

Disturbances of Body-Space Perception through Touch, in Posterior Cortical Atrophy and Alzheimer's Disease.

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INTRODUCTION

- Spatial orientation deficits are a key disabling feature of AD and are especially prominent in PCA¹, the most common atypical AD phenotype.
- Evidence suggests that these deficits in PCA are multisensory², with impairments extending beyond vision to body-space awareness (e.g., altered verticality perception in visual and haptic domains³).
- This study characterised spatial disorientation in PCA and typical AD by examining tactile localisation. We hypothesised that deficits would be greatest when tactile localisation required higher-order spatial transformations.

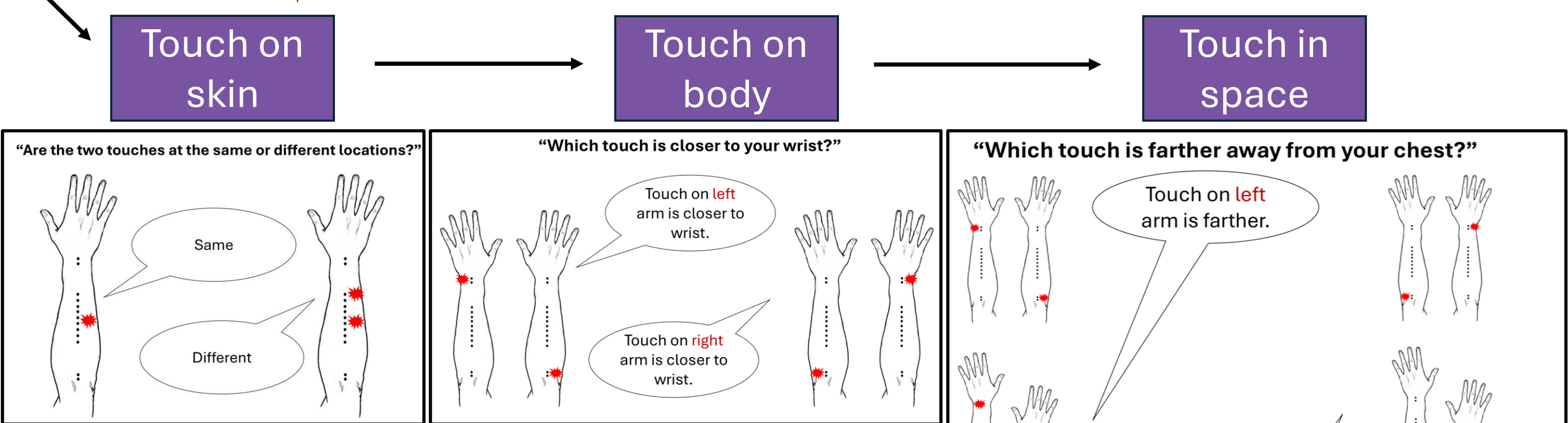
METHODS

Primary function → **Higher level function**

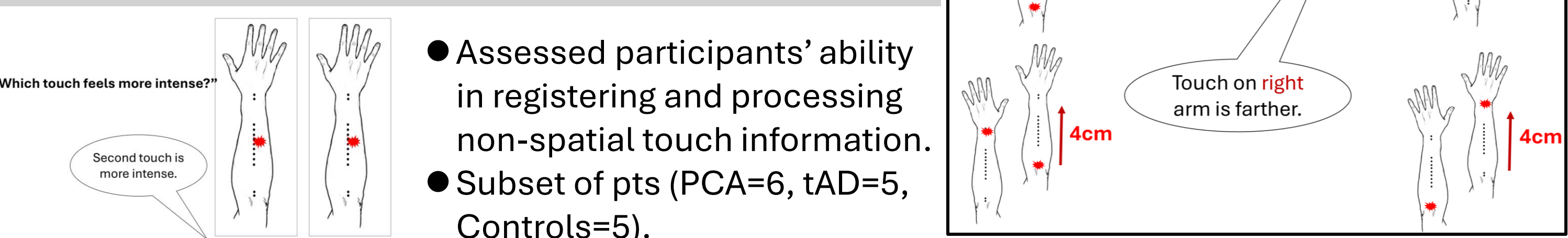
- Sensitivity to touch (Primary Sensory Assessment):
“Tell me as soon as you feel the touch.”



Touch stimuli



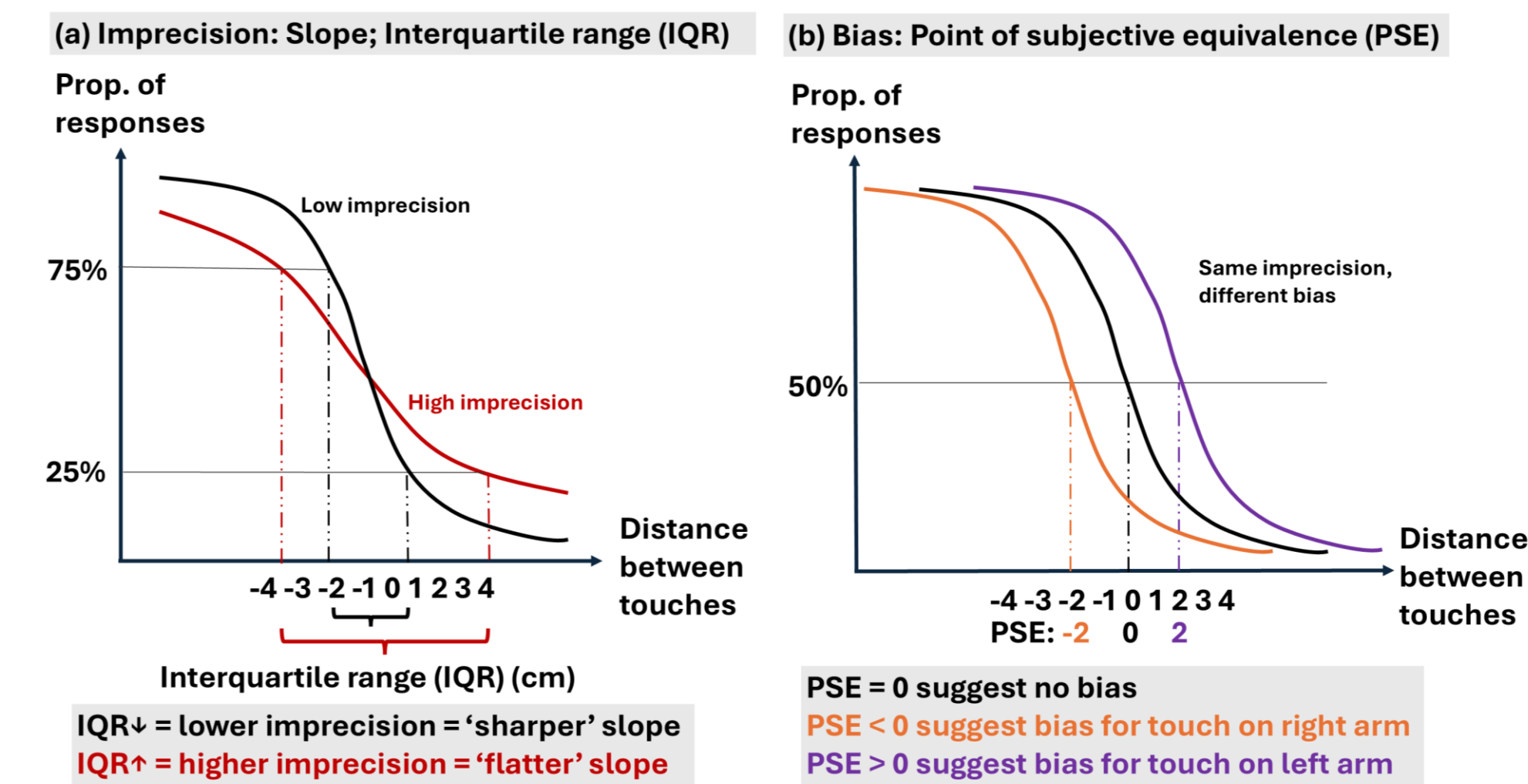
Control experiment: Touch Intensity Perception



Outcome Measures: Task Imprecision and Bias

- Participants' responses modelled using mixed-effects probit regression.
- **Task imprecision:** slope of response curves expressed as interquartile ranges (IQRs).
- **Task bias:** shift of response curves along x-axis (PSE).

Figure A. Conceptual demonstration of task imprecision (a) and bias (b).



Participant Demographics

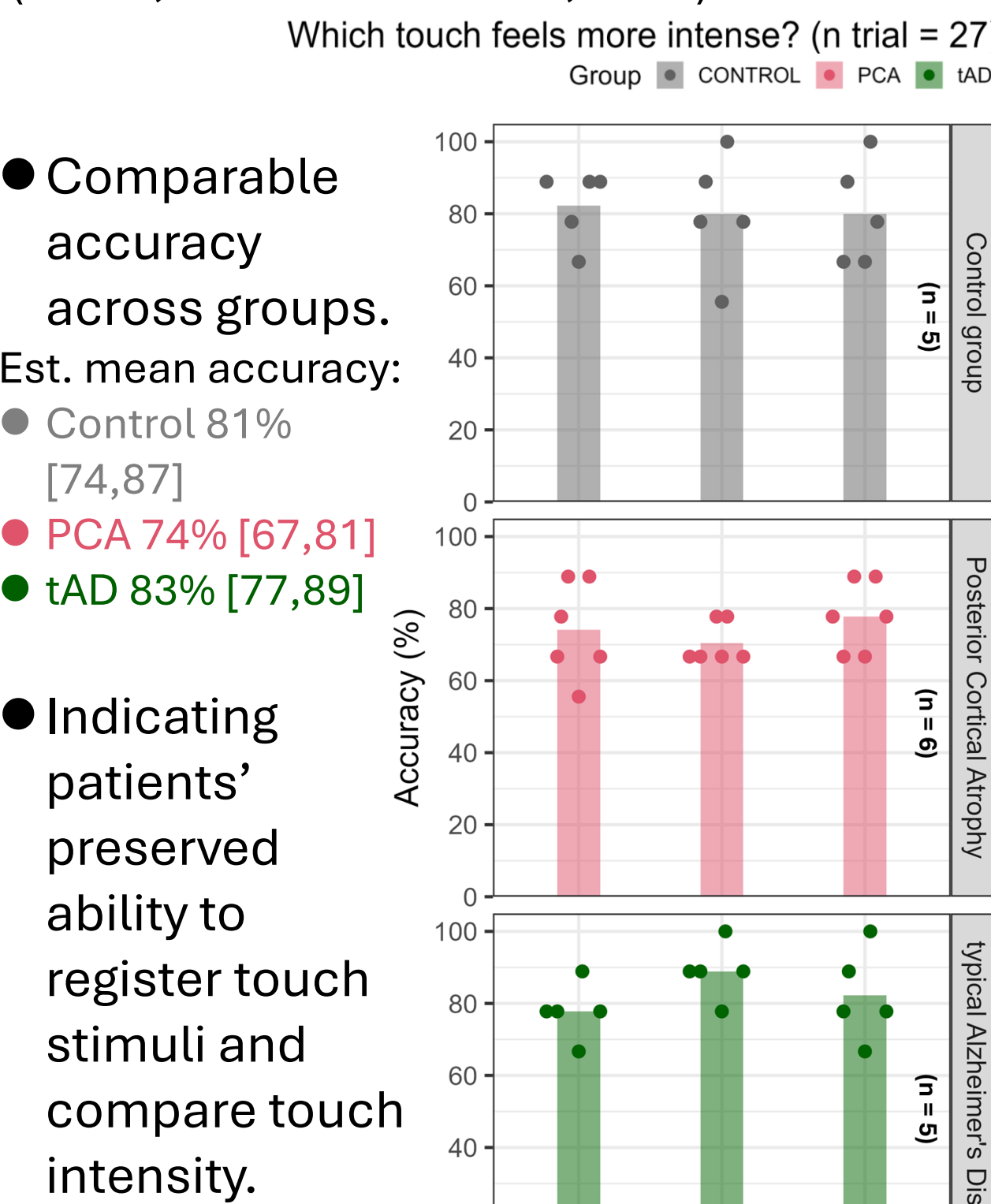
	PCA (n=23)	tAD (n=22)	Control (n=22)
Age	68.2 ± 7.3	69.5 ± 6.5	68.1 ± 6.8
Gender (F:M)	8:15	5:17	14:8
MMSE	21.9 ± 3.8	22.5 ± 4.2	-
+ve AD pathology where available	16/16	12/12	-
Arm Length (cm)	25.1 ± 1.7	25.3 ± 1.6	24.6 ± 2.2
Handedness (R:L)	22:1	20:2	19:3

Primary Sensory Assessments

- Von Frey filament used for assessing participant's sensitivity in detecting light pressure.
- A modestly significant difference was found (global $p=.044$, $\eta^2=.038$), with the PCA group showing on average 1.6g decrease in sensitivity detecting light pressure ($t(64)=2.5$, $p=.040$).

Touch Intensity Perception

Figure 1. Mean (shaded bar) and individual participant (point) accuracy in touch intensity judgement task, across three arm sites (elbow, middle of forearm, wrist).



Which touch feels more intense? (n trial = 27)

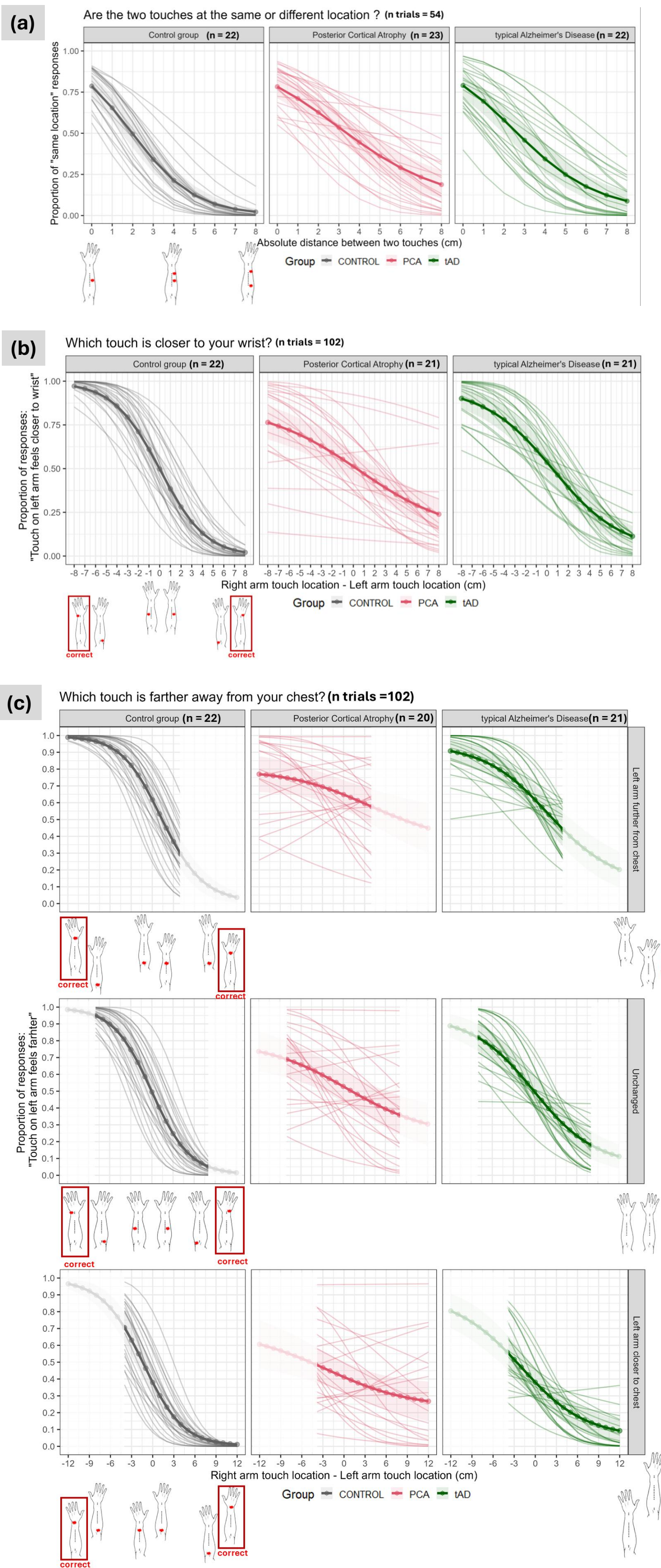
Group: CONTROL, PCA, tAD

● Comparable accuracy across groups. Est. mean accuracy: Control 81% [74,87], PCA 74% [67,81], tAD 83% [77,89]

● Indicating patients' preserved ability to register touch stimuli and compare touch intensity.

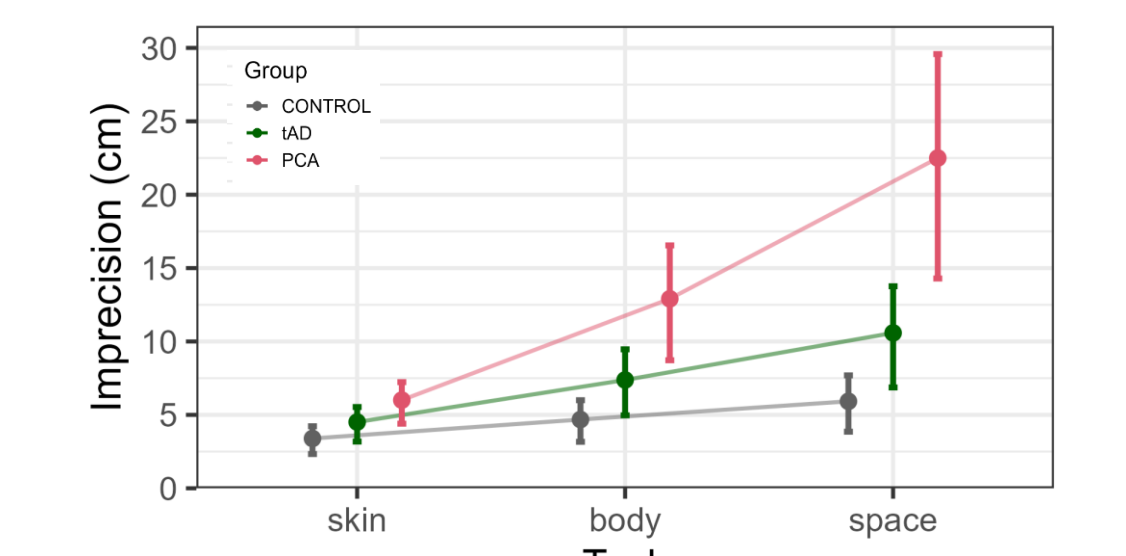
RESULTS

Figure 2. Group-level (bold) and participant-level (light) response curves for: (a) Touch on Skin (Tactile Acuity). (b) Touch on Body (Touch-body mapping). (c) Touch in Space (Tactile-proprioceptive integration).



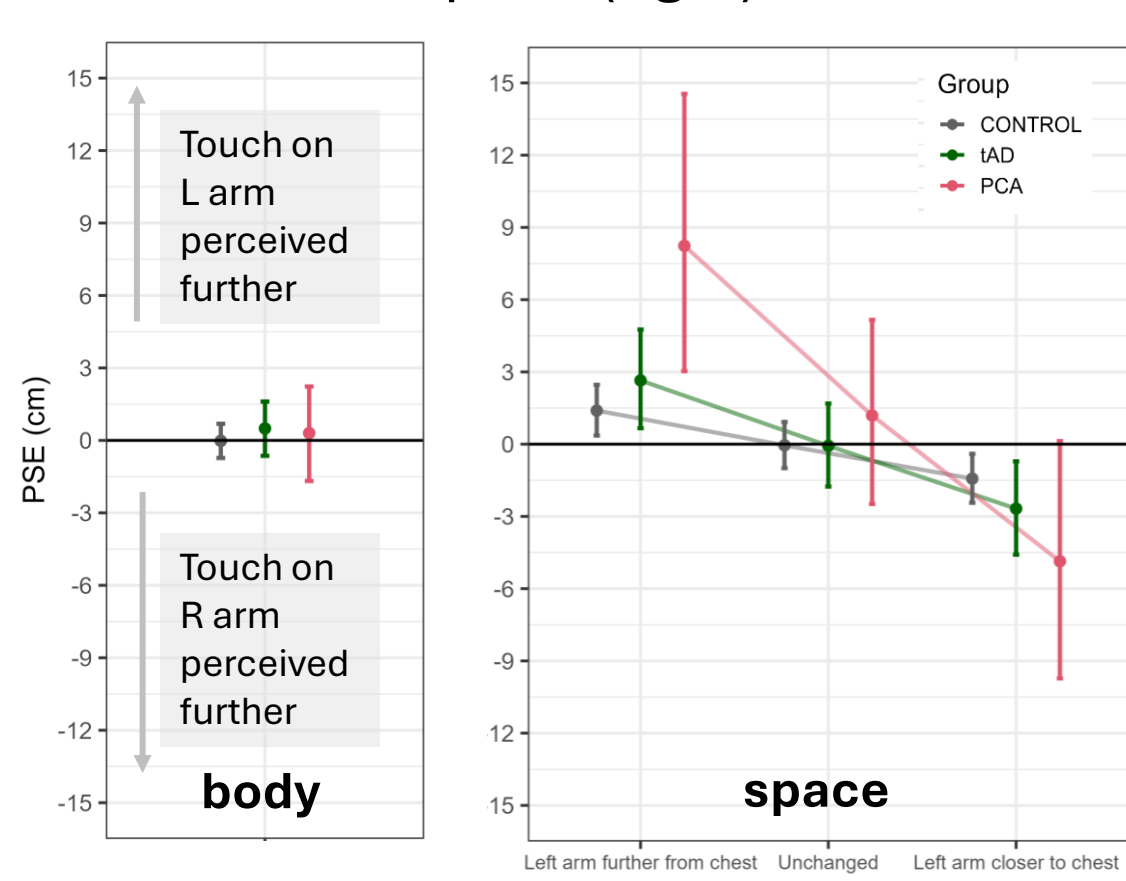
Performance across tasks

Figure 3. Imprecision across three tasks.



- Overall, imprecision patient > controls (PCA>tAD).
- Imprecision increased most dramatically across tasks for PCA group, as task demands shifted toward higher-order perceptual processing.

Figure 4. Bias for 'touch-on-body' (left) and 'touch-in-space' (right) tasks.



- Evidence of localization bias was specifically found in 'space' task, and absent in 'body' task.
- In the 'space' task, patients demonstrated exaggerated bias effects following arm position changes compared with controls (PCA>tAD).

REFERENCES

1Crutch et al., (2017). Consensus classification of posterior cortical atrophy. *Alzheimer's & Dementia : The Journal of the Alzheimer's Association*, 13(8), 870–884. <https://doi.org/10.1016/j.jalz.2017.01.014>

2Yong et al., (2023). Diagnosis and Management of Posterior Cortical Atrophy. *Current Treatment Options in Neurology*, 25(2), 23–43.

3Day et al. (2022). Altered visual and haptic verticality perception in posterior cortical atrophy and Alzheimer's disease. *The Journal of Physiology*, 600(2), 373–391.

CONCLUSIONS:

- We found multiple spatial perceptual deficits for touch in AD, particularly PCA. These deficits were space-specific, higher order perceptual impairments, as patients showed comparable accuracy to controls when judging touch intensity.
- Patient groups showed greater bias (PCA>tAD) when tasks required tactile-proprioceptive integration. Since no evidence of bias was found in a task where participants made spatial judgements within a local body part, biases were likely caused by disturbances in proprioception.