

Age-related Reductions in the Episodic Specificity of Past and Future Events **ADDIS, D.R.^{1,2}, WONG, A.T.^{1,2} & SCHACTER, D.L.^{1,2}**

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Episodic memory enables individuals to recollect past events as well as imagine possible future scenarios. Evidence from amnesic and psychiatric patients demonstrates that deficits in retrieving past events also extends to future events. While it has been shown that the episodic specificity of past event declines with age, whether the same is true of future events is unknown. In an adapted version of the Autobiographical Interview, young and older participants generated events from four time periods (past few weeks, past few years, next few weeks and next few years). The transcription of each event was segmented into distinct details which were then classified as either episodic or non-episodic. We replicated the finding of an age-related decline in the episodic specificity of past events, with older adults generating significantly fewer episodic details than younger adults. Importantly, this deficit in episodic specificity was also evident for future events. Furthermore, there was no group difference in amount of non-episodic information in either past or future events. These findings converge with evidence from other patient groups and providing further evidence of the close linkage of past and future events.

Introduction

Episodic memory enables individuals to project themselves backward in time to re-experience past events as well as forward in time to imagine or pre-experience episodes that may occur in the future. Representations of past and future events can be episodic in nature, containing rich contextual details about events specific in time and place. In line with the idea that past and future events are constructed from information stored in episodic memory, cognitive, neuroimaging and neuropsychological studies have demonstrated considerable overlap in the psychological and neural properties of past and future events (for a review, see Schacter and Addis, in press). Cognitive studies have shown that factors influencing the phenomenology of past events, such as temporal distance from the present and event valence, also influence future events in the same way. For instance, temporally close events in both the past and future comprise more contextual details than temporally distant events, and positive past and future events are associated with subjective ratings of greater re-experiencing and pre-experiencing than negative events. Recent neuroimaging studies have revealed engagement of common neural regions, including medial prefrontal and parietal cortices and the medial temporal lobes, when remembering past episodes and imagining future ones.

Striking evidence of the close linkage of past and future events also comes from studies of patients with episodic memory deficits. Tulving (1985) reported that a patient, K.C., who suffered a total loss of episodic memory, was also unable to imagine specific events in his personal future. Even so, K.C. did not exhibit a loss of general imagery abilities and performed normally on tests requiring him to imagine non-personal information (e.g., the relative sizes of objects). Similarly, another amnesic patient, D.B. (Klein & Loftus, 2002), also exhibited deficits in both retrieving past events and imagining future events. Williams et al. (1996) examined past and future events in suicidally-depressed patients and showed that reductions in episodic specificity affected both event

types, and further, that the reductions in specificity of past and future events were significantly correlated.

Another population exhibiting deficits in episodic memory is healthy older adults. For instance, Levine et al. (2002) examined the episodic quality of past events recalled by older adults using the Autobiographical Interview to parse the episodic from non-episodic information comprising a participant's description of a past event. These authors found an age-related reduction in the number of episodic details recalled. Given that the deficits in retrieval of past events exhibited by amnesic and depressed patients extend to their imaginings of future events, we hypothesized the older adults should show reduced episodic specificity of both past *and* future events.

Methods

Thirteen young (5 male, aged 19 to 35 years, $M=24.92$, $sd=4.86$) and twelve older adults (6 male, aged 65 to 80 years, $M=72.83$, $sd=4.90$) with no history of neurological or psychiatric impairment, participated in this study, completing a version of the AI adapted to probe events from the past *and* the future. Participants were required to generate eight events in each of four conditions (past few weeks, past few years, next few weeks and next few years). Participants completed both time-periods (weeks, years) for one temporal direction (past, future) before completing conditions within the other temporal direction. The order of presentation of temporal direction and time-periods was counterbalanced. Participants were cued with nouns from the Clark and Pavio extended norms. Four lists of eight nouns, all high in Thorndike-Lorge frequency, imageability and concreteness, were created and matched on these variables. Lists cycled through conditions in a fully counterbalanced design. Each participant was randomly assigned to a version.

Participants were instructed to recall/imagine events specific in time and place, and to generate as much detail as possible within a three minute time-limit. When necessary, general, non-specific probes were given to clarify instructions and encourage further description of details. Specific probes were not employed here, given that the use of this condition by Levine et al. (2002) did not change the pattern of group differences evident from use of general probes alone. For the duration of each trial, the relevant cue word was displayed on a computer screen along with the task instruction ("recall past event" or "imagine future event") and time-period. After three minutes, a bell sounded to indicate the end of the trial. Participants then dated the event, rated it on a five-point scale for level of detail, emotionality (i.e., intensity of emotion the event currently evokes) and personal significance (i.e., how life-changing the event is), and decided whether they recalled/imagined the event primarily from a field or observer perspective. The interview took approximately 2 hours. All events were tape-recorded and transcribed.

The standardized scoring procedure (Levine et al., 2002) was used, and for each subject, four events from each condition were scored by one of three scorers. Scoring began with identifying the main event; if more than one event was mentioned, the event discussed in most detail that occurred over a brief timeframe was selected as the main event. The transcription was then segmented into distinct details (i.e., chunks of information, e.g., a unique occurrence or thought), and these details were categorized as *internal* (episodic information relating directly to the main event being described) or *external* (non-episodic information including semantic details, extended events and repetitions). For each participant, an average internal and external detail score was computed for each condition.

Results

A repeated-measures ANOVA was conducted, with three within-subjects factors (temporal direction [past, future]; time-period [weeks, years], and detail score [internal, external]), and one between-subjects factor (group [young, old]). This revealed a significant main effect of temporal direction, $F(1,23)=18.00, p<.001$, with past events containing more details than future events, and a main effect of detail score, $F(1,23)=35.136, p<.001$, with events having more internal than external details. The main effect of time-period was not significant, $F(1,23)=1.598, p=.219$.

The interaction of temporal direction and detail score was significant, $F(1,23)=4.317, p=.049$. Follow-up *t*-tests showed that past events had significantly more internal ($p<.0001$) and external details ($p=.002$) than future events, although the effect for external details was smaller than that for internal details (Figure 1a). The interaction of time-period and detail was significant, $F(1,23)=9.012, p=.006$, with events further from present containing more external details than closer events ($p=.010$; Figure 1b). The time-period difference was not significant for internal details ($p=.115$).

Notably, there was a significant group by detail score interaction, $F(1,23)=15.704, p=.001$, with young adults generating more internal details than older adults ($p=.004$; Figure 1c). Although older adults tended to generate more external details than young adults, this failed to reach significance ($p=.110$). There was no significant main effect of group, $F(1,23)=1.589, p=.220$. The interaction of group, detail score and temporal direction was not significant, $F(1,23)=.077, p=.784$, suggesting that the group by detail score interaction holds for both past and future events, as apparent in as Figure 1d. Indeed, follow-up *t*-tests revealed that the group difference for internal details was evident for both past ($p=.007$) and future events ($p=.005$), and that there was no group difference for the number of external details in past ($p=.086$) or future ($p=.249$) events.

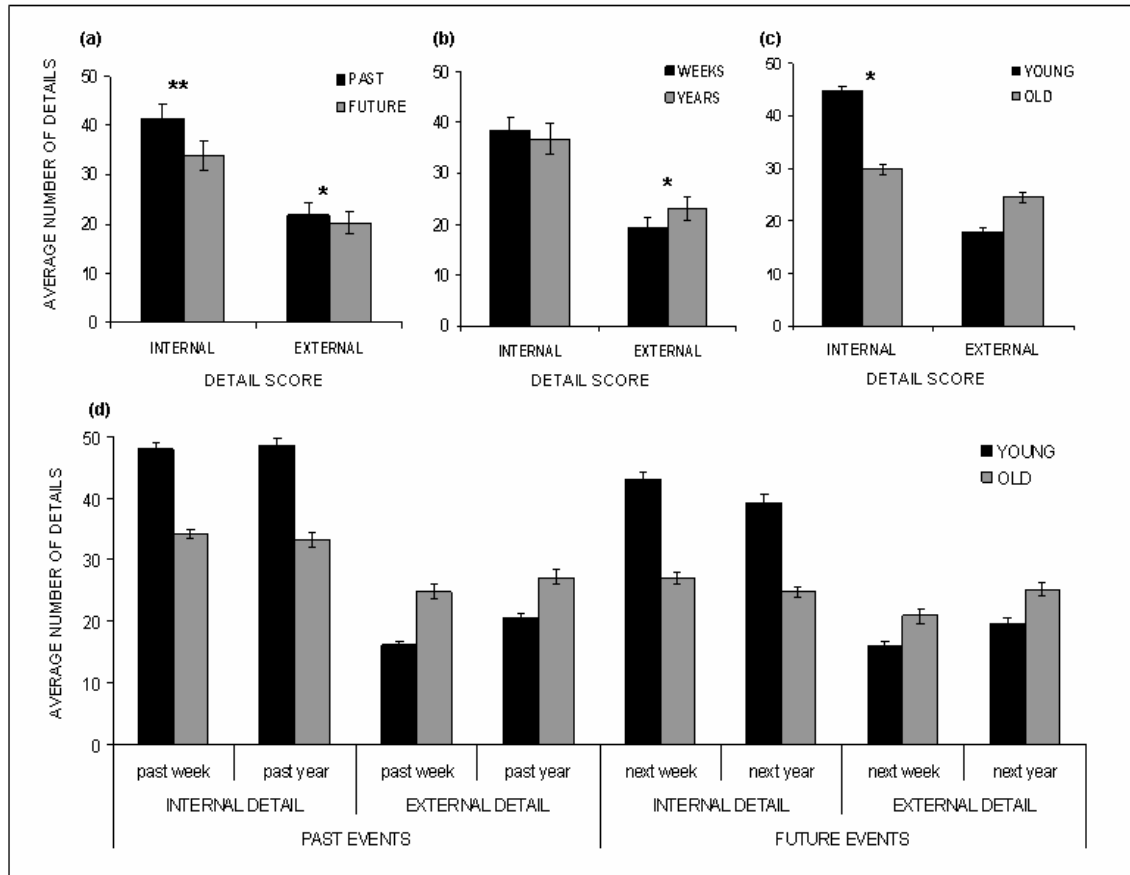


Figure 1. Plots illustrating interactions between detail and (a) temporal direction, with greater past-future differences for internal details; (b) time-period, with a week-year difference for external details; (c) group, with an age difference for internal details. (d) This age difference is evident across all time-periods and temporal directions. * $p \leq .01$; ** $p \leq .001$.

Discussion

This study is the first to investigate whether age-related reductions of episodic specificity of past events also extend to older adults' imaginings of the future. Firstly, we replicated the finding that older adults show a significant reduction in the number of internal, episodic details generated during the recall of past events (Levine et al., 2002), and this is consistent with demonstrations of age-related episodic memory deficits, particularly for contextual information. The group difference reported here was specific to internal episodic details relating to the main event, with the tendency for older adults to generate more external details than younger adults not reaching significance. The preserved ability of older adults to retrieve as many external details on average as younger adults may indicate that the deficit in internal details does not simply reflect a general impairment in verbal output.

Importantly, the present results confirm that the age-related reduction in the episodic specificity of past events extends to future events. Older adults also generated significantly fewer internal, episodic details when imagining events that might occur either in the next few weeks or years. As with past events, the tendency for older adults to

generate more external, non-episodic details in their future events than younger adults did not reach significance.

The results also revealed that on average past events contained more details than future events. This may reflect the ease of retrieving events which have actually occurred compared with creating future events by recombining details from various past events (Schacter & Addis, in press). Additionally, events which were years into the past or future contained significantly more external details than temporally close events. These results are consistent with previous findings from studies of the phenomenology of past and future events (see Schacter & Addis, in press).

In summary, the finding that age-related reductions in episodic specificity affect both past and future events converges with evidence from other patient groups, providing further evidence of the close linkage of past and future events.

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