MAX PLANCK UCL CENTRE for Computational Psychiatry and Ageing Research

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Metamemory in Younger and Older Adults: Neurocognitive Processes Underlying Age Differences in Confidence Computation

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Introduction

Evidence regarding metamemory differences between younger adults (YA) and older adults (OA) is conflicting. Some argue that apparent differences are due to age differences in memory,[1,2] and reflect issues in currently used means of measurement. However, OA and YA may yet differ in the ***way*** in which they make metacognitive judgements, with differential sources of information influencing confidence computation, or differing neural processes underlying the metamemory judgements.[3,4]
Thus, we investigated age differences in OA and YAs' metacognitive processes underlying the construction of trial-by-trial confidence judgements, and associated neural differences.

Research Questions

- ❖ Do older adults experience a confidence leak (past trial confidence influencing current trial confidence)?
- ❖ Are there age differences in the neural activation related to making a high or low confidence judgement?

Methods

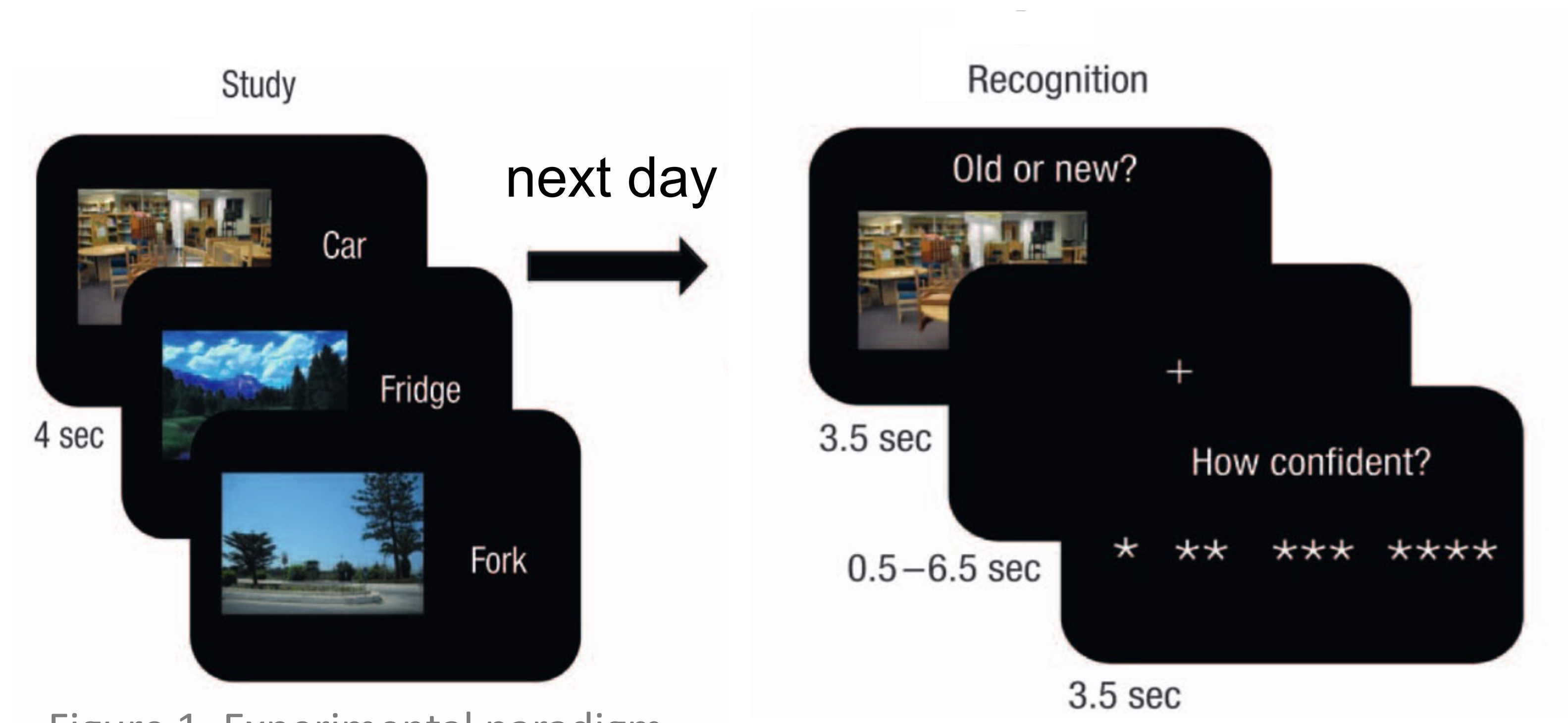

Figure 1. Experimental paradigm.

29 younger adults (YA) (M_{age}= 24.7)

36 older adults (OA) (M_{age}= 70.9)

associative recognition memory task in the MRI scanner[5]

Measures:

- ❖ M-ratio (meta-d'/d') to quantify metacognitive efficiency by normalizing for memory performance
- ❖ Mixed effects models to assess current and past trial influences
- ❖ fMRI analyses to investigate confidence-related neural activity

Results

A. Metacognitive Efficiency

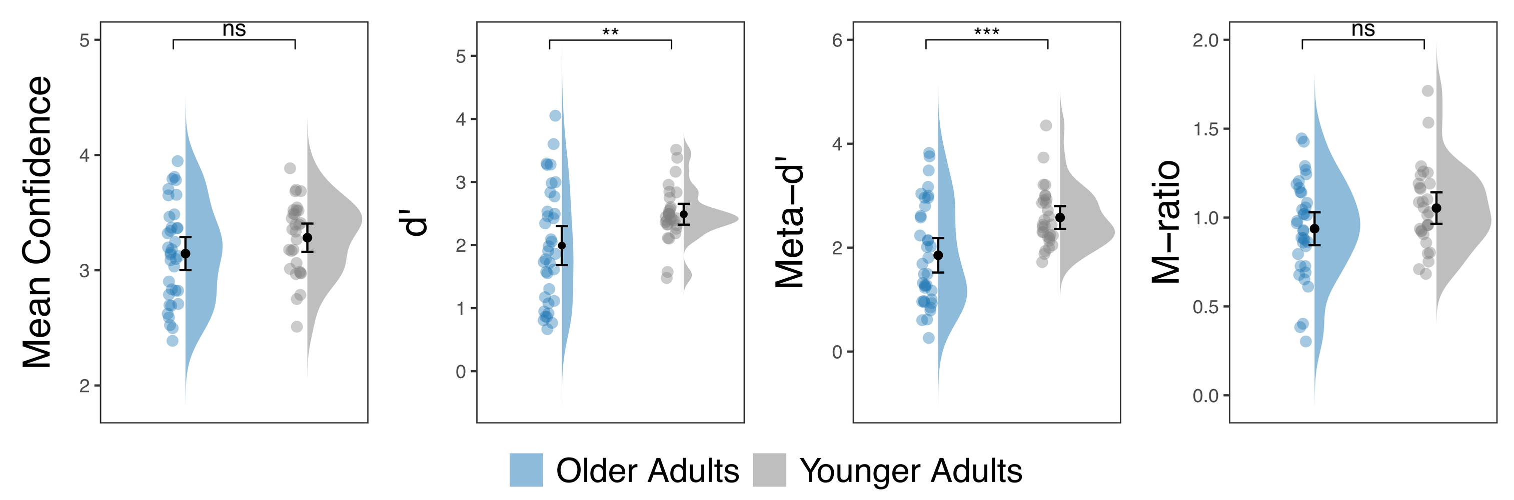

Figure 2. Differences in metametrics for YA and OA. Lower d' and meta-d' in OA than YA. No difference in mean confidence or m-ratio.

→ no difference in metacognitive efficiency between YA and OA

B. Trial-by-Trial Influences on Confidence

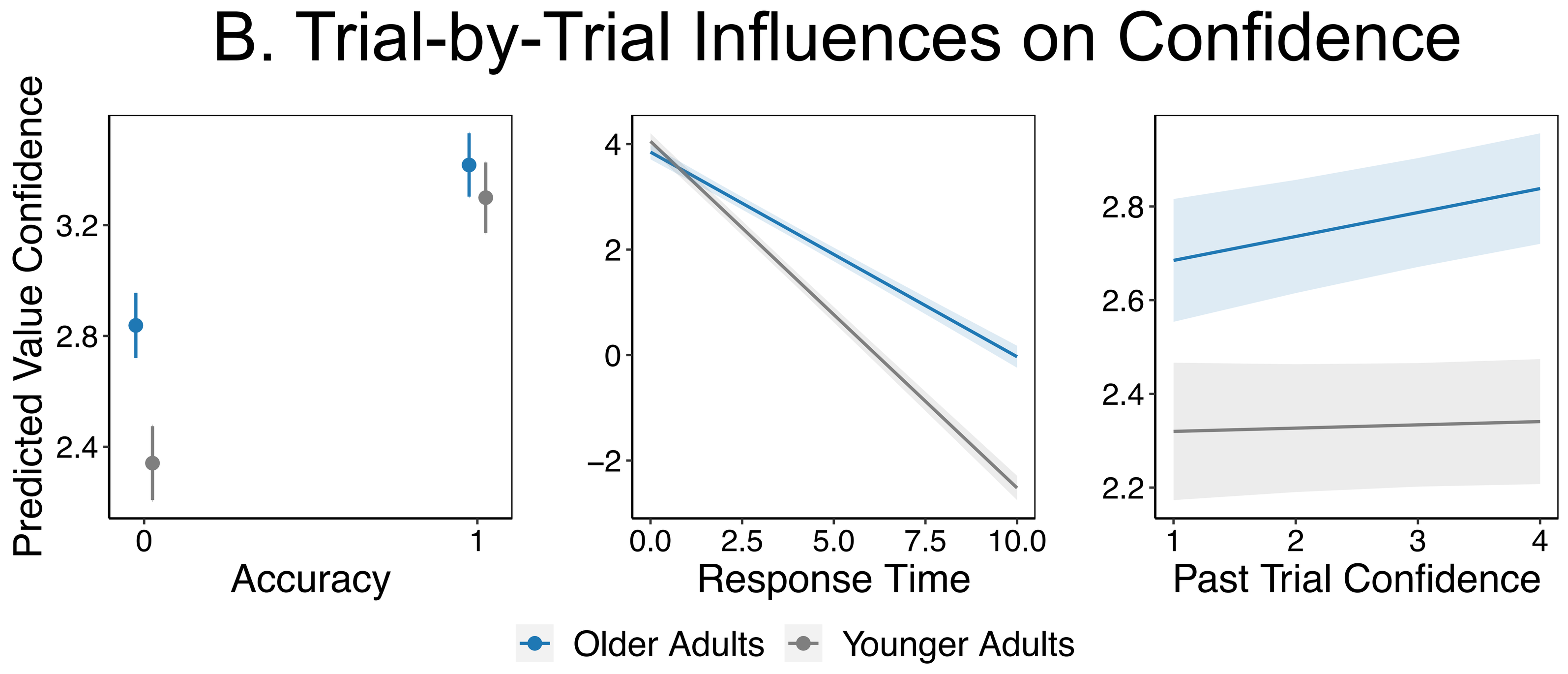

Figure 3. Mixed effects model results predicting confidence by current accuracy, response time and past trial confidence (confidence leak) for YA and OA.

→ OA exhibit a confidence leak (greater influence of past-trial confidence)

C. Low Confidence Neural Activation

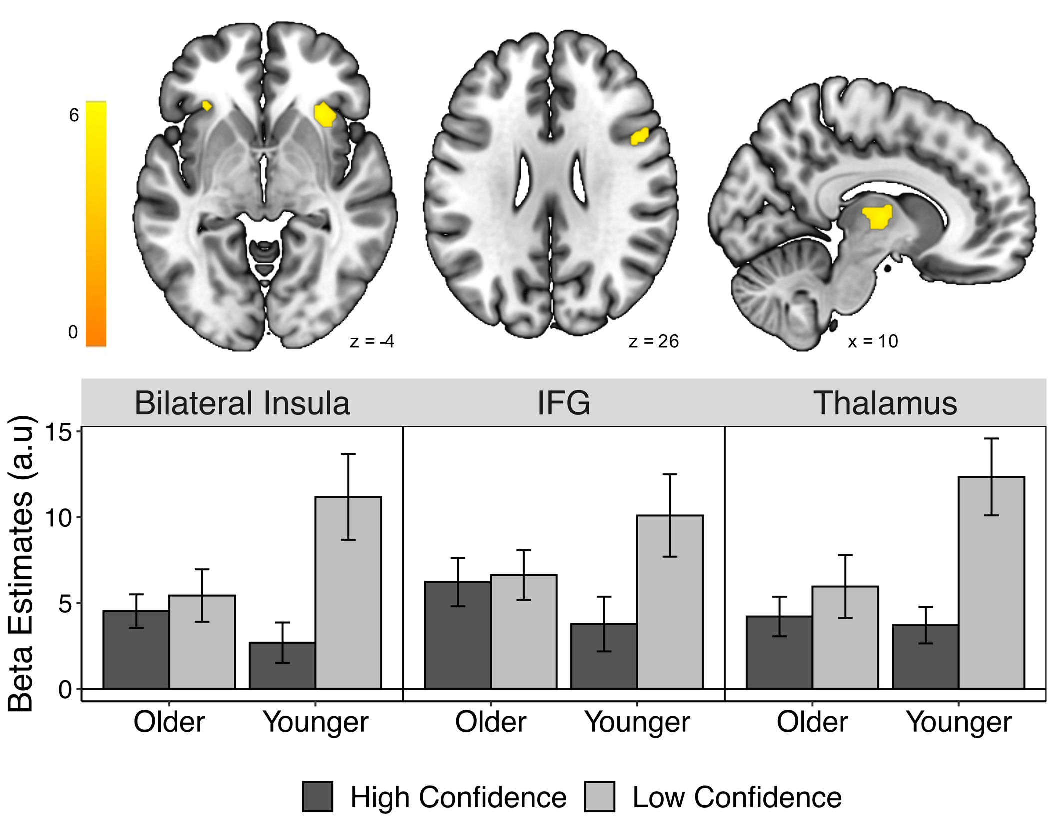

Figure 4. fMRI analyses results showing differences in activation for YA > OA, low > high confidence (p<.05, FWE-corrected) in the bilateral insula, IFG and thalamus.

→ YA upregulated activity during low confidence vs high confidence

→ OA did not display differential activation

→ individual differences in low-confidence neural upregulation were related to confidence leak estimates

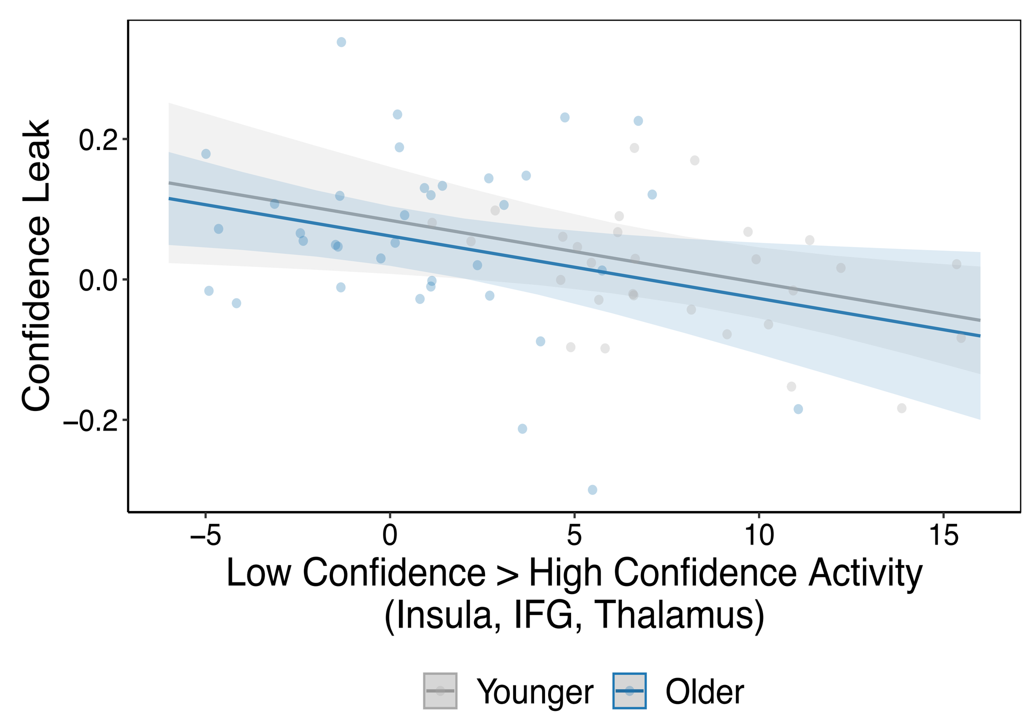

Figure 5. Beta estimates for low > high confidence contrast (avg. across the bilateral insula, IFG and thalamus) regressed against confidence leak estimates.

Discussion

- ❖ Older adults experience a confidence leak whereby past trial confidence positively influences current trial confidence.
- ❖ Less dynamic modulation of neural activity in older adults is related to metamemory, especially when reporting on the level of subjective confidence, indicative of decreased engagement of monitoring processes.
- ❖ The failure to upregulate activation associated with low confidence may lead to a greater susceptibility to potentially misleading cues such as past confidence.

References: [1] Hertzog, C., Curley, T., & Dunlosky, J. (2021). Are Age Differences in Recognition-based Retrieval Monitoring an Epiphenomenon of Age Differences in Memory? *Psychology and Aging.*
[2] McWilliams, A., Bibby, H., Steinbeis, N., David, A. S., & Fleming, S. (2022). Age-related decreases in global metacognition are independent of local metacognition and task performance. *Cognition.*
[3] Rahnev, D., Koizumi, A., McCurdy, L. Y., D'Esposito, M., & Lau, H. (2015). Confidence leak in perceptual decision-making. *Psychological Science.*
[4] Zheng, Y., et al.,(2022). Atypical meta-memory evaluation strategy in schizophrenia patients. *Schizophrenia Research: Cognition.*
[5] Fandakova, Y., Sander, M. C., Grandy, T. H., Cabeza, R., Werkle-Bergner, M., & Shing, Y. L. (2018). Age differences in false memory: The importance of retrieval monitoring processes and their modulation by memory quality. *Psychology and Aging.*