



Published in final edited form as:

Memory. 2018 September ; 26(8): 1140–1150. doi:10.1080/09658211.2018.1434800.

Remembering the Past and Imagining the Future: Attachment Effects on Production of Episodic Details in Close Relationships

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Abstract

Attachment theories and studies have shown that Internal Working Models(IWMs) can impact autobiographical memory and future-oriented information processing relevant to close relationships. According to the constructive episodic simulation hypothesis (CESH), both remembering the past and imagining the future rely on episodic memory. We hypothesized that one way IWMs may bridge past experiences and future adaptations is via episodic memory. The present study investigated the association between attachment and episodic specificity in attachment-relevant and attachment-irrelevant memory and imagination among young and older adults.

We measured the attachment style of 37 young adults and 40 older adults, and then asked them to remember or imagine attachment-relevant and attachment-irrelevant events. Participants' narratives were coded for internal details (i.e., episodic) and external details (e.g., semantic, repetitions). The results showed that across age group, secure individuals generated more internal details and fewer external details in attachment-relevant tasks compared to attachment-irrelevant tasks; these differences were not observed in insecure individuals. These findings support the CESH and provide a new perspective to understand the function of IWMs.

Keywords

Internal Working Models; attachment; episodic specificity; autobiographical memory; imagination

Introduction

According to attachment theory, individuals develop representations of self and others through experiences with caregivers or other attachment figures, which are termed Internal Working Models (IWMs) of attachment (Bowlby, 1969, 1980; Bretherton & Munholland, 2008; Collins & Allard, 2003). IWMs influence the ways in which individuals obtain, organize, and operate on attachment-relevant social information (Bowlby, 1980; Bretherton & Munholland, 2008; Dykas & Cassidy, 2011) and are regarded as bridges that mediate longitudinal links between early experiences and later adaptations (Dweck & London, 2004; Thompson, 2008). How do IWMs bridge the past and future? What is the cognitive mechanism underlying this connection? In the present research, we seek to provide answers to these questions from the perspective of episodic memory. We propose that IWMs may connect past and future via the mechanism of episodic memory, which enables individuals to flexibly retrieve and recombine elements of previous events into future simulations of attachment-relevant interactions (Schacter & Addis, 2007).

The Connecting Roles of IWMs

According to notions from Bowlby and many related studies, Cassidy (2000) proposed a conceptual model to summarize the formation, function, and development of IWMs from a lifespan perspective. IWMs stem from the experience of an individual's interactions with caregivers during childhood. According to Cassidy (2000), IWMs influence many aspects of cognitive-affective processes, including attention, memory, expectation, and attribution, all of which in turn guide an individual's behavior in relationships. Because an individual's behaviors can induce his or her partner's behavioral feedback, the feedback in turn shapes the individual's IWMs. As such, IWMs keep an individual's behavior and partner's feedback moving ahead as a dynamic cycle. This model clarifies the underlying processes involved in the continuity of IWMs from childhood to adulthood attachments. Cassidy's (2000) model suggests that IWMs of attachment act as a bridge to connect one's previous relationship experiences and future adaptations through various information processes (Dweck & London, 2004; Thompson, 2008).

A large body of findings have revealed the impact of IWMs on autobiographical memories (Dykas, Woodhouse, Jones, & Cassidy, 2014; Gentzler & Kerns, 2006; Haggerty, Siefert, & Weinberger, 2010; Kohn, Rholes, & Schmeichel, 2012; Öner & Gülgöz, 2016; Sutin & Gillath, 2009), which indicates that IWMs have connections with previous experiences. Autobiographical memories are recollections of past events to construct one's life history, and reflections of one's self concept and relationships with significant others (Howe & Courage, 1997). These recollections are not literal reproductions of the past, but are generated via a reconstructive process constrained by one's existing social-cognitive structures (Conway & Pleydell-Pearce, 2000; Schacter & Addis, 2007; Schacter, Gallo, & Kensinger, 2007). IWMs, acting as a schema or cognitive structure (Bretherton & Munholland, 2008), are useful in understanding individual differences in how autobiographical memories are reconstructed (Haggerty et al., 2010). Existing studies on autobiographical memory have mainly focused on how attachment shapes autobiographical memories in terms of their accessibility, affective valence, and phenomenological features,

including vividness, coherence, and emotional intensity (Dykas et al., 2014; Gentzler & Kerns, 2006; Haggerty et al., 2010; Kohn et al., 2012; Öner & Gülgöz, 2016; Sutin & Gillath, 2009). For example, attachment insecurity relates to less coherent narratives of attachment-relevant memory (Sutin & Gillath, 2009) and insecure individuals remember daily events less positively than what they originally perceived (Gentzler & Kerns, 2006).

In contrast, relatively limited efforts have been given to IWMs from the perspective of future-oriented information processes. Future-oriented information processes refers to representations of what might happen in the future, and include at least four basic forms: simulation, prediction, intention, and planning. Each of these future-oriented processes can be characterized on an episodic (thoughts about specific events that might occur in the future) to semantic (thoughts about general future states of the world) gradient (Szpunar, Spreng, & Schacter, 2014). Here we focus in particular on *episodic simulation*, that is, the construction of a detailed mental representation of a specific autobiographical future event (Schacter, Addis, & Buckner, 2008; Schacter, Benoit, & Szpunar, 2017; Szpunar et al., 2014). In the context of attachment, an episodic simulation could involve generating a specific instance in the next week in which an individual and their partner will spend time together for a few minutes to a few hours (e.g., making and eating dinner next Saturday night) and filling in the specific details of this event (e.g., the setting, the actions). In the current manuscript, we focus on the future-oriented process of episodic simulation, which we use interchangeably with the terms imagination and imagining the future.

A growing body of experimental evidence shows that episodic simulation is beneficial for various adaptive functions, including goal-directed behavior, problem solving, decision making, and subjective well-being (for reviews, see Schacter, 2012; Schacter et al., 2017). Although attachment theory maintains that IWMs enable individuals to mentally simulate future attachment-relevant events (Bowlby, 1969, p. 81; Bretherton & Munholland, 2008; Dykas & Cassidy, 2011), only a few studies have empirically examined the connections between IWMs and future-oriented processing, such as affective forecasting (Tomlinson, Carmichael, Reis, & Aron, 2010) and expected relational patterns in future long-term romantic relationships (Mohr, Cook-lyon, & Kolchakian, 2010). To the best of our knowledge, no study thus far has focused directly on the relation between IWMs and episodic simulation. Thus we believe that the present study fills an important gap in the literature on attachment theory.

Episodic Memory and IWMs

How can IWMs connect previous experiences with future-oriented information processes? We posit that episodic memory plays an underlying role in this connection, in line with the *constructive episodic simulation hypothesis (CESH)*. Episodic memory, which contains perceptual and contextual details of specific events, is necessary for precise representations of personally experienced events (Hoerl, 2007). The CESH claims that both remembering the past and imagining the future rely on the same constructive episodic memory system, which can flexibly retrieve and recombine elements of previous events into future event simulations (Schacter & Addis, 2007).

This hypothesis has been supported by clinical, behavioral, and neuroscience studies (Addis, Wong, & Schacter, 2008; Gaesser, Sacchetti, Addis, & Schacter, 2011; Klein, Loftus, & Kihlstrom, 2002; Madore, Gaesser, & Schacter, 2014; Tulving, 1985; Williams et al., 1996; for detailed review, see Schacter et al., 2012). For example, many patients with amnesia, depression, and post-traumatic stress disorders who have deficits in remembering the past also have difficulty in imagining future personal events (e.g., Addis, Hach, & Tippett, 2016; Brown et al., 2014; Cole, Morrison, Barak, Pauly-Takacs, & Conway, 2016; Klein et al., 2002; Tulving, 1985; Williams et al., 1996). Recent studies among young and older adults indicate that age-related changes in remembering the past can also be extended to imagining the future. These studies typically use an adapted version of the Autobiographical Interview (Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002) to divide an individual's descriptions of autobiographical memory or imagination (i.e., simulation) into episodic or "internal" details and "external" details (Addis et al., 2008). Internal details, including details such as who, what, where, and when information about an experienced event, draw largely on episodic memory. External details refer to details such as semantic information, repetitions, and other external events, and largely draw on semantic memory (Levine et al., 2002). Older adults typically produce fewer internal details and more external details than young adults when remembering past events using this procedure, and this pattern is the same when they imagine personal future events (Addis et al., 2008; Gaesser et al., 2011; Levine et al., 2002). Evidence from neuroimaging studies also supports the CESH. These studies indicate that remembering past and imagining future events show overlap in the neural activity of particular brain regions that comprise a core network that includes the medial temporal lobes, retrosplenial and posterior cingulate cortices, lateral temporal and parietal areas, and medial prefrontal cortex (Addis, Wong, & Schacter, 2007; Benoit & Schacter, 2015; Schacter et al., 2012).

Based on the CESH, and evidence that remembering the past and imagining the future show similar patterns on behavioral indices, we propose that episodic memory could be a possible mechanism that enables IWMs to connect past experiences and future experiences via the processing of episodic details. Two lines of evidence support this notion.

The first line of evidence comes from attachment theory. It proposes that IWMs are composed at least in part of elements of episodic memories that involve the attachment figure, and that activation of the attachment system will automatically heighten the accessibility of episodic memories about interactions with the attachment figure (Mikulincer & Shaver, 2003), especially among current close relationships (Collins & Allard, 2003). Attachment theory also maintains that IWMs store "if...then..." models, which enable individuals to mentally do a "small scale experiment" to simulate future attachment-relevant events (Bowlby, 1969, p.81). More specifically, IWMs enable individuals to mentally simulate interactions with attachment figures (Bretherton & Munholland, 2008; Gallese, 2005). According to the CESH (Schacter & Addis, 2007), this kind of simulation process is highly reliant on episodic processing.

The second line of evidence comes from studies of the relationship between attachment and autobiographical memory, which indirectly indicate that IWMs influence the episodic specificity of attachment-relevant events. Although there are few studies investigating the

relationship between attachment and the episodic specificity of attachment-relevant memories, IWMs are strongly related to an individual's autobiographical memories for attachment-relevant information, and thus may influence the specificity of episodic memory. More precisely, previous research indicates that secure individuals often process attachment-relevant social information openly, do not exclude or suppress attachment-relevant social information, and flexibly provide coherent episodic and autobiographical memories to support the descriptions of their attachment relationships (Hesse, 1999, 2008). On the contrary, insecure individuals tend to use an exclusion or suppression strategy when processing attachment-relevant information, may have a global impression about what their relationship was generally like but fail to provide specific memories, and limit their access to attachment memories (Fraley & Brumbaugh, 2007; Fraley, Garner, & Shaver, 2000; Main, Hesse, & Goldwyn, 2008). Other studies reveal that insecure individuals exhibit slower retrieval (Dykas, Woodhouse, Ehrlich, & Cassidy, 2010), less specific memory for events (Bosmans, Dujardin, Raes, & Braet, 2012; Farrar, Fasig, & Welch-ross, 1997), and less coherent, organized, and consolidated memory than secure individuals (Shaver, Belsky, & Brennan, 2000; Sutin & Gillath, 2009).

Current study

In the present study, we investigate the bridging function of IWMs by testing the relationship between attachment security and episodic specificity in attachment-relevant and attachment-irrelevant memory and imagination among young and older adults. Episodic specificity, which is closely associated with the amount of episodic detail in a memory or simulation, differs across individuals (Levine et al., 2002). Previous research indicates that the more specific the episodic details retrieved or simulated, the better the performance on a variety of tasks that tap adaptive functions, including simulating future events (Madore, Gaesser, & Schacter, 2014), solving means-end problems (Jing, Madore, & Schacter, 2016; Madore & Schacter, 2014; McFarland, Primosch, Maxson, & Stewart, 2017), and forming prosocial intentions (Gaesser & Schacter, 2014). We used an adapted version of the Autobiographical Interview procedure in our study (Levine et al., 2002), a method that measures an individual's generation of autobiographical memories and imagined events in terms of episodic or internal details (such as who, what, where, and when details) and external details (including semantic information, repetitions, commentary, and related events). The number of episodic or internal details is thought to represent the episodic specificity of an event (Addis et al., 2008; Madore et al., 2014; Madore & Schacter, 2014) in an objective and reliable way.

We first examined the effect of age on internal and external details for memory and imagination to verify the validity of our study procedure, as the methodology adopted was one of the first to be applied to a Chinese sample (see Wang, Hou, Tang, & Wiprovnick, 2011, for another example). Previous studies have revealed that older adults generate fewer internal details and more external details in autobiographical memory and imagination (Addis et al., 2008; Gaesser et al., 2011). If the adopted methodology is valid across cultures, then we hypothesize that the same age effect will be observed:

H1: Older adults would generate fewer internal details and more external details in autobiographical memory and imagination compared to young adults.

According to attachment theory and the studies outlined above, insecure individuals often use a global impression strategy when processing attachment-relevant information (Fraley & Brumbaugh, 2007; Fraley et al., 2000; Main et al., 2008), and shift more attention to attachment-irrelevant information than attachment-relevant information (Rholes, Simpson, Tran, Martin, & Friedman, 2007). Attachment-relevant information refers to that involving an attachment figure, whereas attachment-irrelevant information refers to that without an attachment figure. If insecure individuals have deficiencies in the specificity of attachment-relevant autobiographical memory, then they might generate more details that are irrelevant to specific attachment events. Combining these observations with the CESH, which claims that individual differences in episodic memory extend to future imagination, we hypothesized that:

H2: There would be a significant interaction between attachment style and the type of details generated. It was expected that secure individuals would generate more internal details and fewer external details in attachment-relevant memory than insecure individuals, and also that this pattern would extend to attachment-relevant imagination.

Dykas and Cassidy (2011) have proposed that when investigating the relationship between attachment and the processing of social information, researchers should also examine issues of discriminant validity by incorporating non-attachment-relevant variables for consideration. In the present study, in order to assess whether the bridging function of IWMs only exists in attachment-relevant events, we asked participants to recall or imagine personal events experienced with their attachment figure (i.e., attachment-relevant) and also personally experienced events that are irrelevant to the attached person (i.e., attachment-irrelevant). According to attachment theory, attachment-irrelevant memory and imagination should not activate the attachment system like attachment-relevant memory and imagination, so we proposed that:

H3: The difference between secure and insecure individuals in internal and external details would be significant in attachment-relevant memory and imagination tasks but not significant in attachment-irrelevant memory and imagination tasks.

Method

Participants

There were 37 young adults (age 19–27 years, $M = 22.41$, $SD = 1.95$, 20 female) and 40 older adults (age 60–77 years, $M = 64.58$, $SD = 4.02$, 29 female) that participated in this study. All young adults were recruited from Beijing Normal University with the following criteria: (1) currently in a romantic relationship and (2) the current romantic relationship was maintained for no less than 6 months (6–125 months, $M = 32.27$, $SD = 25.45$), to ensure that their close relationship had been relatively stable and participants would likely have sufficient significant autobiographical events to be retrieved. Older adults whose spouses were still living were recruited from communities near the university (married for 8–47

years, $M = 35.38$, $SD = 7.86$). Both young and older adults had normal or corrected to normal vision and no history of neurological impairments. All older adults also completed the Mini-Mental Status Examination (Folstein, Folstein, & McHugh, 1975) and had a score of 26 or above (26–30, $M = 28.48$, $SD = 1.15$).

Procedure

Participants first completed a basic information sheet and the Relationship Questionnaire (Bartholomew & Horowitz, 1991). Then they completed four Autobiographical Interview-based tasks, i.e., attachment-relevant memory, attachment-irrelevant memory, attachment-relevant imagination, and attachment-irrelevant imagination. For each task, participants completed three test trials. In total, there were 14 trials, including two practice trials at the very beginning of the whole procedure. For each trial, participants were presented a picture cue while being asked to verbally describe an event from either memory or imagination related to this cue, i.e. three events should be generated in each task. Each task condition was presented in a block, and the order of the blocks was counterbalanced across participants.

Measurements

Relationship Questionnaire (RQ)—The Relationship Questionnaire was used to measure the general attachment style of participants (Bartholomew & Horowitz, 1991). It included four passages, with each describing one typical attachment style, namely preoccupied, fearful, secure, or dismissing. Participants needed to choose the one best representing them. Distinct from the secure individuals, those individuals who chose the other three styles were grouped into the insecure style in the present study. Among all the subjects, 15 young adults and 22 older adults belonged to the secure style, and 22 young and 18 older adults belonged to the insecure style.

Adapted Autobiographical Interview—In the present study, we used a version of the adapted Autobiographical Interview (AI) that has been used previously by Gaesser et al. (2011), where pictures of everyday scenes are used to cue both autobiographical memories and imagined future events. We modified the original tasks into a four-block task. The pictures (size: 964×734 pixels) used in this study were selected from a pilot study. In the pilot study, 15 participants for each age group were recruited to rate the pictures regarding the familiarity, imaginability, and accessibility. For each age group, 14 pictures were selected as the experimental cues, as they met the following criteria: 1) the average scores of 15 raters were above 4 on familiarity and imaginability on a 7-point Likert scale and 2) most raters reported that their memory with or without their attachment figures could be accessed by the picture cue.

For attachment-relevant memory trials, participants were asked to recall one event per trial that they had previously experienced with their lover or spouse. For attachment-irrelevant memory trials, participants were asked to recall one event per trial that they had experienced by themselves, with acquaintances, or with strangers. For attachment-relevant imagination trials, participants were asked to imagine one event per trial that would be experienced in the future with their lover or spouse. For attachment-irrelevant imagination trials, participants

were asked to imagine one event per trial that would be experienced in the future by themselves, with acquaintances, or with strangers. All of the recalled and imagined events were required to be recent events, namely, within the last few years or next few years. Each event was also required to be specific in one time and one place. For each trial, participants were given 3 minutes and instructed to describe the event in as much detail as possible.

Coding—Consistent with the procedures of previous research (Gaesser et al., 2011; Madore et al., 2014), all of the descriptions were first audio-recorded and transcribed. Next, the central event was identified in each transcription by reading through each description on a trial-by-trial basis and identifying the main event defined as occurring on one specific day in one place. Then each description was segmented into distinct details as specifically as possible and coded as internal details or external details as specifically as possible. For each of the tasks, internal details were defined as episodic bits of information about the central event of each memory or imagination, including the people, actions, thoughts, feelings, setting, time, objects, and so on; the number of internal details was the main index of episodic specificity. In contrast, external details were defined as any details not related to the central event in an episodic way. External details included those bits of information that were semantic in nature (e.g., factual or general statements), off-topic (e.g., commentary about the task), or repetitive. Episodic information that was off-topic (i.e., not related to the central event) was also scored as external details. Thus, external details as an index includes, but is not limited to, semantic information.

The coding system was also adapted from Gaesser et al. (2011) and Madore et al. (2014) to better meet the characteristics of the Chinese language. Two of four raters were assigned to code the discourses of young adults and the other two raters coded the discourses of older adults. These four raters were assessed for interrater reliability based on intraclass correlation analyses for scores of 10 participants in each block before separating into two coding groups, using a two-way mixed model. The standardized Cronbach's α ranged from 0.87 to 0.98 for internal and external scores of these four blocked tasks (attachment-relevant memory: 0.89, 0.89; attachment-relevant imagination: 0.97, 0.93; attachment-irrelevant memory: 0.98, 0.91; attachment-irrelevant imagination: 0.96, 0.87). We also assessed the interrater reliability of the two raters in each age group, and the standardized Cronbach's α for internal and external ranged from 0.80 to 0.96 in the young adult group, and 0.93 to 0.98 in the older adult group. All raters were blind to the experimental hypotheses.

We also had two coders rate the emotional valence of each event generated by participants on a scale ranging from -3 (very negative) to $+3$ (very positive) to ensure that any differences in task performance that we observed could not be attributed to this phenomenological factor. The interrater reliability of the two raters ranged from 0.83 to 0.91 (attachment-relevant memory: 0.85; attachment-relevant imagination: 0.87; attachment-irrelevant memory: 0.91; attachment-irrelevant imagination: 0.83).

Results

Before examining our main hypotheses, we performed two preliminary analyses to ensure that our task paradigm and scoring procedures were adequate. First, we tested whether

emotional valence influenced the internal details of events that participants generated. The results indicated that there was no significant correlation between emotional valence and internal details for any of the task conditions ($r_{\text{attachment-relevant memory}} = 0.13$, $r_{\text{attachment-relevant imagination}} = -0.04$, $r_{\text{attachment-irrelevant memory}} = -0.19$, $r_{\text{attachment-irrelevant imagination}} = -0.1$; $ps > 0.05$). Given the results of these analyses, we did not evaluate emotional valence in the study further. Second, we examined the consistency between memory and future simulation by conducting a set of regression analyses. Controlling for age and attachment style, we found that the number of internal details in attachment-relevant memory significantly correlated with internal details in attachment-relevant imagination, $\beta = 0.59$, $R^2 = 0.31$, $p < 0.001$ (Fig. 1), and that the number of internal details in attachment-irrelevant memory significantly correlated with the number of internal details in attachment-irrelevant imagination, $\beta = 0.44$, $R^2 = 0.19$, $p < 0.001$ (Fig. 2). These results confirm that episodic details were being generated in all four task conditions and that episodic specificity may bridge attachment narratives of memory and imagination.

We then tested our main hypotheses in a series of analyses. Table 1 summarizes the number of details generated by young and older adults in each task as a function of attachment style. We addressed our hypothesis 1 by conducting a 2 (Task: Memory vs. Imagination) \times 2 (Event: Attachment-relevant vs. attachment-irrelevant) \times 2 (Detail: Internal vs. External) \times 2 (Age: Young vs. Older adults) mixed-factorial analysis of variance (ANOVA) without including Attachment style. Task, Event, and Detail were within-subject variables and Age was a between-subject variable. We found significant main effects of Task and Detail, as participants generated more internal details than external details, $F(1, 75) = 302.597$, $p < 0.001$, $\eta^2 = 0.80$, and there were more details generated in memory than in imagination, $F(1, 75) = 94.390$, $p < 0.001$, $\eta^2 = 0.56$. There was no main effect of Age or Event. Critically, we found that the interaction of Detail \times Task \times Age was significant, $F(1, 75) = 8.105$, $p < 0.01$, $\eta^2 = 0.10$. The simple effect analysis revealed that there were more internal details than external details generated in memory and imagination among young adults, and the tendency was similar among older adults ($ps < 0.01$). Importantly, young adults also generated more internal details and fewer external details than older adults both in memory and imagination ($ps < 0.001$) despite one marginally significant difference between internal details for memory in young adults and in older adults ($p = 0.071$) (Fig. 3). These results are consistent with previous research on age-related differences in memory and imagination with respect to internal and external details (Addis et al., 2008; Gaesser et al., 2011; Madore et al., 2014), which supports the CESH and indicates that an AI-based methodology is applicable to a Chinese sample (cf., Wang et al., 2011).

Critically, the Age \times Detail \times Event interaction was not significant, $F(1, 75) = 0.981$, $p = 0.33$, $\eta^2 = 0.013$, suggesting that the attachment relevance of the event did not affect age-related performance. While not of central interest, the interaction of Event \times Detail \times Task was significant, $F(1, 75) = 5.547$, $p < 0.05$, $\eta^2 = 0.07$. Specifically, there were more internal details than external details generated in attachment-relevant memory and imagination, and this pattern was almost the same among attachment-irrelevant tasks ($ps < 0.001$). However, there were also more internal details generated in attachment-relevant imagination than in attachment-irrelevant imagination, while there were no other differences between details

generated in these two kinds of events (Fig. 4). There were no other interaction effects found in the analysis.

In order to address our other main hypotheses, we next examined differences in performance as a function of Attachment style by conducting a 2 (Task: Memory vs. Imagination) \times 2 (Event: Attachment-relevant vs. Attachment-irrelevant) \times 2 (Detail: Internal vs. External) \times 2 (Age: Young vs. Older adults) \times 2 (Attachment style: Secure vs. Insecure) mixed-factorial analysis of variance (ANOVA). The results showed that there was no main effect of Attachment style. Critically, a significant interaction effect related to Attachment style was found for Event \times Detail \times Attachment style, $F(1, 73) = 8.290, p < 0.01, \eta^2 = 0.10$. Secure individuals generated more internal details and fewer external details in attachment-relevant memory and imagination than in attachment-irrelevant memory and imagination ($ps < 0.05$) (Fig. 5) across age groups, while these differences were not found among insecure adults across age groups. No other interactions in the analysis reached full significance (though not of central interest, the interaction of Event \times Age \times Attachment style was marginally significant, $F(1, 73) = 3.113, p = 0.08, \eta^2 = 0.04$).

Discussion

The present study applies a novel perspective to examine the role of IWMs in connecting attachment-relevant memory and imagination, and new evidence in support of the CESH. Specifically, two main findings were obtained. First, attachment differences were demonstrated in terms of episodic specificity. This difference was exhibited when processing attachment-relevant in contrast to attachment-irrelevant episodic information. Moreover, we found that secure individuals generated more internal details and fewer external details for attachment-relevant events than attachment-irrelevant events, while this difference was not observed among insecure individuals.

Second, we found that the difference between secure and insecure attachment in the episodic specificity of memory was also observed in imagination. This finding identifies a potential connecting role of IWMs of attachment from past to future experiences, and provides additional evidence in support of the CESH. We discuss below the main findings on attachment differences and episodic specificity, and the connecting role of IWMs, followed by a discussion about implications for the CESH.

Validity of the Autobiographical Interview

As expected, regardless of age and attachment style, the number of internal details of memory significantly correlated with internal details of imagination both in attachment-relevant events and attachment-irrelevant events. Older adults also generated fewer internal details and more external details in autobiographical memory and imagination than young adults. These results confirmed those of previous studies (Addis et al., 2008; Gaesser et al., 2011; Levine et al., 2002; Madore et al., 2014) and supported our first hypothesis, H1, which validated the adapted Autobiographical Interview in a Chinese sample. The robust results across previous studies and the current study demonstrate that the CESH is applicable in accounting for the common mechanism underlying both memory and imagination in

different cultural samples (for additional evidence, see Wang et al., 2011) and in attachment narratives.

Attachment Difference in Episodic Specificity

Our findings partially support hypothesis H2 and H3. As expected in H2, we found a significant interaction of Attachment style \times Event \times Detail, which revealed attachment effects on episodic specificity. However, the post-hoc test showed that the interaction patterns were manifested in a way that was different from the pattern expected for H2 and H3. With respect to the attachment effects, secure participants generated more internal details and fewer external details for attachment-relevant tasks than for attachment-irrelevant tasks, while such differences were not significantly observed among insecure participants. None of the other interactions in the analyses reached full significance in regards to these hypotheses.

It is arguable that these findings still indicate a distinguishable difference between the secure and the insecure individuals in processing attachment-relevant information. For example, the findings suggest a difference in the salience of attachment-relevant events between the two groups. According to the self-memory system view (Conway, 2005), attachment-relevant events are more salient in emotional intensity and higher in self-relevance and thus are more accessible than attachment-irrelevant events. However, the current study suggested that this was only the case for the secure individuals. The reason might lie in the observation that secure individuals, compared to their insecure counterparts, tend to process attachment-relevant information openly, do not exclude or suppress attachment-relevant social information, and provide coherent episodic and autobiographical memories to illustrate the descriptions of their attachment relationships (Hesse, 1999, 2008). This result is also consistent with the finding that desirable future simulations (i.e., attachment-relevant events for secure individuals) are richer in internal details than less desirable future events (de Vito, Neroni, Gamboz, Della Sala, & Brandimonte, 2015). For the insecure, the results suggest that information is processed for attachment-relevant and attachment-irrelevant events in non-distinguishable ways. This result is consistent with previous notions that insecure attachment might be a factor that leads to a person developing overgeneralized autobiographical memory (Beyderman & Young, 2016; Valentino, 2011). One possible reason for this effect could be that insecure people tend to not recall specific attachment-relevant events during remembering, as previous evidence suggests that insecure individuals tend to fail to provide specific memories as they use an exclusion and suppression strategy when processing attachment-relevant information and may rely on global impressions about what their relationship was generally like but fail to provide specific memories (Fraley & Brumbaugh, 2007; Fraley et al., 2000; Main et al., 2008). The findings of the present study are also consistent with the rationale of the Adult Attachment Interview (AAI). In the AAI, participants are asked to draw on specific memories of their past regarding their attachment relationships. Whether interviewees can provide specific memories to support their perceptions of their attachment relationships is an important indicator of a secure state of mind (Hesse, 1999, 2008). The present study indicates that this adopted method in the AAI could also be extended to future simulation.

The connecting roles of IWMs

As expected in H3, the present study found that the difference between secure and insecure individuals in remembering past events can also be observed in future imagination, which supported the notion that IWMs of attachment can connect one's previous experiences with future adaptations (Cassidy, 2000). According to the present study, we can infer that the connecting role of IWMs may work through the mechanism of episodic memory. This idea is similar to Conway's (2005, p. 597) notion that IWMs are not abstracted knowledge structures "that exist independently of specific temporally defined incidents (episodic memories and autobiographical knowledge), but are connected to autobiographical knowledge and the episodic memory system to activate specific instances that exemplify, contextualize, and ground their underlying themes or concepts". The results in our study provide direct empirical evidence to support this viewpoint.

Likewise, this mechanism of episodic memory seems to enable individuals to retrieve and recombine stored episodic information into a novel scenario that reflects their expectations of the availability and responsiveness of an attachment figure. However, the flexibility of retrieving and recombining episodic information is restricted by an individual's attachment style. For instance, secure individuals may be better able to retrieve attachment-relevant episodic details to form the expectations of an attachment figure (Fraley & Brumbaugh, 2007; Fraley et al., 2000; Main et al., 2008), whereas insecure individuals may be less able to generate accurate or detailed expectations and thus may exhibit less proper adaptations towards an attachment figure.

Implications for the CESH

In the present study, we report two main findings that bear on the CESH. First, the replication of age effects on internal/external details across memory and imagination demonstrates that deficits of episodic memory processing in older adults compared to young adults can account, at least in part, for age-related differences on these tasks, as stipulated by the CESH (cf., Gaesser et al., 2011). Second, we provide a new way to test the CESH from an individual differences perspective. The current study is the first to apply this hypothesis to a developmental individual differences topic focused on attachment style. Future research could examine other developmental individual differences by applying the CESH to additional contexts related to episodic processing, such as coping style (Ganly, Salmon, & McDowall, 2016).

Limitations and Future Directions

There are several limitations to the present study. First, although our study tends to support the connecting function of IWMs between past and future experiences of close relationships, this is a cross-sectional design and therefore cannot totally verify the dynamic bridging function of IWMs proposed by Cassidy (2000). A better way to investigate this idea would be to conduct a longitudinal study to observe how past experience affects IWMs and in turn impacts future relationships. Second, the current sample is limited to one secure and one insecure group, as there were not enough cases of each insecure type of attachment to justify further analyses. This approach might have underestimated potential attachment differences in episodic processing within insecure styles of attachment. In addition, caution is warranted

in generalizing these findings due to the limited sample. Third, while our findings that secure individuals generated more internal details and fewer external details for attachment-relevant than attachment-irrelevant memory and imagination indicates an important link between episodic retrieval and simulation on the one hand and attachment processes on the other, our findings concerning external details should not be taken as evidence against a link between semantic memory and attachment processes. As noted earlier, external details include semantic information, but also include repetitions, commentary, and other events. Thus there is no one-to-one mapping between external details and semantic memory, and the relationship between internal and external details is complex (for recent evidence and discussion, see Devitt, Addis, & Schacter, 2017). Fourth, while our study focused on the coding of internal and external details because our interest was in the role of episodic specificity in attachment, future work should examine other elements that could bridge memory and simulation in attachment narratives, such as coherence (Hesse, 1999, 2008), or other phenomenological features of remembered and imagined events (see D'Argembeau & Van der Linden, 2004).

Despite these limitations, the present results provide novel evidence for a link between research concerning constructive episodic simulation of past and future events on the one hand, and IWMs and attachment styles on the other. In addition, the present study provides some implications for the improvement of attachment security. Methods that have been shown to boost the episodic specificity of remembered and imagined events, such as an episodic specificity induction (Madore et al., 2014; Jing et al., 2016; Jing, Madore, & Schacter, 2017; Madore & Schacter, 2014; for review, see Schacter & Madore, 2016), could be applied to attachment-relevant events with the goal of promoting attachment security and positive behavior toward a partner. Future studies that build on the foundations established here should increase our understanding of the adaptive functions of memory and imagination.

Acknowledgments

This work was supported by the Ministry of Education of China under Grant 13JJD190001; and the National Institute on Aging under Grant AG08441 to D.L.S

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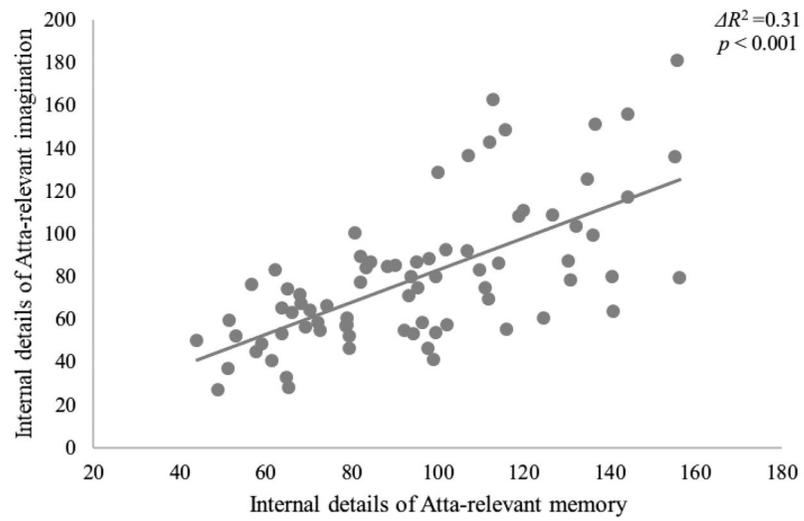


Figure 1. Correlation between memory and imagination on internal details of attachment-relevant events

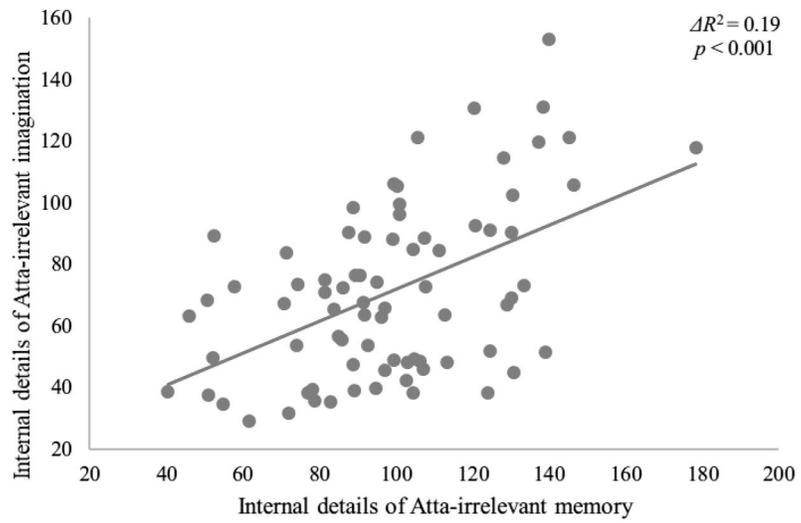


Figure 2. Correlation between memory and imagination on internal details of attachment-irrelevant events

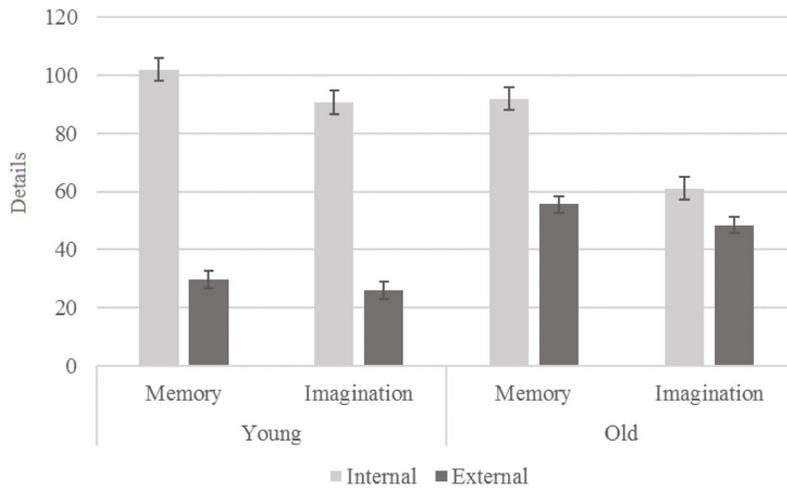


Figure 3. Mean details reported by young and older adults across memory and imagination

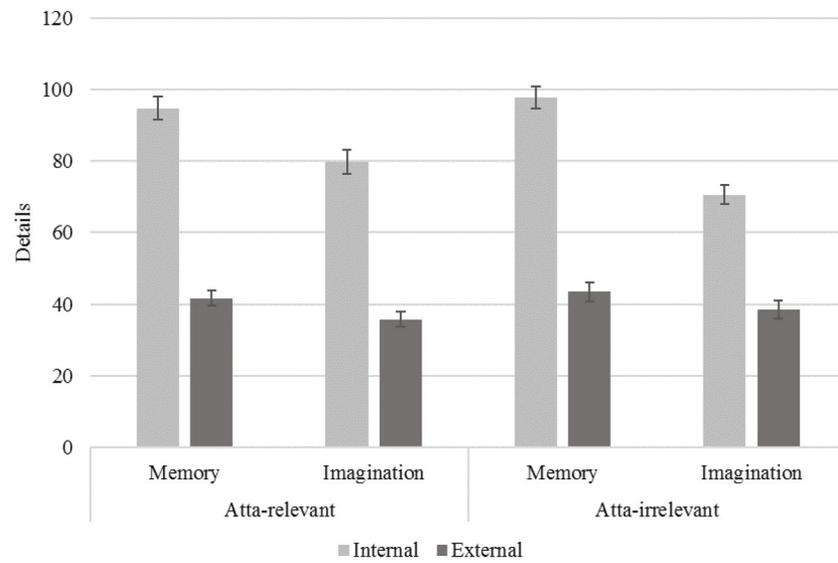


Figure 4. Mean details of attachment-relevant events and attachment-irrelevant events across memory and imagination

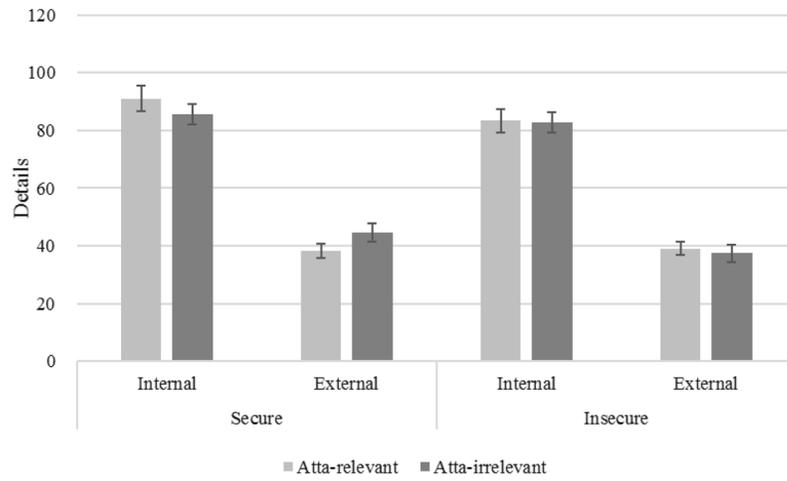


Figure 5. Mean details of attachment-relevant events and attachment-irrelevant events as a function of attachment style

Table 1

Number of details generated by young and older adults in each task as a function of attachment style

	Atta-relevant memory		Atta-relevant imagination		Atta-irrelevant memory		Atta-irrelevant imagination	
	Internal	External	Internal	External	Internal	External	Internal	External
Young adults								
Secure (n=15)	101.61 (28.1)	28.61 (12.26)	94.3 (32.83)	24.27 (10.71)	97.82 (28.79)	32.43 (18.81)	79.28 (21.64)	28.67 (11.28)
Insecure (n=22)	102.45 (31.54)	29.44 (11.15)	95.95 (34.94)	23.88 (13.55)	104.53 (29.51)	28.96 (13.36)	90.53 (25.4)	27.79 (14.44)
Total (n=37)	102.11 (29.79)	29.1 (11.45)	95.28 (33.64)	24.04 (12.32)	101.81 (29.01)	30.37 (15.65)	85.97 (24.29)	28.15 (13.09)
Older adults								
Secure (n=22)	97.82 (22.38)	54.34 (19.94)	70.47 (29.07)	46 (19.72)	101.11 (25.5)	63.05 (31.72)	64.32 (28.56)	54.17 (29.64)
Insecure (n=18)	77.28 (28.07)	54.27 (25.81)	58.08 (17.43)	48.9 (25.28)	87.78 (22.67)	49.59 (22.47)	48.48 (12.98)	43.59 (24.01)
Total (n=40)	88.58 (26.84)	54.31 (22.46)	64.89 (25.03)	47.3 (22.14)	95.11 (24.89)	56.99 (28.42)	57.19 (24.01)	49.41 (27.43)

Note. Standard deviations are given in parentheses.