Age-related MTL task interference in implicit perceptual sequence learning

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Introduction

Implicit learning has been thought to be well preserved in healthy aging, yet recent research has begun to suggest otherwise. Preliminary studies from our lab have suggested that older and younger adults rely on different brain regions for learning of implicit probabilistic associations in a non-motor task, and other research has recently shown age-related deficits in implicit probabilistic associative learning in a motor-based sequence learning task. In both implicit associative learning tasks, young adults show activation in the MTL (medial temporal lobe) as well as the striatum, with the latter typically coming to dominate with practice. These studies find that older adults differ from young, and show continued reliance on the MTL throughout training, possibly due to age-related striatal impairment. If there is such a difference in the systems upon which the two age groups are relying for this associative learning, then taxing the MTL with a memory load should decrease implicit perceptual sequence learning in older, but not younger adults.

Participants

• 24 older adults, age 70.39 ± 3.27, 15 male, 8 female
• 24 younger adults, age 20.5 ± 1.06, 12 male, 12 female

Triplets Learning Task

• Two red cues are shown, followed by a green target to which participants respond
• Unbeknownst to participants, the 1st red cue predicts the location of the green target
• 16 triplets occur with high probability (90% of the time), while 32 triplets occur with low probability (10% of the time)
• High and low probability trials are randomly presented throughout the task

Memory Load Task

• Adapted from Mitchell et al. (2000)³, activates the MTL
• Old adults saw 3 and Young adults saw 4 matrices, one at a time, for three seconds each
• Participants were instructed to “Remember both the letter and the location”
• Memory for the letter and location together were tested – participants responded “yes” if a letter and location were exactly as seen previously, and “no” if otherwise

Experimental Condition (Memory Load)

• Participants saw the matrices and then completed a block of the TLT at the end of which was the Memory Load test

Control Condition

• Participants saw the matrices and were then given the Memory Load test after a 3s delay, and then completed a block of the TLT

Memory Load Accuracy

• Old and young adults are similar
• Experimental condition is less accurate than the Control – for both Old and Young (p < .001)

Results

• Both groups show skill-learning, getting faster over time (p < .001)
• Older adults are slower, overall, than younger adults (p < .001)
• Both Old and Young adults are faster on High probability than Low probability triplets (p < .001)

Discussion

• As predicted, a memory load impaired learning in older adults but not in younger adults
• Older adults learned significantly less in the experimental memory load than the control condition
• Younger adults learned equally well in both conditions
• Because the memory load task engages the MTL (Mitchell et al.), these findings suggest that:
• Older adults rely on the MTL throughout Triplets learning because the memory load interfered with learning
• Younger adults rely on the striatum during late learning in the TLT because the memory load did not interfere with Triplets learning

Implications

• A secondary task may prevent older adults from being able to learn regularities in their environments
• Eg: Learning new languages
• Older adults, in light of a decreased capacity to multi-task, may choose the task of most importance to them
• Future studies may help to support this hypothesis
• A double-dissociation using a striatal-loading task while performing the TLT should show learning interference in young, but not older adults

References


Cognitive Aging Conference

Supported by: NIH/NIA Grant R37AG15450
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TLT Reaction Time

• Both groups show skill-learning, getting faster over time (p < .001)
• Older adults are slower, overall, than younger adults (p < .001)
• Both Old and Young adults are faster on High probability than Low probability triplets (p < .001)

TLT Associative Learning Scores

• Older adults
• Have decreased TLT learning
• ML condition learned less than Control condition (p = .004)
• Young adults
• No differences in learning across conditions (p > .05)

Associate Learning Score Calculation

• Avoids artifacts due to RT differences in age groups
• For each individual, the frequency with which they see a specific triplet within a session, correlated with their average RT for that triplet during that session gives the associative learning score for that session
• Multiply that score by -1 such that a positive learning score = higher A.L. score indicates more learning