

Novel Digital Reversal Learning and Perceptual Discrimination Task Differentiates Alzheimer's Disease and Frontotemporal Dementia

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Background

Alzheimer's Disease Dementia (ADD) and Frontotemporal Dementia (FTD) show clinical heterogeneity, atypical presentations, and overlapping symptoms, which often lead to misdiagnosis or delayed diagnosis.

We developed a task targeting **perceptual discrimination and reversal learning** – two abilities thought to be differentially affected across the two subtypes – to test whether it can distinguish between them.

Participants

- Patients with clinically confirmed diagnoses of Mild Cognitive Impairment (MCI), FTD, and ADD
- A reference population of cognitively unimpaired older adults (CU)

	MCI (n = 20)	ADD (n = 20)	FTD (n = 12)	CU (n = 20)	p-value
Age (years)	73 (±8.0)	79 (±6.6)	66 (±6.7)	66 (±2.8)	< 0.001 [†]
Sex (%female)	55 %	55 %	16.7%	65 %	0.058 [†]
Education (years)	13 (±3.0)	11 (±1.7)	14 (±2.3)	N.A.	0.007

Table 1: Participant Demographics. Group comparisons conducted via independent measures ANOVA or Kruskal-Wallis test as non-parametric alternative (as indicated by [†]).

The Reversal Learning and Perceptual Discrimination Task

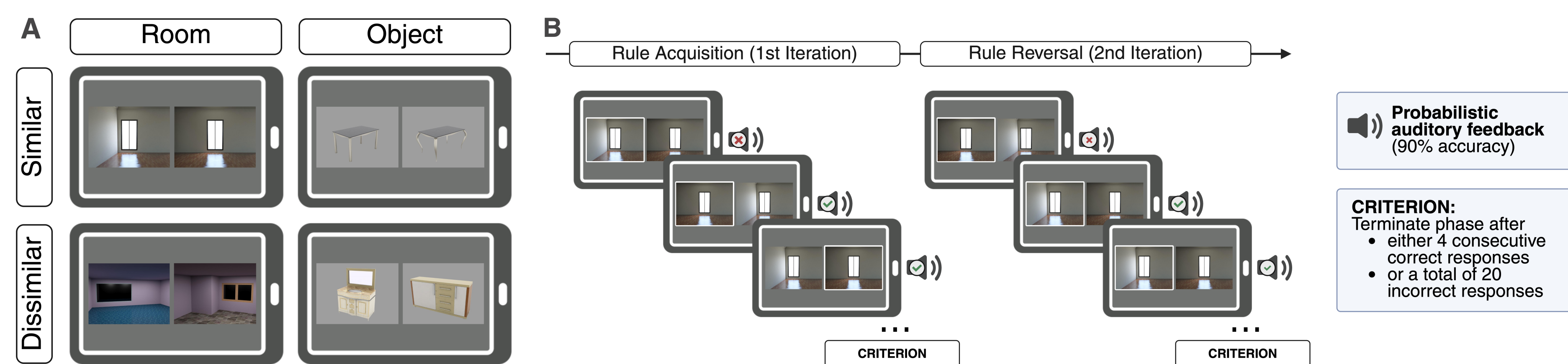


Figure 1: Task Design. A: Stimulus pairs differ in terms of (i) similarity and (ii) domain B: Each trial consists of 2 iterations: (i) an initial rule acquisition and (ii) a subsequent rule reversal phase. A total of 16 stimulus pairs were used, equally distributed across the 4 task conditions.

Differential Impairment Across Task Conditions

Performance ~
(similarity + domain + iteration) x
group + age + sex + (1|participant)

- * main effect of iteration
- * interaction effects of similarity level and each clinical group
- * interaction effect of domain and ADD
- * interaction effect of iteration and FTD

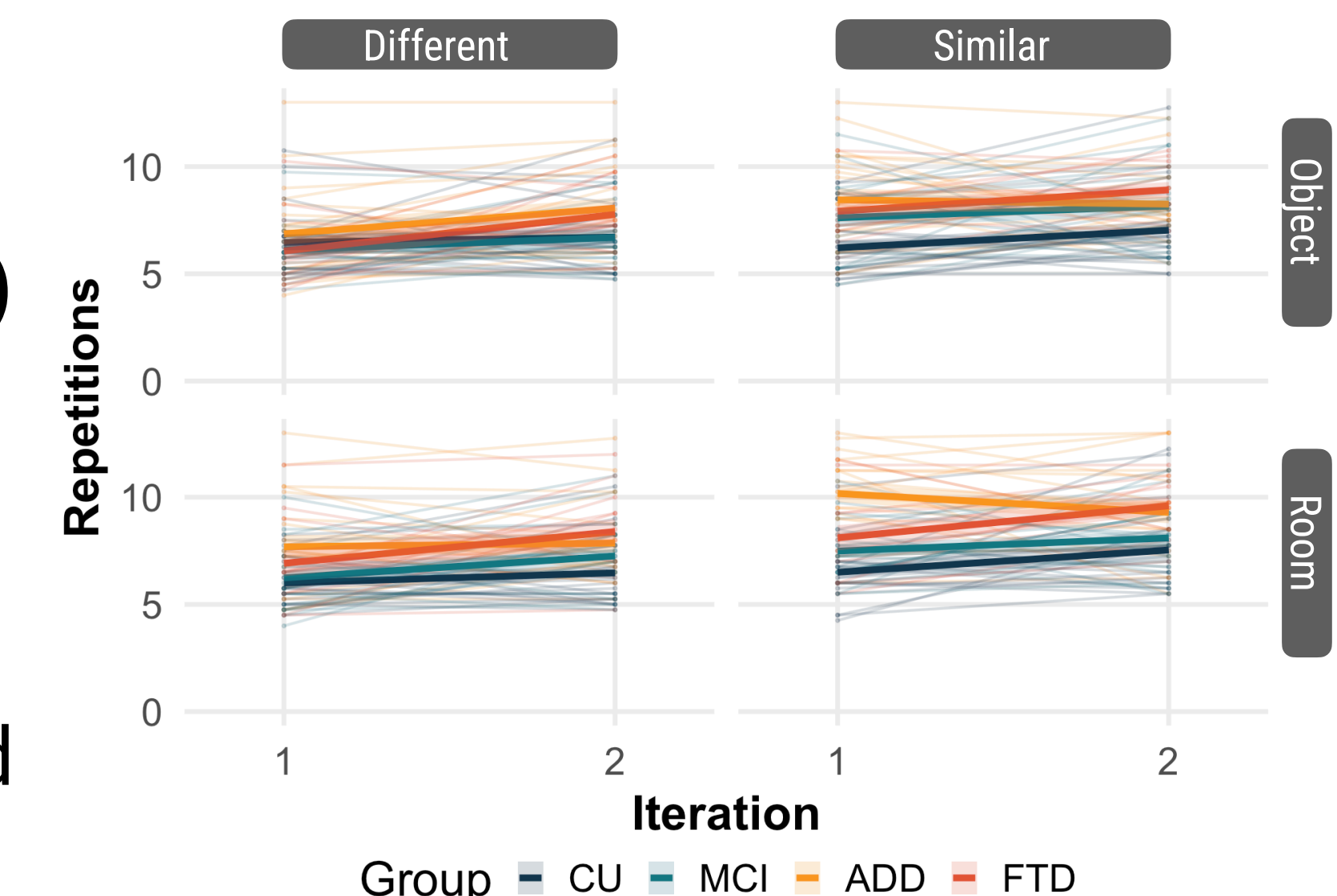


Figure 2: Performance by Task Condition and Group. Thick lines indicate group means ± SE (shaded area); thin lines represent individual participants.

Successful Discrimination of ADD and FTD

Two-Step Logistic Modelling:

- 1 Clinical Status ~ Similarity difference score + age + sex
- 2 FTD vs. ADD/MCI ~ Domain difference score + iteration difference score + age + sex

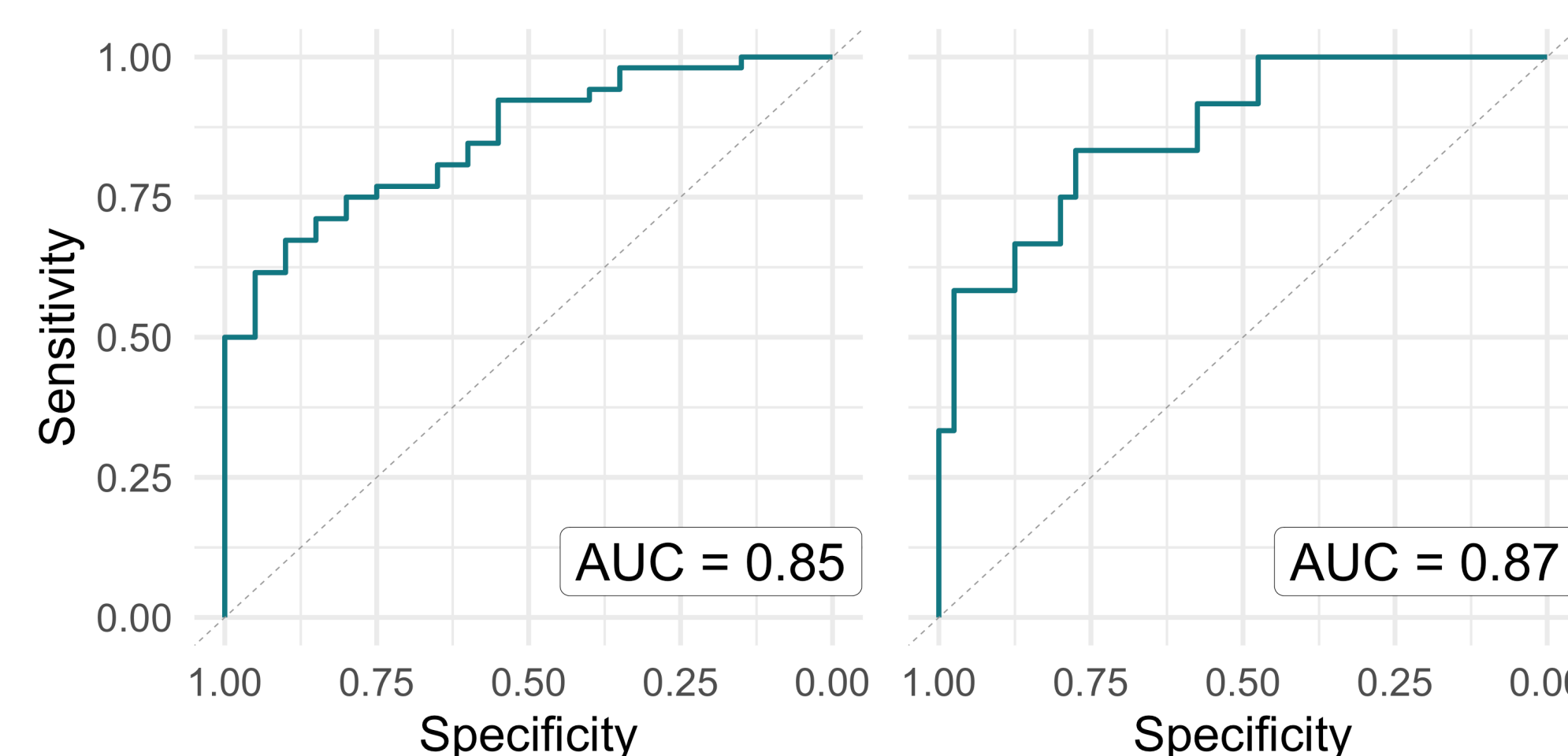


Figure 3: Receiver Operating Characteristics (ROC). Logistic Model No. 1 and 2 on the left and right, respectively.

Conclusion & Future Directions

This novel paradigm demonstrated strong discriminative utility for FTD and ADD:

- Patients with MCI, ADD, and FTD showed worse perceptual discrimination between similar stimuli compared to CU.
- Patients with ADD demonstrated selective deficits in the room domain, while patients with FTD demonstrated deficits in rule reversal.

Further validation in a larger, independent sample is needed to assess the generalisability of these findings, particularly in patients at early disease stages where misdiagnosis is most prevalent.