Impaired body representations post-stroke: insights from drawing and lesion-symptom mapping

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Background

- Humans possess the extraordinary ability to produce line drawings that capture detailed information about their perceptual experience of the world.
- Drawing provides a powerful tool to investigate how the human brain represents the visual world [1]. It engages several cognitive functions including visual perception, memory, imagery and visuomotor control.
- Most vision research has focused on visual recognition, and little is known about the mechanisms that support drawing ability. Here, we used precision pen-tracking [1] of drawings to investigate:

  - ➢whether visual representations are affected in stroke;
  - ➢whether visual body representations (self- and/or other) are specifically distorted when compared to other symmetrical non-human categories (daisy and butterfly);
  - ➢how these deficits relate to visual, cognitive and/or motor function.

Recruitment (4 NHS hospitals)

- Inclusion: ≥ 18 years of age; no previous neurological conditions (e.g., dementia); stroke confirmed using clinical imaging; able to execute a 2-step command; live within 70 miles of UEA.
- Patients were tested in their own homes with battery of tests (ClinicalTrials.gov identifier: NCT04752982).

Neglect = impaired in star, hearts or bisection	Neglect (n=38)	No Neglect (n=45)	Age-Matched controls (n=37)
Age: mean (SD, min, max)	68.5 (12.6, 26, 88)	70.1 (12.6, 32, 90)	72.8 (5.36, 65, 84)
Days post-stroke: mean (SD, min, max)	104 (56.2, 32, 252)	107 (116, 16, 783)	
Sex: N (%)			
Female	13 (34.2%)	22 (48.9%)	23 (62.2%)
Male	25 (65.8%)	23 (51.1%)	14 (37.8%)
Handedness: N (%)			
Right	30 (78.9%)	38 (84.4%)	34 (91.9%)
Left	8 (21.0%)	7 (15.6%)	3 (8.1%)
Lesion side N (%)			
Right	25 (65.8%)	27 (60.0%)	
Left	10 (26.3%)	16 (35.6%)	
Bilateral	3 (7.9%)	1 (2%)	

Participants (N = 83 stroke patients + 37 age-matched controls)

Tasks

1. Drawing Task

Drawings of 4 symmetrical categories, 2 human bodies (self and other) and 2 non-human bodies (daisy and butterfly)

2. Hand laterality task [2]

Pictures of left and right hands shown in 2 orientations (palm-up and palm-down). Participants say whether it is a left or right hand. Accuracy and reaction time (in ms) are recorded.

	Butterfly	Daisy	Body- Self	Body -Other
Neglect				
No Neglect				
Age-Matched Control				

Scan the QR code for drawing videos

Thank you to recruiting sites

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NHS Cambridge University Hospitals NHS Foundation Trust

NHS Norfolk Community Health and Care NHS Trust

east coast community healthcare

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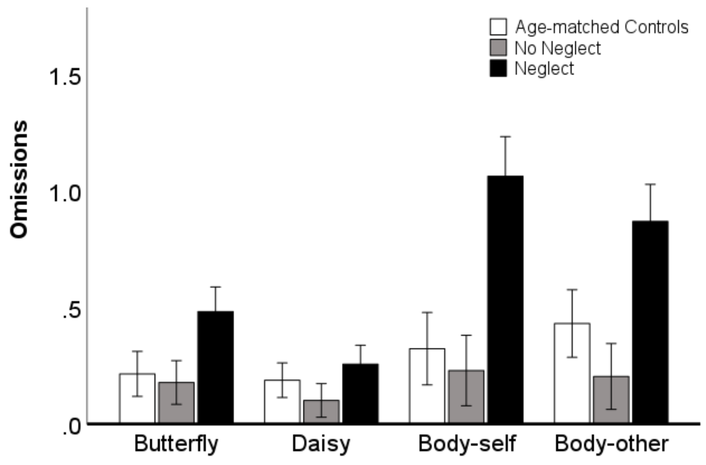
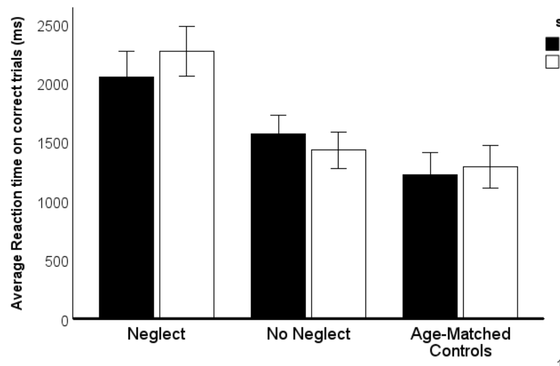
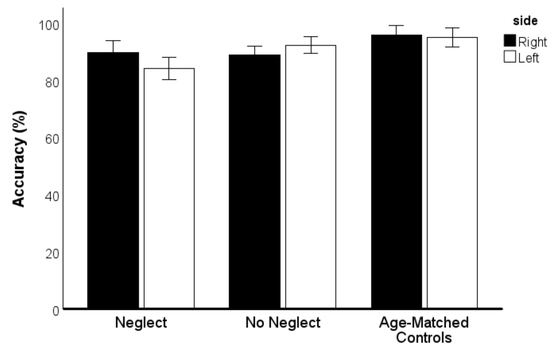
Neglect-specific deficits on body drawing, especially on self-drawing





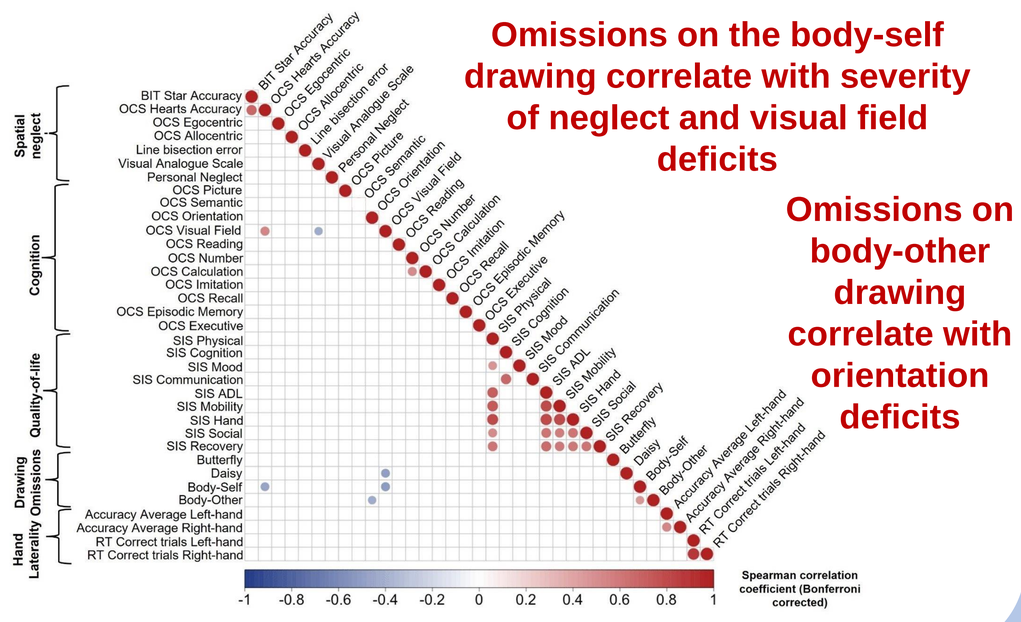
Neglect patients were slower on the hand laterality task compared to those without neglect and controls

Neglect patients were particularly impaired when judging left hand stimuli



Omissions on the body-self drawing correlate with severity of neglect and visual field deficits

Omissions on body-other drawing correlate with orientation deficits



Conclusions and Ongoing work

- Findings are in line with a previous study showing that body representation deficits are prevalent post-stroke and correlate with visuospatial function [3].
- Despite the Behavioural Inattention Test [4] requiring a butterfly, daisy and a person to be drawn, the most neglect sensitive drawing is body-self, suggesting drawing a self-portrait is sufficient to detect neglect.
- Body ownership and body representations of one's own body are thought to relate to interoceptive and exteroceptive multisensory processing [5-7]. This could explain why body-self drawings are more sensitive to neglect compared to body-other drawings as body ownership is not involved for representing others. The importance of visual attention system in accurate body schemas is shown.
- Neither the drawing task nor the hand laterality task correlated with a measure of personal neglect, however the personal neglect test used has limitations. Future research should use a combination of neglect tests [8] or use hand laterality accuracy on left hand stimuli as the measure of personal neglect.
- Hand laterality findings of left-hand stimuli judgements being particularly impaired in neglect patients supports previous findings [2] while extending to a larger sample size.
- Ongoing work is investigating the neural mechanisms of body representation deficits using lesion-symptom mapping.
- Our study provides a new rapid drawing task with easy quantifiable scoring that correlates with neglect severity.

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