive distractor effect (**B**). Statistically significant voxels (threshold $Z>1.74$, $p<0.05$ corrected for multiple comparisons using false discovery rate) are shown in dark blue, overlaid on the region of interest shown in red. The arrows indicate statistically significant voxels in the corona radiata (yellow) and superior longitudinal fasciculus (light blue). The region of interest comprised the internal capsule, corona radiata and the superior longitudinal fasciculus in the right hemisphere, white matter fibres that bring corollary discharge input from the superior colliculus and the frontal eye field to the posterior parietal cortex. The statistical maps are superposed on the average structural brain image in the spatial neglect group to enable anatomical localisation. Each structural brain image was coregistered to the standard brain template MNI152 (ICBM). Only voxels lesioned in at least 50% of the group (6 patients) were included in the analysis. The same analyses in the stroke control group did not return any statistically significant voxels.

Thank you for reading this poster!

Funding acknowledgment.
This work was supported by an award from the Wellcome Trust Institutional Strategic Support Fund at the University of St Andrews, grant code 204821/Z/16/Z (DB).