Predicting across the lifespan: Evidence from the visual world paradigm

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While a compelling body of empirical research suggests that comprehenders predict during sentence processing, considerable individual variability has also been observed. The current research tested the hypothesis that prediction "declines" across adulthood.

Individual differences in prediction have been observed along a variety of dimensions. For example, comprehenders with better memories, faster processing speeds and larger vocabularies have variously been observed to predict more (e.g., Borovsky et al., 2012; Huettig & Janse, 2016; Kukona et al., 2016). Given age-related changes in cognition, older vs. younger adults might also be expected to show differences in prediction. On the one hand, Federmeier and Kutas (2005) found that older adults were less able to exploit predictive cues, exhibiting weaker N400 effects in strongly constraining sentence contexts. On the other hand, Huettig and Janse (2016) found that predictive eye movements in the visual world paradigm were uncorrelated with age. However, these discrepancies may reflect a number of factors: for example, the former may reflect integration rather than "pre-activation" (i.e., responses were measured post-stimulus); alternatively, the latter focused on non-semantic predictive cues.

The current research used the visual world paradigm to investigate age-related differences in prediction stemming from verb selectional restrictions (Altmann & Kamide, 1999; Experiment 1) and real world knowledge (Kamide et al., 2003; Experiment 2), which were interleaved within the same session. Both older (age M = 68.98; range = 60-81; N = 43) and younger (age M = 24.20; range 18-56; N = 51) participants' working memories and vocabularies (WAIS-IV), cognitive impairments (MMSE) and education were also assessed as covariates.

Experiment 1. Participants heard 16 sentences like "The boy will eat/move the cake" while viewing visual scenes with objects like a cake and distractors. Average proportions of fixations to the cake during the predictive "eat" (Older: M = 0.22, SD = 0.14; Younger: M = 0.22, SD = 0.13) and non-predictive "move" (Older: M = 0.15, SD = 0.11; Younger: M = 0.13, SD = 0.10) are depicted in Fig. 1. While a mixed effects (by-participants) model revealed a significant main effect of verb type (*Est*. = -0.08, SE = 0.02, t = 4.86, p < .001), with significantly more fixations to the cake during "eat" vs. "move", there were no significant age or covariate effects.

Experiment 2. Participants heard 24 sentences like "The man will ride the motorbike" while viewing visual scenes with objects like a motorbike, beer, carousel and lollipop (targets were also rotated across lists; e.g., "The man/girl will ride/taste…"). Average proportions of fixations during "ride" to the predictable motorbike (Older: M = 0.13, SD = 0.06; Younger: M = 0.15, SD = 0.08) and non-predictable beer (Older: M = 0.09, SD = 0.06; Younger: M = 0.11, SD = 0.05) are depicted in Fig. 2. While a mixed effects (by-participants) model revealed a significant main effect of object type (*Est*. = -0.04, SE = 0.01, t = 5.07, p < .001), with significantly more fixations to motorbike vs. beer during "ride", there were no significant age or covariate effects.

Discussion. In contrast to the ERP literature (e.g., see Federmeier, 2007), the current results reveal that predictive eye movements are strikingly stable across adulthood, suggesting that predictive processes during sentence processing are robust to brain aging (e.g., Shafto & Tyler, 2014).