Explicit and implicit memory in aging: Effects of attention and processing style

Dr Emma V. Ward[1], Dr Christopher J. Berry[2], Prof David R. Shanks[3]

[1]Middlesex University, London; [2]University of Plymouth; [3]University College London

Middlesex University London

e.ward@mdx.ac.uk

Highlights

- **Priming and recognition were compared over the lifespan using a large sample (N=1059)**
- **Measures were taken for each test item trial-by-trial using a CID-R task**
- **Priming and recognition were affected by attention but not depth of processing, and for attended items both priming and recognition declined as a function of aging**
- **Implicit memory is not preserved in normal aging**

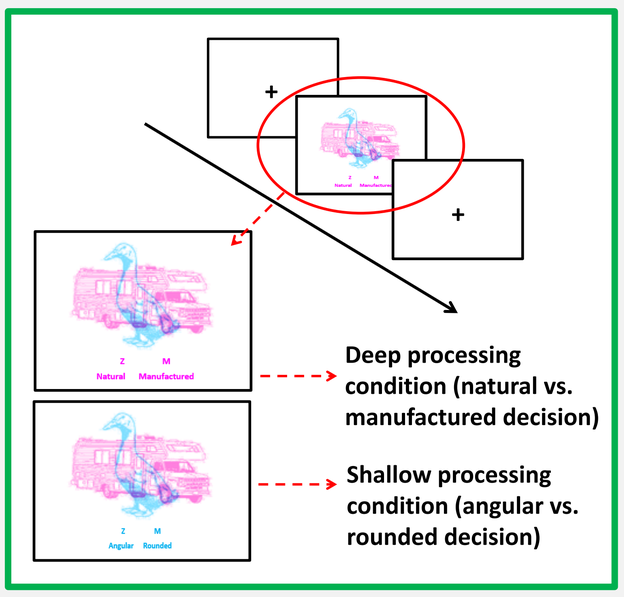
Background

The decline in explicit memory with age is well documented, but there is a lack of consensus surrounding the lifespan trajectory of implicit memory. While many have argued that implicit memory remains stable over the lifespan, growing evidence suggests that this may not be the case.(reviewed in 1,2,3) Age effects in implicit memory may depend on the type of task and its information processing demands, as well as the statistical power of the experiment.[4,5] In an attempt to clarify age effects on explicit and implicit memory and the role of differential processing, we recruited a large lifespan sample of participants at the London Science Museum. Participants witnessed a continuous stream of overlapping line drawings in a rapid serial visual presentation procedure and attended to one stream while ignoring the other. Half of the participants were engaged in a shallow processing task and the other half in a deep processing task. Priming and recognition were subsequently measured.

Table 1. Participant Characteristics

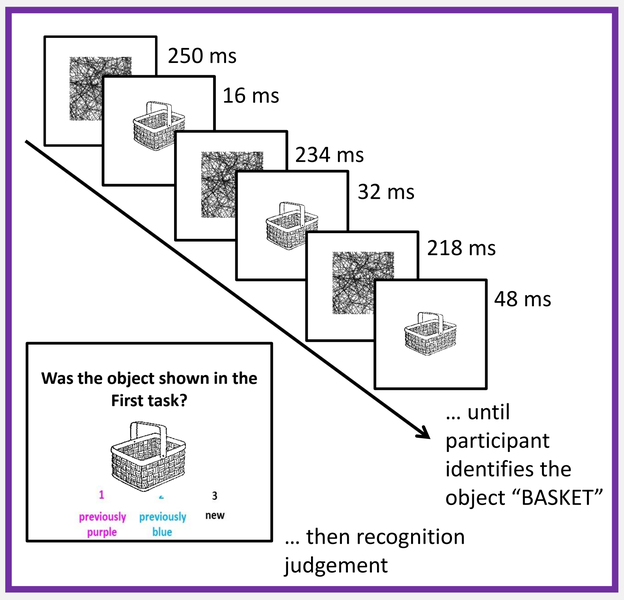
	Adolescents N = 211	Young Adults N = 291	Mid-Young Adults N = 261	Middle Adults N = 170	Mid-Older Adults N = 83	Older Adults N = 35
Age range (years)	12-17	18-24	25-34	35-49	50-64	65-82
Mean age (years)	14.67 (1.89)	21.07 (2.00)	28.83 (2.98)	41.42 (4.19)	55.30 (4.36)	70.60 (4.40)
N Male / Female	72 / 139	122 / 169	123 / 138	78 / 92	32 / 51	16 / 19
N Deep / Shallow	118 / 93	152 / 139	138 / 123	90 / 80	45 / 38	18 / 17
Education (years)*	10.51 (2.31)	15.60 (2.68)	17.45 (3.09)	17.98 (3.87)	17.88 (6.05)	16.26 (5.11)
WTAR*	39.12 (8.71)	39.91 (7.51)	42.06 (6.79)	43.18 (6.35)	42.55 (7.16)	45.94 (3.64)
Vision*	37.03 (12.23)	37.36 (13.62)	34.94 (7.04)	40.89 (16.27)	42.25 (11.68)	49.50 (27.89
Processing speed (mean ID RT new items)*	2412 (461)	2217 (449)	2225 (453)	2414 (559)	2580 (638)	2870 (640)
% correct identifications (CID)*	95.53 (3.75)	96.77 (3.06)	97.11 (2.96)	97.49 (2.87)	97.29 (2.42)	96.71 (2.45)

Methods and Procedure



Encoding phase:
Participants (N=1059) viewed a continuous stream of overlapping objects. They were asked to attend to one colour and ignore the other, and decide whether the attended object was natural or manufactured (deep processing) or angular or rounded (shallow processing).

CID-R phase:
On each trial participants identified a previously studied object (half attended / half ignored) or a new object before judging whether or not it had appeared in the encoding phase.

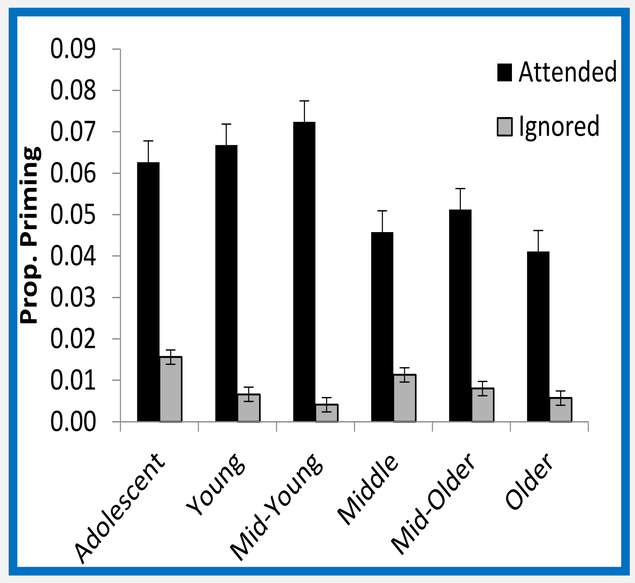


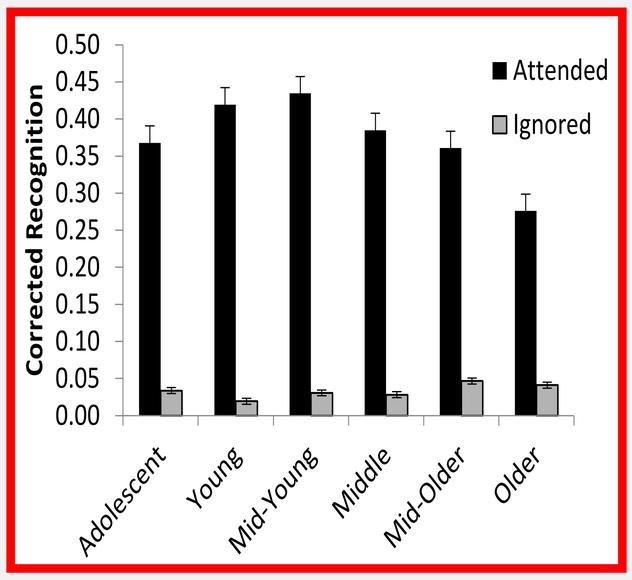
Participants:
Age ranged from 12-82 years (Table 1). Fluent in English, normal vision, no colour blindness, good self-reported health.

Design:
- 6(age)*2(attention)*2(processing) mixed factorial
- Attention manipulated within-subjects
- Depth of processing manipulated between-subjects

Results

Priming:
- **Main effect of attention** (p < .001, η_p^2 = .140), **interaction between attention and age** (p = .002, η_p^2 = .018). No other main effects or interactions, so deep and shallow conditions collapsed.
- Interaction between age and attention suggests age effects for attended but not ignored items. One-way ANOVA on attended items indicated a **main effect of age** (p = .003).
- Significant differences between Adolescents and Middle adults, Young and Middle adults, Young and Older adults, Mid-young and Middle adults, Mid-young and Mid-older adults, and Mid-young and Older adults (p < .05 all two tailed).





Recognition:
- **Main effect of attention** (p < .001, η_p^2 = .581), **main effect of age** (p = .015, η_p^2 = .014), **interaction between attention and age** (p < .001, η_p^2 = .033). No other main effects or interactions, so deep and shallow conditions collapsed.
- No significant age differences for ignored items, but recognition of attended items significantly differed between Adolescents and Older adults, Young and Mid-older adults, Young and Older adults, Mid-young and Middle adults, Mid-young and Mid-older adults, Mid-young and Older adults, and Middle and Older adults (p < .05 all two tailed).

Conclusion

The study provides evidence that both explicit and implicit memory decline with age, contrary to the view that implicit memory remains stable over the lifespan. Differences in processing style do not explain age effects in priming, but age effects emerge for attended items when there is adequate statistical power.

References: [1]Ward, E.V., & Shanks, D.R. (2019). *Implicit Memory and Cognitive Aging.* Oxford Research Encyclopaedia. [2]Fleischman, D. A., & Gabrieli, J. D. E. (1998). Repetition priming in normal aging and Alzheimer's disease: A review of findings and theories. *Psych. and Aging, 13,* 88–119. [3]Mitchell, D. B., & Bruss, P. J. (2003). Age differences in implicit memory: Conceptual, perceptual, or methodological? *Psych. and Aging, 18,* 807–822. [4]Ward, E.V., & Berry, C.J., & Shanks, D.R. (2013). An effect of age on implicit memory that is not due to explicit contamination: Implications for single and multiple-systems theories. *Psych. and Aging, 28,* 429-442. [5]Buchner, A., & Wippich, W. (2000). On the reliability of implicit and explicit memory measures. *Cog. Psych., 40*, 227-259.

EPS Experimental Psychology Society