Supplementary Information

## Eye-ISC Around the Clips and Cued Recall

Before examining the relationship between eye-ISC around the time of the clips and cued recall, we first examined whether eye-ISC itself differs around the time of the clips. Past work suggests that eye-movements and pupil dilation change at event boundaries (Clewett et al., 2020; Smith et al., 2006), but it remains to be seen whether eye-ISC also changes at event boundaries. To this end, we calculated eye-ISC for the time points during the movie that later served as the clips ('during clip') and the two-seconds that followed each clip ('after clip'). We entered these means into a 2 (boundary type: within, between) x 2 (time point: during clip, after clip) Bayesian repeated-measures ANOVA (when age was entered as an additional factor, there was no evidence for its inclusion, $BF_{incl} = 0.29$). There was substantial evidence for an interaction between Boundary Type x Time Point ($BF_{10} = 8.145 \times 10^8$). We followed up this interaction with two Bayesian paired t-tests for each boundary type. For within-event clips, there was moderate evidence of no difference in eye-ISC during and after the clip time points ($BF_{01} = 3.19$; see Figure S1). However, for between-event clips, there was decisive evidence that synchrony increased following the event boundary ($BF_{10} = 125.06$). Thus, eye-ISC increases at event boundaries, similar to previous work showing increased pupil dilation at event boundaries.

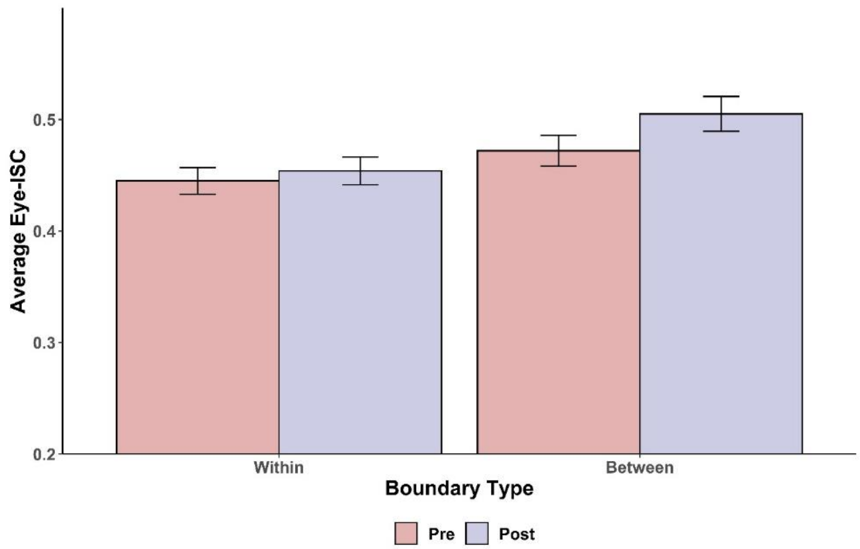


*Figure S1.* Eye-ISC averaged during the cued-recall clips (pre-boundary) and after the boundary (post-boundary) for each boundary type and across both age groups. Error bars represent standard error of the mean.

To determine whether eye-ISC predicts memory on the cued recall task when using only timepoints surrounding the clips, we used the scores calculated above (i.e., eye-ISC during and after the clip) and ran separate regression analyses using age and these time-constrained mean eye-ISC scores as predictors of cued recall for within- and between-event cues. Similar to the results with overall mean eye-ISC scores, there was substantial evidence that eye-ISC did not predict accuracy for within-event cues (during: $BF_{01} = 2.57$, after: $BF_{01} = 3.30$). For the between-event cues, there was no evidence either way (during: $BF_{01} = 2.37$, after: $BF_{01} = 1.61$). These analyses suggest that even when constraining eye-ISC values to periods surrounding the clips, eye-ISC did not predict cued recall.

**Awareness**

To further explore the effects awareness, we tested an additional group of 10 younger adults who were informed about the upcoming memory test. These participants were added to the seven aware younger adults from the original sample, resulting in a final aware sample of 17 young and 18 older adults. Demographic information is shown in Table S1. New eye-ISC scores were calculated using only these sub-groups of aware participants using the same method as the main experiment.

*Table S1.* Demographic Information

| | Age | Edu (yrs) | Shipley | MOCA |
|---|---|---|---|---|
| Aware Y (N=17) | 21.13 (3.64) | 14.16 (2.34) | 28.24 (3.49) | -- |
| Aware O (N=18) | 69.83 (4.27) | 16.50 (3.62) | 35.77 (2.97) | 26.61 (2.23) |

***Eye-ISC***

In line with the results reported in the main manuscript, there was anecdotal to moderate support that there were no differences in eye-ISC scores between aware older (*M* = .64, 95% CI [0.61, 0.67]), and younger adults (*M* = .62, 95% CI [0.58, 0.66]), $BF_{01}$ = 2.79[1].

***Cued Recall***

The data from the cued recall task for the aware participants were entered into a 2 (age: young, old) x 2 (event: within, between) ANOVA, in which age was a between-subjects variable and event was a within-subjects variable. This analysis replicated the results from the main manuscript, indicating that there was decisive evidence that Event should be included in the model ($BF_{incl}$ = 1.040 x $10^6$), but no evidence either way for the inclusion of Age ($BF_{incl}$ = 0.34) or the interaction ($BF_{incl}$ = 0.42). There was decisive evidence that the model that included a main effect of Event was more likely than the null model ($BF_{10}$ = 1.040 x $10^6$, error = 7.39%). This main effect was a result of better memory performance when cues came from within-events

[1] The mean eye-ISC scores in this sub-group are higher than the original sample, but highly correlated with participants' previous eye-ISC scores (*r* = .85, $BF_{10}$ = 1.000 x $10^8$).

(posterior *M* = 8.97, 95% CI [6.04, 11.79]) vs. between-events (posterior *M* = -8.97, 95% CI [-11.84, -6.09]; see Table S2 for means and standard deviations).

To test whether eye-ISC predicted memory in the cued-recall task, the data were submitted to two separate regressions for within- and between-events with age and eye-ISC are predictors. For both regression models, there was anecdotal evidence that the null model was more likely than models that included Eye-ISC. Thus eye-ISC did not predict accuracy following a within-event cue, $BF_{01}$ = 2.90, or a between-event cue, $BF_{01}$ = 2.21. Taken together, these results parallel those found in our primary analyses, further indicating that awareness did not influence the effect of boundary on memory accuracy.

### ***Free Recall***

To determine whether age affected the types of details recalled in this aware subsample, the data were entered into a 2 (age: younger, older) x 3 (recall category: internal, external, incorrect) mixed ANOVA, in which Age was a between-subjects factor and Recall Category was within. There was decisive evidence to include Recall Category in the model ($BF_{incl}$ = 2.548 x $10^{32}$), but no evidence either way to include Age ($BF_{incl}$ = 0.73). The main effect of Recall Category reflects that all participants recalled more internal details than external and incorrect details, but a similar number of external and incorrect details (see Table S2). We ran the same analysis with proportions as the dependent variable. In this model, there was decisive evidence to include the interaction term ($BF_{incl}$ = 4509.08) and the model with two main effects and the interaction was decisively supported over the null hypothesis of no difference ($BF_{10}$ = 2.538e x $10^{90}$, error = 1.63). Follow-up Bayesian t-tests suggest that the interaction was driven by older adults recalling a lower proportion of internal details than young adults ($BF_{10}$ = 26.18) and a higher proportion of external details ($BF_{10}$ = 11.54). There was no evidence either way that there was an age difference for the proportion of incorrect details recalled ($BF_{10}$ = 0.65). These results are in line with those from our main sample, suggesting that awareness did not affect the pattern of results on the free recall task.

*Table S2.* Means and standard deviations for memory tasks.

| | Aware Younger | | Aware Older | |
|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* |
| Cued Recall | | | | |
| Within | 77.08 | 11.08 | 75.55 | 13.74 |
| Between | 55.63 | 12.09 | 58.61 | 12.09 |
| Free Recall | | | | |
| Total Details | | | | |
| Internal | 91.50 | 39.21 | 104.00 | 38.22 |
| External | 3.66 | 3.66 | 10.78 | 8.81 |
| Incorrect | 6.69 | 2.54 | 10.22 | 6.69 |
| Proportion | | | | |
| Internal | 0.90 | 0.04 | 0.84 | 0.06 |
| External | 0.03 | 0.02 | 0.08 | 0.05 |
| Incorrect | 0.07 | 0.03 | 0.09 | 0.03 |

To determine whether age or eye-ISC predicted the proportion of internal, external, and incorrect details recalled, we entered the data into separate regressions for each detail type. The regression model for internal details indicated that there was strong evidence for the inclusion of Age in the model ($BF_{incl}$ = 20.58), but no evidence either way for the inclusion of Eye-ISC ($BF_{incl}$ = 0.64). The main effect of Age was more likely than the null model ($BF_{10}$ = 26.21). For external details, there was strong evidence that age should be included in the model ($BF_{incl.}$ = 9.35), but no evidence either way for the inclusion of Eye-ISC ($BF_{incl}$ = 0.72). There was strong evidence that the Age only model was more likely than the null model ($BF_{10}$ = 11.55, $R^2$ = .24). Finally, for incorrect details, there was no evidence either way for the inclusion of Age ($BF_{incl}$ = 0.56) or

Eye-ISC ($BF_{incl}$ = 0.34) in the model. Thus, eye-ISC did not relate to recall in this subsample of aware participants.

Overall, the main purpose of these analyses was to ensure that memory performance and age differences (and lack thereof) in our experiment were not a result of older adults being aware that their memory was going to be tested. The results from this sub-group of aware participants largely parallel the results from the main experiment. While the regression analyses relating eye-ISC to memory did not hold up, this may be due to the smaller sample used here or possibly a change in how aware participants process the movie. Most critically, the lack of age differences in eye movement synchrony in the main paper does not seem to be due to older adults suspecting that their memory would best tested (which presumably would lead to heightened attention for the movie).

## References

Clewett, D., Gasser, C., & Davachi, L. (2020). Pupil-linked arousal signals track the temporal organization of events in memory. *Nature Communications, 11*(1), 1–14. https://doi.org/10.1038/s41467-020-17851-9

Smith, T. J., Whitwell, M., & Lee, J. (2006). Eye movements and pupil dilation during event perception. *Proceedings of the 2006 Symposium on Eye Tracking Research & Applications  - ETRA '06*, 48. https://doi.org/10.1145/1117309.1117333