Research Article

Age-Related Changes in the Episodic Simulation of Future Events

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ABSTRACT—*Episodic memory enables individuals to recollect past events as well as imagine possible future scenarios. Although the episodic specificity of past events declines as people grow older, it is unknown whether the same is true for future events. In an adapted version of the Autobiographical Interview, young and older participants generated past and future events. Transcriptions were segmented into distinct details that were classified as either internal (episodic) or external. Older adults generated fewer internal details than younger adults for past events, a result replicating previous findings; more important, we show that this deficit extends to future events. Furthermore, the number of internal details and the number of external details both showed correlations between past and future events. Finally, the number of internal details generated by older adults correlated with their relational memory abilities, a finding consistent with the* constructive-episodic-simulation hypothesis, *which holds that simulation of future episodes requires a system that can flexibly recombine details from past events into novel scenarios.*

Considerable research has documented age-related changes in the functioning of episodic memory (Craik & Salthouse, 2000). As has been the case with most theoretical and empirical work on episodic memory, research on aging memory has traditionally focused on the recollection of past events. However, episodic memory allows individuals to project themselves both backward and forward in subjective time; representations of both past and future events can contain rich contextual details about events specific in time and place (Tulving, 1983). Recently, there has been growing interest in the role of episodic memory in simulating or imagining future episodes and scenarios (for recent reviews, see Buckner & Carroll, 2007; Schacter & Addis, 2007a; Schacter, Addis, & Buckner, 2007). The main purpose of the present study was to compare younger and older adults' ability to simulate future personal events and past personal events.

The conceptual framework for our study is provided by the *constructive-episodic-simulation hypothesis* (Schacter & Addis, 2007a, 2007b; see also Suddendorf & Corballis, 1997), which holds that simulation of future episodes requires a system that can flexibly recombine details from past events. According to this view, (a) past and future events draw on similar information stored in episodic memory and rely on similar cognitive processes during construction (e.g., self-referential processing and imagery), and (b) episodic memory supports the construction of future events by extracting and recombining stored information into a simulation of an event that never occurred previously in that exact form. We consider evidence supporting the constructive-episodic-simulation hypothesis and then spell out the implications for aging memory.

Converging lines of evidence have demonstrated considerable overlap in the cognitive properties and neural substrates of past and future events (Buckner & Carroll, 2007; Schacter & Addis, 2007a). It has been shown that although representations of past events are associated with more perceptual detail than are representations of future events, factors influencing the phenomenology of past events influence the phenomenology of future events in the same way. For instance, D'Argembeau and van der Linden (2004) and Szpunar and McDermott (in press) demonstrated that temporally close events in either the past or the future had more detailed representations than temporally distant events. Moreover, Szpunar and McDermott found that increased familiarity of the event context increased the amount of detail in representations of past and future events. It has also been shown that individual differences in imagery ability and emotion regulation influence the qualities of representations of past and future events (D'Argembeau & van der Linden, 2006).

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Recent neuroimaging studies have indicated that a common neural network is engaged when people remember past events and when they imagine future events (Addis, Wong, & Schacter, 2007; Okuda et al., 2003; Szpunar, Watson, & McDermott, 2007). For example, we (Addis et al., 2007) examined the neural correlates of past and future events during (a) an initial construction phase in which participants generated a past or future event in response to a cue (e.g., "dress") and (b) an elaboration phase in which participants generated as much detail as possible about the event. Despite some neural differences during the construction phase, there was neural overlap between the past and future tasks; neural overlap was even more apparent during the elaboration phase. Results were consistent with the constructive-episodic-simulation hypothesis in that this common past-future network of medial prefrontal, temporopolar, hippocampal-parahippocampal, and medial and lateral parietal regions was remarkably similar to the network consistently engaged by retrieval of past autobiographical events (Maguire, 2001).

This finding of common neural activity associated with past and future events is consistent with the case reports of two amnesic patients: K.C., who developed severe amnesia after a head injury that damaged the medial temporal and frontal lobes (Rosenbaum et al., 2005; Tulving, 1985), and D.B., who developed memory problems after cardiac arrest (Klein, Loftus, & Kihlstrom, 2002). Both of these patients were reported to have difficulty envisaging future personal events. A more recent study showed that 4 of 5 amnesic patients with bilateral hippocampal damage had difficulties imagining new experiences, and in particular, had difficulty forming coherent imagined events (Hassabis, Kumaran, Vann, & Maguire, 2007). Finally, Williams et al. (1996) demonstrated reduced specificity of representations of both past and future events in suicidally depressed patients.

Taken together, these lines of evidence support the constructive-episodic-simulation hypothesis and provide a basis for generating hypotheses concerning simulation of future events as people grow older. Healthy older adults exhibit a number of deficits in episodic memory, but two are especially relevant to the simulation of future events and to the constructive-episodic-

simulation hypothesis. First, older adults sometimes have difficulties with relational processes that link together elements of an episode (e.g., Chalfonte & Johnson, 1996; Lyle, Bloise, & Johnson, 2006). As noted earlier, the constructive-episodic-simulation hypothesis holds that construction of future events relies on recombining elements of past episodes, which draws on relational processes. Second, previous work has shown that aging is associated with reductions in the episodic specificity of past events. Levine, Svoboda, Hay, Winocur, and Moscovitch (2002) examined age-related changes in the episodic quality of past events using the Autobiographical Interview (AI), a measure that distinguishes episodic information from other, "external" details (e.g., semantic information, other external events, repetitions) in a participant's description of a past event. This analysis revealed that older adults recalled significantly fewer episodic details and tended to produce more external information than younger adults did.

Given these findings of age-related reductions in episodic specificity of past events and age-related impairment in relational processing, which is likely relevant to construction of future events, we hypothesized that older adults would exhibit reduced episodic specificity in their simulations of future events, compared with young adults. We also hypothesized that such a deficit would be correlated with performance on a memory task sensitive to relational processing.

METHOD

Participants

Seventeen young and 17 older adults with no history of neurological or psychiatric impairment gave informed written consent in a manner approved by the Harvard Institutional Review Board. Data from 1 young adult and 1 older adult were excluded because of technical difficulties; thus, data from 16 young and 16 older adults are presented. In a session separate from that described next, all older adults completed a neuropsychological battery (see Table 1 for a summary of the results of this testing, as well as the two groups' demographics).

TABLE 1

Demographic and Neuropsychological Characteristics of the Participants

Characteristic	Group mean	
	Young	Older
Sex	6 male, 10 female	10 male, 6 female
Age (years)	25.31 (4.66)	72.30 (5.00)
Digit Span Backwards (maximum = 14)	—	8.31 (2.02)
Mini-Mental State Examination (maximum = 30)	—	29.31 (0.79)
Phonemic fluency (total score; no maximum)	—	49.38 (10.99)
Verbal Paired Associates I (Recall Total Score; maximum = 32)	—	22.81 (8.46)
Wisconsin Card Sorting Test (number of categories; maximum = 6)	—	5.56 (1.50)

Note. Standard deviations are given in parentheses. The neuropsychological battery was administered only to the older participants.

Adapted AI

Participants completed an adapted version of the AI that probed events from both the past and the future. In each of four conditions (past few weeks, past few years, next few weeks, and next few years), participants generated eight events in response to randomly presented cue words (Crovitz & Schiffman, 1974). Although studies with young adults have sampled events further into the past or future (e.g., 20 years in Addis et al., 2007), the advanced age of the older adults meant that this was not feasible in the current study. Both time periods (weeks and years) for one temporal direction (past or future) were completed before the conditions in the other temporal direction began. Conditions were blocked in this manner to reduce load and facilitate older adults' understanding of the instructions for each condition. Order of presentation of temporal direction and time periods was counterbalanced.

Stimuli

The cues were 32 nouns taken from Clark and Paivio's (2004) extended norms. All cues were high in Thorndike-Lorge frequency ($M = 1.72$, $SD = 0.26$), imageability ($M = 5.92$, $SD = 0.35$), and concreteness ($M = 6.83$, $SD = 0.29$). They were divided into four lists of eight nouns matched for these variables. Analysis of variance (ANOVA) confirmed that the lists did not differ significantly in frequency, $F(3, 28) = 0.02$, $p_{rep} = .03$, $\eta^2 = .002$; imageability, $F(3, 28) = 0.06$, $p_{rep} = .07$, $\eta^2 = .006$; or concreteness, $F(3, 28) = 1.80$, $p_{rep} = .75$, $\eta^2 = .16$. Lists of cue words cycled through conditions in a fully counterbalanced design. Each participant was randomly assigned to a counterbalanced version.

Interview

On each trial, participants were instructed to recall or imagine an event and to generate as much detail about that event as possible within a 3-min time limit. The event generated in response to a cue word did not have to strictly involve the named object; participants were encouraged to freely associate so that they would be successful in generating an event. Each event was required, however, to be temporally and contextually specific (i.e., episodic), occurring over minutes or hours, but not more than 1 day. Future events had to be plausible, given the participant's plans, and novel, that is, not previously experienced by the participant. Participants were asked to try to experience events from a field perspective (i.e., from the perspective of being there) rather than an observer perspective (i.e., from an external vantage point in which they observed themselves).

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. When necessary, general probes were given to clarify instructions and encourage further description of details. After 3 min, a bell sounded to indicate the end of the trial. The participant then dated the event and rated it on 5-point scales for level of detail (1 = *vague with no/few details*, 5 = *vivid*; for brevity, results for this variable are not discussed, given that more extensive measures of detail were obtained using the AI), emotionality (i.e., intensity of emotion experienced upon recalling or imagining the event; 1 = *nonemotional*, 5 = *highly emotional*), and personal significance (i.e., how life-changing the event was or would be; 1 = *insignificant*, 5 = *life-changing*). The interview took approximately 2.5 hr. Participants were tested individually, and responses were recorded using a digital audio recorder so that they could be transcribed later.

Scoring

The standardized AI scoring procedure (Levine et al., 2002) was used. For each participant, events generated in response to the first four randomly presented cue words in each condition were scored by one of three scorers. First, the central event was identified; if more than one event was mentioned, the event that was discussed in most detail and that occurred over a brief time frame was selected as the central event. The transcription was then segmented into distinct details, or chunks of information (e.g., a unique occurrence or thought), and these details were categorized as *internal* (episodic information relating to the central event) or *external* (nonepisodic information, including semantic details and information concerning extended events that are not specific in time and place, and repetitions). For each event, the numbers of internal and external details were tallied, and the totals were then averaged across the four events in each condition to create internal and external AI scores for each condition for each participant. Interrater reliability of scoring, established on the basis of 20 events scored by all three raters and an intraclass correlation analysis, was high (two-way mixed model; standardized Cronbach's $\alpha = .96$ for internal AI scores and .92 for external AI scores). Note that all scorers were blind to group membership, but given that event content could imply group membership, we ensured that the principal scorer (who scored 288 of the 512 event transcripts) was blind to the hypotheses of this study.

RESULTS

Phenomenology of Past and Future Events

Table 2 summarizes the phenomenological qualities of the past and future events generated by participants. To ensure that temporal distance of events did not differ significantly between groups or temporal directions (past vs. future), we analyzed the dates of the events (converted to weeks from the present) using a series of repeated measures ANOVAs with the within-groups factors of time period (weeks vs. years) and temporal direction (past vs. future) and the between-groups factor of age group (young vs. old). Recency did not differ between age groups, $F(1, 30) = 0.14$, $p_{rep} = .35$, $\eta^2 < .01$. Thus, any group differences in

TABLE 2

Phenomenological Qualities of the Generated Past and Future Events

	Past events		Future events	
Measure and age group	Past few weeks	Past few years	Next few weeks	Next few years
Temporal distance from the present (in weeks)				
Young	1.59 (0.77)	135.59 (67.78)	1.95 (0.74)	122.43 (41.92)
Older	2.09 (1.17)	155.82 (71.68)	4.15 (5.48)	87.585 (41.62)
Rating of emotional intensity				
Young	2.66 (0.97)	2.60 (0.88)	2.89 (0.85)	2.79 (0.70)
Older	3.13 (0.80)	3.27 (0.94)	3.30 (0.86)	3.36 (0.73)
Rating of personal significance				
Young	2.33 (1.15)	2.50 (1.17)	2.48 (1.09)	2.98 (1.07)
Older	2.65 (0.90)	2.79 (1.09)	3.06 (1.05)	3.32 (0.91)

Note. Standard deviations are given in parentheses.

the AI scores cannot be accounted for by recency. This analysis did reveal, however, a main effect of time period, $F(1, 30) = 231.72, p_{rep} > .99, \eta^2 = .89$, confirming that events in the year conditions (past few years, next few years) were significantly more distant than events in the week conditions (past few weeks, next few weeks). There was also a significant effect of temporal direction, $F(1, 30) = 10.23, p_{rep} = .97, \eta^2 = .25$, with past events being more distant than future events, and a significant interaction of time period and temporal distance, $F(1, 30) = 11.17, p_{rep} = .98, \eta^2 = .27$, indicating that within the week condition, past events were closer to the present than future events, whereas within the year condition, past events were further from the present than future events. Also, older adults generated more distant past events and closer future events than younger adults, $F(1, 30) = 4.68, p_{rep} = .89, \eta^2 = .14$.

We also wanted to examine whether the phenomenological qualities of events differed across age groups, temporal directions, or time periods, given that such differences could change interpretations of other effects. Mann-Whitney U tests revealed that older adults produced more emotional events than younger adults ($U = 73.00, p_{rep} = .89$). In contrast, there were no group differences in ratings of personal significance ($U = 87.00, p_{rep} = .80$). Wilcoxon sign tests showed that the emotional intensity of events did not differ with temporal direction ($Z = -1.51, p_{rep} = .79$) or time period ($Z = -0.19, p_{rep} = .23$). Ratings for personal significance were higher for future than for past events ($Z = -2.79, p_{rep} = .97$) and were also higher for temporally distant than for close events ($Z = -2.79, p_{rep} = .97$).

Adapted AI

We conducted two repeated measures ANOVAs, one each for the internal and external AI scores. Each ANOVA had two within-subjects factors (temporal direction: past vs. future; time period: weeks vs. years) and one between-subjects factor (group: young vs. old). Of most interest here, we found significant group differences, with older adults producing fewer internal details,

$F(1, 30) = 14.49, p_{rep} = .99, \eta^2 = .326$, but more external details, $F(1, 30) = 6.54, p_{rep} > .94, \eta^2 = .179$, than young adults (see Fig. 1a). These group effects were remarkably similar for both temporal directions and both time periods (i.e., there were no interactions; see Fig. 1d). The analyses also revealed differences between past and future events, with past events containing more internal details than future events, $F(1, 30) = 25.21, p_{rep} > .99, \eta^2 = .457$ (see Fig. 1b). Additionally, temporally close events contained more internal details than distant events, $F(1, 30) = 4.12, p_{rep} = .88, \eta^2 = .121$ (see Fig. 1c). No such effects were evident for external details.

Combining the data for the two age groups, we found that past and future internal AI scores were significantly correlated ($r = .82, p_{rep} > .99$), as were past and future external AI scores ($r = .65, p_{rep} > .99$; see Fig. 2). In contrast, past internal and external AI scores were uncorrelated ($r = -.001, p_{rep} = .50$), as were future internal and external AI scores ($r = -.07, p_{rep} = .61$).

For older adults, we also computed correlations between AI scores and neuropsychological measures. To measure relational episodic memory, we used the Recall Total Score from the Verbal Paired Associates I (VPA) subscale of the Wechsler Memory Scale–Third Edition; studies have demonstrated that this score is sensitive to medial temporal function (Glisky, Polster, & Routhieaux, 1995; Lezak, 1995). To measure executive functioning, we used the Digit Span Backwards subscale from the Wechsler Adult Intelligence Scale–Third Edition, the number of categories achieved on the Wisconsin Card Sorting Test (WCST; i.e., the number of card-sorting rules, out of six, that the participant applies correctly on 10 successive trials), and phonemic fluency (i.e., the number of words generated in response to the letters *F*, *A*, and *S*; Glisky et al., 1995; Lezak, 1995). VPA performance was significantly and positively correlated with the number of internal details in the descriptions of past ($r = .43, p_{rep} = .88$) and future ($r = .55, p_{rep} = .94$) events (see Fig. 3). External AI scores, however, did not correlate with relational memory (past events: $r = -.23, p_{rep} = .73$; future events: $r = -.01, p_{rep} = .51$; see Fig. 3). Digit Span Backwards scores
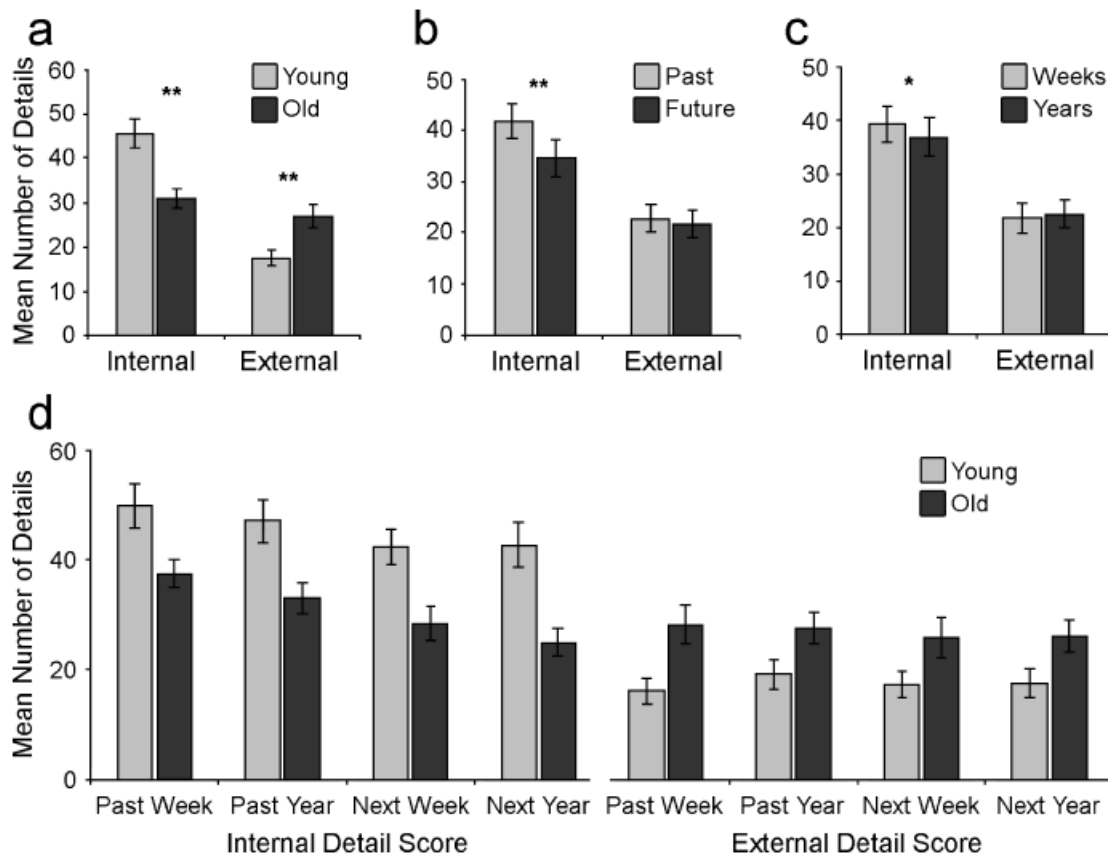
Fig. 1. Mean number of internal and external details as a function of (a) age group, (b) temporal direction, (c) time period, and (d) age group, temporal direction, and time period. Error bars represent standard errors of the means. Asterisks indicate significant differences, *$p_{rep} \geq .88$, **$p_{rep} \geq .99$.

correlated with internal AI scores, and this relationship was significant for future events (past events: $r = .41$, $p_{rep} = .86$; future events: $r = .47$, $p_{rep} = .90$). There were no correlations between this measure and external AI scores (past events: $r = .09$, $p_{rep} = .60$; future events: $r = .06$, $p_{rep} = .56$). Moreover, the other two measures of executive functioning showed no correlations with either internal or external AI scores. For phonemic fluency, correlational analysis yielded r values of .07 ($p_{rep} = .57$) for past internal details, $-.13$ ($p_{rep} = .63$) for past external details, .04 ($p_{rep} = .54$) for future internal details, and .20 ($p_{rep} = .70$) for future external details. The corresponding values for the WCST were $-.08$ ($p_{rep} = .58$), .22 ($p_{rep} = .72$), .002 ($p_{rep} = .50$), and .08 ($p_{rep} = .59$). Note that the lack of correlations with WCST scores may reflect the restricted variance of these scores.

DISCUSSION

Our data show that the age-related reduction in the episodic specificity of past events (Levine et al., 2002) extends to future events, a finding consistent with recent findings of similar temporal distributions for past and future events generated by older adults (Spreng & Levine, 2006). Compared with young

adults, older adults generated significantly fewer internal, episodic details, and more external details, when remembering past events or imagining future events. It seems unlikely that the group difference in the emotional intensity of events (i.e., greater emotional intensity for events generated by older adults than for events generated by young adults) can account for the age-related reduction in specificity, as these two effects were in opposite directions.

The striking similarity between the episodic specificity of past and future events was also reflected in the strong correlations between the past and future internal (.82) and external (.65) AI scores. These correlations are similar to, but stronger than, the correlations Williams et al. (1996) reported for depressed patients ($r = .57$), and they likely reflect the sensitivity of the AI to the specificity of autobiographical events. Notably, only the correlations between past and future events were significant; correlations between past internal and external scores and between future internal and external scores were negligible.

Our data provide further support for the constructive-episodic-simulation hypothesis. Not only do the common age-related deficits for past and future internal details support the hypothesis, but so too does the positive correlation between degree of impairment and performance on VPA, an episodic-
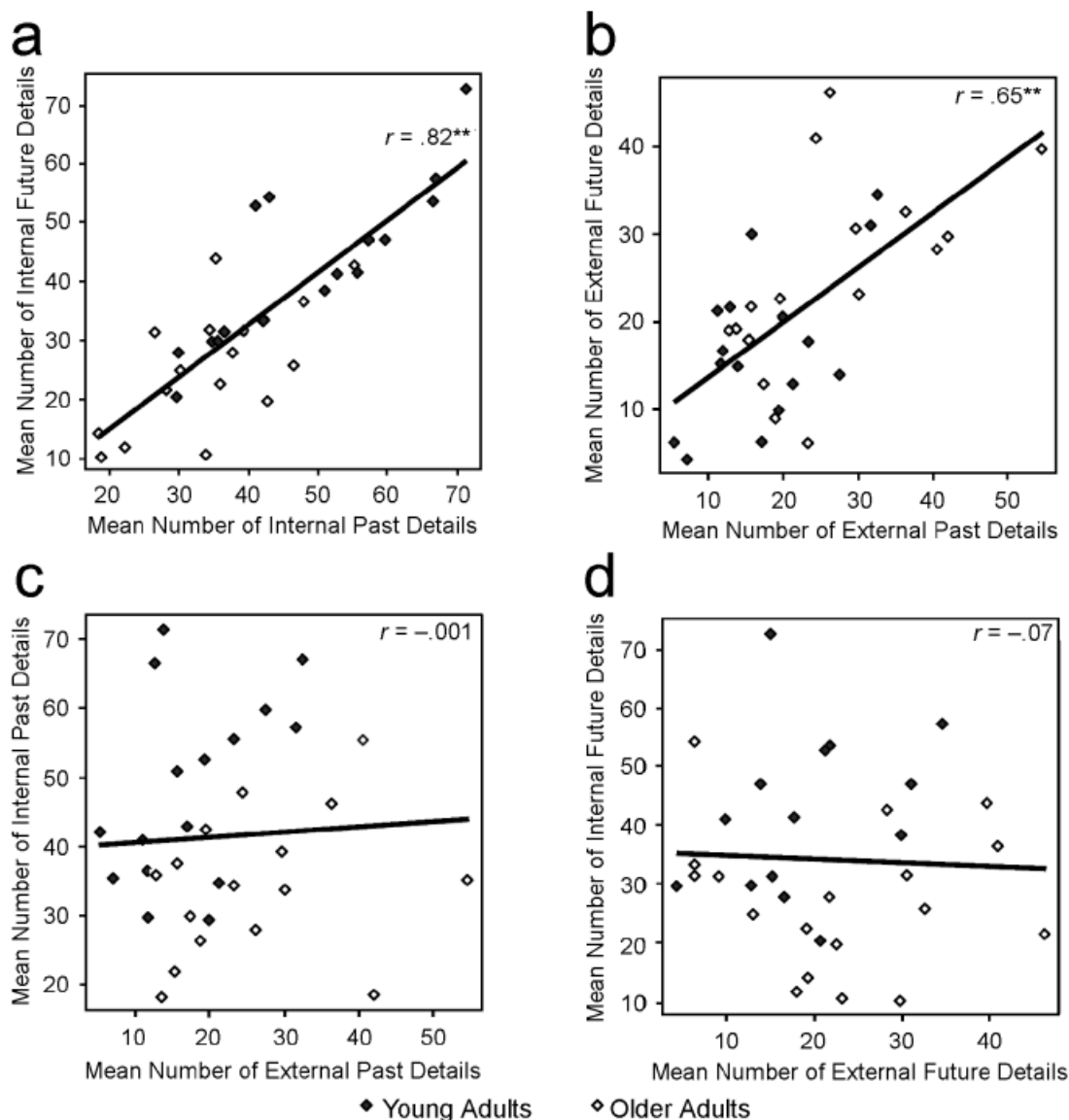
Fig. 2. Scatter plots and regression lines showing the correlations between (a) the numbers of internal details in generated past and future events, (b) the numbers of external details in generated past and future events, (c) the numbers of internal and external details in generated past events, and (d) the numbers of internal and external details in generated future events. Asterisks indicate significant correlations, $**p_{rep} = .94$.

memory measure that probes the ability to integrate information and form relations between items (i.e., relational memory). Paradigms using paired associates (e.g., pairs of words or objects) are known to engage the hippocampus (Giovanello, Schnyer, & Verfaellie, 2004) and are sensitive to medial temporal function (Glisky et al., 1995). The association of episodic specificity of past and future events with this measure of relational memory is consistent with reports that patients with medial temporal damage experience difficulty imagining future events (Hassabis et al., 2007; Rosenbaum et al., 2005; Tulving, 1985). Furthermore, the correlation between VPA performance and the specificity of remembered past events dovetails with the idea that the retrieval of past autobiographical events requires

reintegration of various episodic details (Moscovitch et al., 2005).

Given that age-related deficits in episodic memory are pronounced for relational-memory tasks (Chalfonte & Johnson, 1996; Lyle et al., 2006; Spencer & Raz, 1995), it is not entirely surprising that the episodic specificity of past events was also reduced in older adults. Moreover, the strong correlation between VPA performance and the episodic specificity of future events suggests that imagining detailed future events also relies on relational memory and the ability to recombine and integrate details from various episodic memories. Indeed, Hassabis et al. (2007) noted that even if hippocampal amnesic patients could imagine some details about a future experience, their imagin-
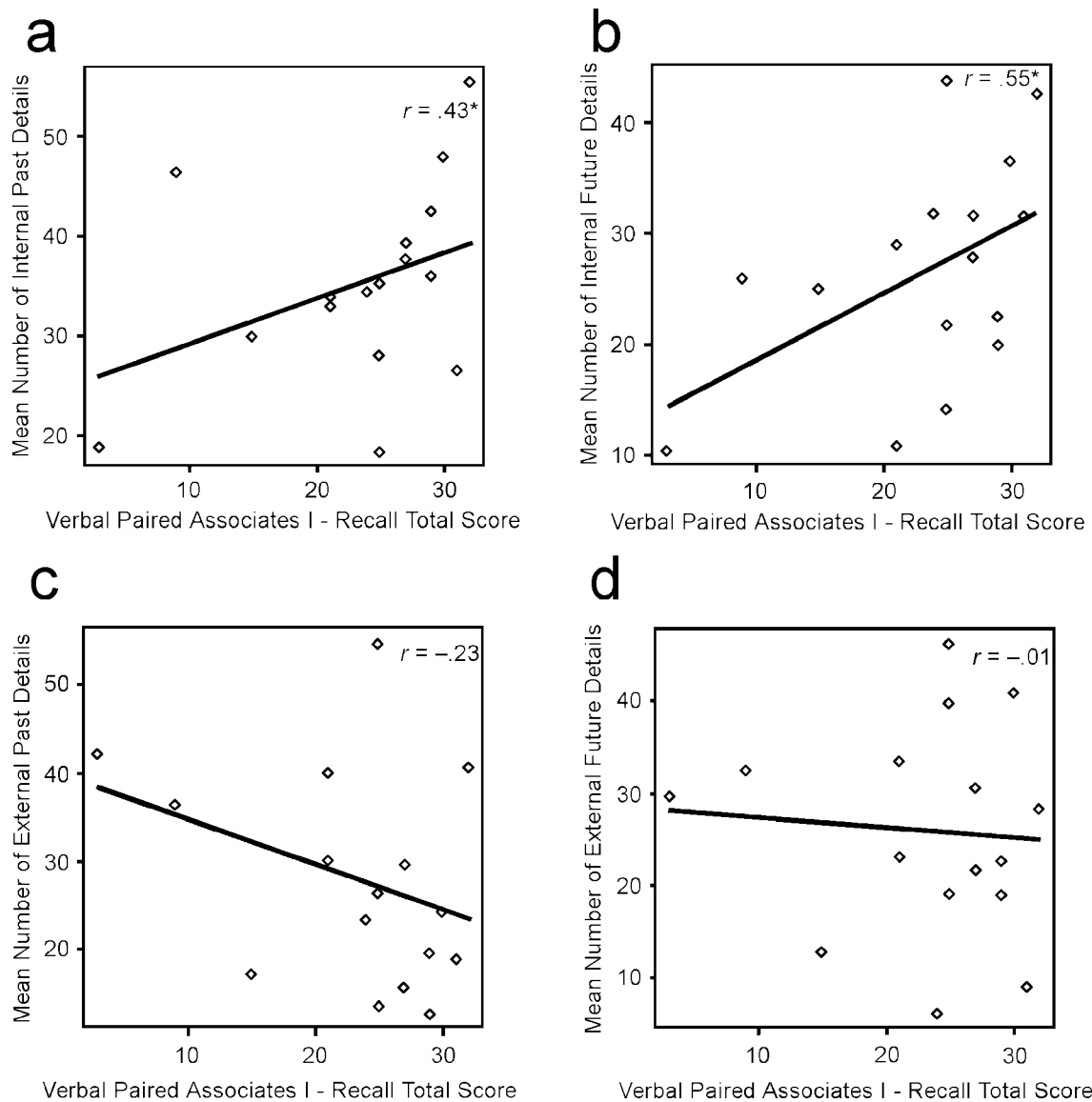
Fig. 3. Scatter plots and regression lines showing the correlations between the integrity of relational memory function in older adults (as measured by Recall Total Score from Verbal Paired Associates I) and the mean number of internal details in generated (a) past and (b) future events, as well as the mean number of external details in generated (c) past and (d) future events. Asterisks indicate significant correlations, $*p_{\mathrm{rep}} \geq .88$.

ings lacked overall coherence. Additionally, we (Addis et al., 2007) found not only that the construction of past and future events engaged the left hippocampus, but also that construction of future events recruited the right hippocampus as well. We suggested that this recruitment of additional hippocampal resources may reflect the increased relational processing required when recombining disparate details into a unique coherent event. Further research is needed, however, to examine whether the generation of past and future episodic details is associated specifically with relational episodic memory, or whether it also correlates with other measures probing different types of memory, including semantic memory.

The specificity of these findings to memory functions also remains to be determined. Do cognitive abilities aside from memory, such as executive functions, contribute to the generation of past and future episodic details? There was evidence that the episodic specificity of past and future events correlates with one measure of executive functioning, Digit Span Backwards. This observation suggests that executive functioning plays a role in event-generation tasks, as well as in digit-span tasks, which would not be entirely surprising, given that both tasks should engage attention and that executive functions are known to be involved in the retrieval (Conway & Pleydell-Pearce, 2000; Moscovitch, 1992) and specificity (Dalgleish et al., 2007) of past events. Although other studies have found specificity of future events and executive measures tapping verbal generation (e.g., phonemic fluency) to be uncorrelated (Williams et al., 1996), as reported here, neuroimaging studies suggest that the left pre-

frontal cortex plays a role in both generative processing and construction of future events (Addis et al., 2007). Future research is required to better characterize the nature of prefrontal contributions to the generation of past and future events.

The preserved ability of older adults to generate external details suggests that the age-related reduction in internal details does not simply reflect a general reduction in verbal output. This observation is further supported by the lack of correlation between AI scores and phonemic fluency. It is possible that differences in the narrative styles of young and older adults influenced the types of details generated and the apparent difference in the episodic specificity of events. For instance, older adults may have provided more external details as a result of their breadth of knowledge and wisdom (Labouvie-Vief & Blanchard-Fields, 1982) and as a means of placing events within broader and more meaningful contexts (Levine et al., 2002), whereas young adults may have adhered to the instructions to focus on a specific event. If older adults spent more of their 3-min retrieval time providing external information, their time spent producing internal details may have been minimized. If this were the case, one would expect the internal and external AI scores to have been negatively correlated. However, these correlations were negligible, which suggests that the generation of internal details was unrelated to the generation of external details and that the age-related reduction in internal details was not simply a function of focusing on external information. Rather, it was likely due to some other mechanism, and the constructive-episodic-simulation hypothesis suggests that the most likely candidate is relational episodic-memory function.

This study also provided an opportunity to examine the ways in which past and future events differ, for instance, with respect to phenomenological qualities. Representations of past and future events should differ in some respects, given previous evidence showing differences between remembered and imagined events. Thus, one would expect past and future events to differ at least in the amount of detail produced, as suggested by the reality-monitoring framework, which posits that real events contain more detail than imagined events (Johnson, Foley, Suengas, & Raye, 1988). Indeed, our study replicated previous work by D'Argembeau and van der Linden (2004) in that we found past events contained, on average, more details than future events. We also replicated D'Argembeau and van der Linden's finding that personal significance is greater for future than for past events, a pattern likely reflecting the fact that future events can be relevant to one's current goal states in a way that past events, by definition, are not.

Temporal distance also influenced event phenomenology. Events weeks into the past or future contained significantly more internal details than temporally distant events, a finding that is consistent with previous results (D'Argembeau & van der Linden, 2004; Szpunar & McDermott, in press) and that provides some support for the idea that temporally close events are represented more concretely (cf. temporal construal theory; Trope &

Liberman, 2003). Temporally distant events tended to be rated as more personally significant than close events, possibly because one can focus on insignificant, everyday events within temporally close time frames, but only more important events stand out when one is projecting further out in time. However, although D'Argembeau and van der Linden (2004) found this same pattern for future events, they found the opposite effect for past events (i.e., close events were more personally significant than distant events).

In summary, this study demonstrates that the age-related reduction of episodic specificity evident for past events extends to future events, a finding consistent with data from patients suggesting that deficits in memory can be associated with difficulties in imagining future experiences. Both the number of internal details and the number of external details showed strong positive correlations between past and future events—further evidence of the close linkage of mental representations of past and future events. Finally, in older adults, the integrity of relational memory was positively correlated with the ability to generate internal, but not external, details for both past and future events. This finding is consistent with data from hippocampal amnesic patients and with neuroimaging data implicating the hippocampus in the generation of both past and future events. Moreover, this finding is consistent with the constructive-episodic-simulation hypothesis (Schacter & Addis, 2007a, 2007b), suggesting that relational memory is an important component process of both remembering the past and imagining the future, likely supporting the reintegration of details for remembering past events and the recombination of details for imagining novel future events.

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