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Divergent thinking and constructing future events: Dissociating old from new ideas

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Abstract

Divergent thinking (the ability to generate creative ideas by combining diverse types of information) has been previously linked to the ability to imagine novel and specific future autobiographical events. Here, we examined whether divergent thinking is differentially associated with the ability to construct novel imagined future events and recast future events (i.e., actual past events recast as future events) as opposed to recalled past events. We also examined whether different types of creative ideas (i.e., 'old ideas' from memory or 'new ideas' from imagination) underlie the linkage between divergent thinking and various autobiographical events. Divergent thinking ability was measured using the Alternate Uses Task (AUT). In Experiment 1, the amount of episodic details for both novel and recast future events was associated with divergent thinking (AUT scores), and this relationship was significant with AUT scores for new creative ideas but not old creative ideas. There was no significant relationship between divergent thinking and the amount of episodic detail for recalled past events. We extended these findings in Experiment 2 to a different test of divergent thinking, the Consequences Task. These results demonstrate that individual differences in divergent thinking are associated with the capacity to both imagine and recast future events.

Keywords

episodic memory; episodic simulation; creativity; individual differences; future thinking

Divergent thinking refers to the ability to generate creative ideas by combining diverse kinds of information in novel ways (Guilford, 1967). In the laboratory, the Alternate Uses Task (AUT) has been frequently used to measure divergent thinking ability (Guilford, 1967). In this task, participants are presented an object cue word, such as 'newspaper', and asked

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to generate unusual and creative uses for the object (e.g., 'to use it as an umbrella'). Importantly, performance on the AUT is positively correlated with real-world measures of creative thinking (e.g., Carson, Petersen, & Higgins, 2005; see also, Plucker, 1999; Runco, Millar, Acar, & Cramond, 2010). The dominant view is that semantic processing, such as the retrieval, selection, and integration of associated concepts, supports divergent thinking (e.g., Howard-Jones, Blakemore, Samuel, Summers, & Claxton, 2005; Abraham et al., 2012; Acar & Runco, 2014; Beaty, Silvia, Nusbaum, Jauk, & Benedek, 2014; Wu et al., 2015; Hass, 2017; for reviews, see Abraham, 2014; Benedek & Fink 2019).

A growing body of studies have provided support for an alternative view which states that episodic processing, such as the retrieval of specific and self-relevant personal events (i.e., episodic memory), can also contribute to divergent thinking. For example, patients with hippocampal damage not only have deficits in episodic memory but also perform lower on divergent thinking tasks relative to controls (Duff, Kurczek, Rubin, Cohen, & Tranel, 2013). In addition, studies have shown that participants draw on episodic memories to generate creative ideas in the AUT (e.g., Gilhooly, Fioratou, Anthony, & Wynn, 2007; Storm & Patel, 2014). In addition to this behavioral evidence, some studies have employed functional magnetic resonance imaging (fMRI) to test for overlap in the neural regions recruited during episodic and divergent thinking. In one fMRI study, Beaty, Thakral, Madore, Benedek, and Schacter (2018) found that the regions engaged during episodic remembering and future imagining (i.e., the 'core network'; Benoit & Schacter, 2015), are also engaged during divergent thinking in the AUT.

Additional evidence for a link between episodic and divergent thinking comes from studies directly manipulating episodic processing to test for a concomitant effect on divergent thinking. Some have examined this link using the episodic specificity induction (ESI), a brief training in recollecting specific details of a specific event (for a review, see Schacter & Madore, 2016). Following the ESI relative to a control induction, participants generate more episodic details (e.g., who, what, when, and where information) when recalling past events and imagining novel future events (i.e., episodic simulations), and they also generate more creative ideas on the AUT (e.g., Madore, Addis, & Schacter, 2015; Madore Thakral, Beaty, Addis, & Schacter, 2019). These effects of the ESI were specific to episodic and divergent thinking: ESI effects were not observed on tasks that do not draw on episodic processing (e.g., describing a picture; Madore, Gaesser, & Schacter, 2014) or divergent thinking (e.g., on the Remote Associates Task, a standard test of convergent creative thinking; Mednick, 1962). Complementing the ESI, we recently employed fMRI-guided transcranial magnetic stimulation (TMS) to manipulate episodic processing by applying a virtual lesion that indirectly impacted the hippocampus, a core network region known to be engaged during episodic memory and simulation (Thakral, Madore, Kalinowski, & Schacter, 2020). Following TMS that impacted the hippocampus, participants generated fewer episodic details when imagining future events and also generated fewer creative ideas on the AUT, than following TMS to a control site.

The prior findings suggest that episodic processing is involved in divergent creative thinking. The main goal of the present study is to build on these findings by identifying the *specific* episodic processes that overlap those engaged during divergent creative thinking. To our knowledge, only one study has reported a dissociation between specific types of episodic processing in relation to divergent creative thinking (Addis, Pan, Musicaro, & Schacter, 2016). Addis et al. (2016) employed an individual differences approach and tested for a correlation between performance on the AUT and the number of episodic details comprising three different types of autobiographical episodes by using the *experimental recombination paradigm* (Addis et al., 2009). In this paradigm, participants first retrieve autobiographical memories, specifying a person, place, and object that features in each. They later return for a separate session in which they are cued with sets of person, place and object details to recall and/or imagine episodes in as much detail as possible; critically, in the imagine conditions, the details are recombined across multiple autobiographical memories. In Addis et al., (2016), participants recalled memories from the past (*past-recall* task), simulated novel future events using recombined details from disparate memories (*future-imagine* task), and simulated novel past episodes using recombined details from disparate memories (*past-imagine* task). By testing for a differential correlation across these types of episodes, Addis et al. (2016) were able to tease apart different episodic-related processing. Specifically, the three types of autobiographical episodes differ as a function of temporal orientation (i.e., past versus future) and the degree of recombination needed to construct the episode (i.e., original episodes in the recall task [low recombination demand] versus novel episodes in the imagine tasks [high recombination demand]). The finding that divergent thinking correlates with the amount of episodic detail for imagined events (both past and future) but not recalled events would have indicated that divergent thinking is supported by the flexible recombination of stored episodic details that also supports the imagination of novel events. However, Addis et al. (2016) found that AUT performance was significantly correlated with the amount of episodic detail for only imagined future events, with no relationship to imagined or recalled past events. Addis et al. (2016) interpreted these effects as reflecting differential levels of 'cognitive constraint'. That is, both imagined and recalled past events are constrained by what has actually happened. In contrast, during both divergent thinking and imagining the future, there is greater opportunity for flexible and open-ended thought. These findings suggest that divergent thinking is associated with the ability to create detailed simulations of future possible experiences.

The present study had three aims. Our first aim was to assess whether future episodic thinking contributes to divergent thinking. To achieve this aim, we ran a series of hierarchical multiple regression analyses where the number of episodic details generated for the future-imagine task was entered as a predictor for divergent thinking performance in Step 1, and the number of episodic details generated for the past-recall task was entered as an additional predictor in Step 2. Findings consistent with Addis et al. (2016) would be evidenced in a significant link between imagined future events and divergent thinking, with the relationship to the recalled past events being non-significant. Our second aim was to assess whether divergent thinking relates to the simulation of *any* kind of future autobiographical episode. Because Addis et al. (2016) tested only imagined future events, we examined whether divergent thinking is differentially associated with not only the ability to construct *imagined* future events but also with we have referred to as *recast* future events – i.e., actual past events that participants recast as future events. Although recast events share a temporal orientation with imagined future events, they do not require the same degree of detail recombination. If divergent thinking is linked to the construction of all kinds of future episodes, the number of episodic details comprising both imagined and recast future events should predict divergent thinking performance. Such a finding would provide further support for the idea that divergent thinking is linked to episodic thinking via a common temporal orientation process to the future, and not the need to flexibly recombine episodic information. With respect to this latter issue, our usage of the same experimental recombination paradigm as in Addis et al. (2016, see above) is critical. For novel imagined future events, this paradigm makes cognitive demands on participants to think of how to recombine episodic details from disparate past events into a coherent, novel episode. It is possible this kind of recombinatory episodic processing is what links future imagining to divergent thinking (e.g., Madore et al., 2016). By contrast, recasting a past event into the future does not require the same sort of recombinatory processing, and instead relies primarily on cognitive activities related to temporal orientation, such as attaching a new temporal label to an existing memory (for a discussion, see Addis et al., 2009). Because recasting does not make the same sort of demand on recombinatory processing as does imagining a future event, but does require participants to project an event into the future, including this condition can help to determine whether the observed link to divergent thinking is primarily related to recombinatory processing or orientation to the future.

Our third aim was to examine whether different types of creative ideas underlie the linkage between divergent thinking and episodic future thinking. In addition to having participants complete the AUT, we also had participants label each alternate use they generated as either an ‘old’ idea from memory (i.e., a generated use that a participant had previously experienced or known about) or a ‘new’ idea from imagination (i.e., a novel use that the participant generated for the first time during the experiment; for similar procedures; see Gilhooly et al., 2007; Benedek et al., 2014; Madore et al., 2015; Madore, Jing, & Schacter, 2016). Given that new responses in the AUT, akin to imagined future events, involve the generation of ‘novel’ output, we predicted that the number of episodic details in the future-imagine task would correlate uniquely with new idea production, relative to old idea production. In contrast, new idea production may not positively correlate with episodic details in the future-recast task as these events, relative to imagined future events, are not novel with the exception of their temporal orientation (i.e., past to future).

Experiment 1

Material and Methods

Participants—The experimental protocol was approved by the Institutional Review Board of Harvard University and informed consent was obtained prior to participation. All participants had normal or corrected-to-normal vision, no history of neurological impairment, and were not currently taking any psychoactive medications. Our sample consisted of 36 undergraduates who received credit for a general psychology course or $10/hour for participation (mean age of 21.25 years [range 18–30], 23 females). This sample size was selected to be identical to Addis et al. (2016).

Stimuli and Task

Session 1, Stimulus collection: The procedures employed in the current experiment followed closely those detailed in Addis et al. (2016). In Session 1, participants were asked to recall 35 episodic memories. Each memory had to be a specific event from the past 5 years, last only a few minutes to a few hours, be personally experienced, and involve an interaction with another *person* and an *object*. Participants were required to generate unique memories that did not share a location, person, or object (i.e., across all 35 generated memories, no person, location, or object could be repeated). Participants were asked to briefly describe the memory. These descriptions were used by the experimenter to ensure that the memories provided were specific in time and place. Participants were also instructed to create a short memory title. These titles were meant to distinguish each event from the others and serve as a reminder of the event later (e.g., 'graduation ceremony'). In addition to generating the titles, participants were asked to specify three details. The first was the first and last name of the person of interest (other than themselves) who participated in the event (participants had to know the first and last name of anyone they listed); if there were multiple people at the event, they were instructed to choose the person who stood out as the main person. The second detail was the location of interest where the event occurred; participants were instructed to be specific regarding the location name (i.e., the location name would allow them to instantaneously imagine the location (e.g., instead of "Brighton", put "kitchen of Brighton apartment") and to avoid using people's names when writing down the location name (e.g., avoid "Aleea's apartment, living room"). The third detail was an object of interest that featured in the event and was small enough to fit inside a backpack; participants were instructed to be specific (e.g., instead of "sweater" to use "my blue cat sweater").

Before Session 2, the location-person-object triplets provided in Session 1 were used to create the experimental stimuli. We randomly selected 25 triplets from those that met the above criteria (the additional 10 triplets had been collected to ensure that at least 25 met the criteria). For the past-recall and future-recast events, 10 triplets were selected, 5 trials for each event type. For the future-imagine events, a set of 15 triplets were used to create the 5 trials containing randomly recombined detail sets (i.e., each future-imagine trial comprised a person, location, and object taken from non-overlapping memories provided in Session 1). Of the five trials for each event type, 1 trial was selected to be a practice trial, leaving 4 trials per autobiographical event (Addis et al., 2016).

Session 2, Experimental phase: Session 2 took place 2–7 days after the completion of Session 1, and it was split into two task tasks: the AUT and the autobiographical task (completed in that order). We chose not to counterbalance the task order to be consistent with Addis et al. (2016) and to also to prevent the autobiographical task boosting subsequent performance on the AUT as would be predicted based on our prior ESI data (for a review, see Schacter & Madore, 2016). In the AUT, participants were instructed to generate as many uses as possible for a given item cue within a minute. Six items were used: eyeglasses, shoes, keys, button, wooden pencil, and automobile tire. For each participant, the order of item presentation was randomized. A single practice AUT trial using the item 'newspaper', was given before the 6 experimental trials. Each item was visually presented, and participants generated uses out loud and were audio-recorded while the experimenter transcribed the responses in real time. After each trial, participants provided two ratings on a 5-point scale: how vivid were the uses generated (1 = vague with no/few details to 5 = vivid and highly detailed) and how difficult it was it to generate the uses (1 = very easy to 5 = very difficult). After the AUT, participants viewed each use generated and rated each as either ‘old’ or ‘new’, with an old idea being a previous memory or thought before the study and a new idea being a thought that came to mind for the first time during the study (Madore et al., 2016, 2019; Gilhooly et al., 2007; Benedek, et al., 2015). Importantly, the validity of self-defining old-new uses has been previously documented by Gilhooly et al. (2007) who showed that self-defined ‘new’ relative to ‘old’ uses are rated as significantly more novel by independent observers.

Following the AUT, participants completed the autobiographical task, with 4 trials for each of 3 event types: past-recall, future-imagine, and future-recast. Trials were blocked according to event type and event order was counterbalanced across participants. Before each block, participants were instructed on the ensuing type of event to be generated and completed 1 practice trial. Trials involved showing participants a set of person, location and object details from their own memories recalled in Session 1 along with the corresponding memory titles to provide the appropriate context for each detail so the participant knew exactly which person, location, or object was being referred to (e.g., the object “coat” might differ depending on whether it is from a skiing event versus an interview event). For all conditions, participants were required to generate an event that was specific in time (i.e., a few minutes to a few hours) and place. They were instructed to use a first-person perspective and to verbally describe the event in as much detail as possible within the 3-minute time limit. For past-recall events, participants recalled the specified past event, including how the person, location, and object details featured in that particular experience. For the future-imagine events, participants imagined a novel yet plausible future experience that could occur within the next 5 years and involved the recombined person, location and object details taken from three different memories. Participants were instructed to include only the person/location/object details from those original events and not the entire event(s); further, they were told to not recast a past memory into the future. For the future-recast events, participants imagined the specified event, including the specified person, location and object, occurring in the next few years thus recasting the past event into the future. At the end of each trial, participants completed two ratings on a 5-point scale: (1) How vivid was the recalled/imagined event? (1 = vague with no/few details to 5 = vivid and highly detailed); and (2) How difficult was it to recall/imagine the event (1 = very easy to 5 = very difficult). All responses were audio-recorded.

Scoring and analysis—Each autobiographical event was transcribed and then segmented into internal and external details following the guidelines outlined in the Autobiographical Interview (Levine et al., 2002; for more information, see Addis et al., 2016). Internal details refer to episodic information (i.e., the who, what, where, when information) relating to the central event described, and external details refer to non-episodic information including sematic details, repeated and extended events, repetitions, and metacognitive statements. For each participant, a mean internal and mean external detail score was computed for each event type by averaging across the 4 trials.

AUT responses were scored for standard metrics of divergent thinking: *fluency* (total number of uses generated), *flexibility* (the number of distinct categories the uses could be divided into), *appropriateness* (number of appropriate uses), *elaboration* (amount of detail for a given use; scale of 0–2 with 0 = brief descriptions [e.g., using a brick as a 'doorstop'] and 2 = very detailed [e.g., using a brick as a doorstop to prevent a door slamming in a strong wind"]), and *originality* (calculated by comparing each response generated by a participant to the responses of all other participants; a score of 3 was assigned if less than 5% of other participants generated that response, 2 if 5–10% of other participants had the response, 1 if 10–15% of other participants had that response and 0 if more than 15% of other participants gave that response). For each metric, the scores were averaged across 5 items. The individual divergent thinking metrics were highly intercorrelated (r values > .64). Thus, each of the 5 metrics were individually z-scored, and then averaged to compute a mean divergent thinking measure (see also, Addis et al., 2016). Critically, in addition to calculating divergent thinking scores across all generated uses, we also computed the above divergent thinking metrics and z-scores separately for old and new uses. All scoring was conducted by two raters. We confirmed interrater reliability and obtained high interrater reliability (Cronbach's $\alpha > .90$ across the divergent thinking measures, as well as internal and external details).

In our first set of analyses, we analyzed data from the autobiographical task as a function of the episodic (internal) and non-episodic (external) details generated for each type of event (i.e., past-recall, future-imagine, and future-recast). We also assessed whether the three types of autobiographical events differed with respect to their subjectively-rated difficulty and vividness. In our second set of analyses, correlation and hierarchical multiple regression analyses were used assess the ability of episodic autobiographical thinking to predict divergent thinking performance. Given the previous results of Addis et al. (2016), our first set of correlation and regression analyses was conducted in an attempt to replicate those findings by identifying a link between the internal detail score for imagined future events and divergent thinking for total ideas generated in the AUT, with the relationship to the past-recall internal detail score being non-significant. In a novel extension of Addis et al. (2016), we then tested whether this relationship holds for all types of future autobiographical episodes by testing for the presence of a relationship between divergent thinking for total ideas generated in the AUT and episodic details comprising recast future events. In a final set of analyses, we examined whether different types of creative ideas generated in the AUT (i.e., 'old ideas' from memory or 'new ideas' from imagination) underlie the linkage between divergent thinking and episodic details comprising future autobiographical events. Before conducting regression analyses, we confirmed that there were no violations of the assumptions of normality, linearity, multicollinearity (variance inflation factor (VIF) < 5), and homoscedasticity. All results are considered significant at the $p < .05$ level; effects sizes are reported as partial η^2 for main effects and interactions resulting from an analysis of variance (ANOVA) and as d for t-tests.

Results

Autobiographical task differences—Figure 1 illustrates the mean number of internal and external details generated for each of the three autobiographical event types. A 3 × 2 ANOVA was conducted with factors Event (past-recall, future-imagine, and future-recast) and Detail Type (internal and external). The ANOVA failed to reveal a significant Event by Detail Type interaction ($F < 1$). The main effect of Event was significant ($F(2, 70) = 61.33$, $p = 1.40 \times 10^{-15}$, partial $\eta^2 = 0.64$). Follow-up comparisons collapsed across Detail Type revealed that more details were generated for the past-recall event type relative to both the future-imagine and future-recast events ($ts(35) > 5.65$, $ps < 2 \times 10^{-6}$, $ds > 0.94$, 95% confidence interval (CI) = [7.41, 15.71]), with the number of details not statistically differing between the two future event types ($t < 1$). These latter findings are consistent with Addis et al. (2016), where participants generated fewer details for imagined future events than recalled past events. Also consistent with Addis et al. (2016), the main effect of Detail Type was significant, with more internal than external details generated across events ($F(1, 35) = 240.62$, $p = 2.96 \times 10^{-17}$, partial $\eta^2 = 0.87$).

Figure 2 illustrates the mean difficulty and vividness ratings for each event type. A one way-ANOVA on the difficulty ratings (Figure 2A) revealed a significant main effect of Event ($F(2, 70) = 25.77$, $p = 4.12 \times 10^{-9}$, partial $\eta^2 = 0.42$). Follow-up comparisons revealed that the past-recall events were subjectively experienced as easiest to generate relative to both future-imagine and future-recast events ($ts(35) > 4.95$, $ps < 1.90 \times 10^{-5}$, $ds > 0.82$, 95% CI = [0.40, 0.96]). Of the latter two events, future-recast events were experienced as easier to generate than future-imagine events ($t(35) = 2.27$, $p = .03$, $d = 0.38$). A one way-ANOVA on the vividness ratings (Figure 2B) revealed a significant main effect of Event ($F(2, 70) = 11.49$, $p = 4.8 \times 10^{-5}$, partial $\eta^2 = 0.25$). Follow-up comparisons revealed that past events were subjectively experienced as more vivid than imagined future events (i.e., past-recall > future-imagine ($t(35) = 5.64$, $p = 2.00 \times 10^{-6}$, $d = 0.94$, 95% CI = [0.44, 0.93]), but not recast future events ($t(35) = 1.85$, $p = .07$). Recast future events were also experienced as more vivid than imagined future events ($t(35) = 2.57$, $p < .02$, $d = 0.43$, 95% CI = [0.09, 0.74]).

Autobiographical and divergent thinking: Correlation analyses—Complete creativity data for the AUT are listed in Table 1. AUT scores collapsed across old and new ideas (i.e., total ideas) are similar to those reported in Addis et al. (2016). In our first set of analyses, we tested whether divergent thinking performance was correlated with the mean number of internal details comprising each type of autobiographical event (Table 2). Replicating Addis et al. (2016), the future-imagine internal detail score, but not the past-recall internal detail score, significantly correlated with divergent thinking performance[1]. Further replicating Addis et al. (2016), we conducted a hierarchical multiple regression where the future-imagine internal detail score was entered as a predictor for divergent thinking performance in Step 1, and the past-recall internal detail score was entered as an additional predictor in Step 2. This regression analysis (Table 3) revealed that the future-

[1]Consistent with Addis et al., (2016), no significant correlations were observed between divergent thinking performance in the AUT and the number of external details generated for any task.

imagine internal detail score accounted for 15.7% of the variance in divergent thinking ($F(1, 34) = 7.52$, $p = .01$). The addition of the past-recall internal detail score in Step 2 resulted in a non-significant increase in explained variance (< 0.05%, $F < 1$). Therefore, replicating Addis et al. (2016), we found that internal details comprising recalled past events did not explain a significant amount of variance in divergent thinking performance ($\beta = -0.03$, $t < 1$) over and above that explained by imagined future events which remained significant in the regression model with both predictors ($\beta = 0.45$, ($t(35) = 2.07$, $p = .046$, 95% CI = [3.81×10^{-4}, 0.04]).

In a novel extension of Addis et al. (2016), the future-recast internal detail score was also found to be significantly correlated with divergent thinking performance (Table 2). We conducted a hierarchical regression analysis analogous to that above, but where the internal detail scores for the future-imagine events were replaced with those for future-recast events (Table 4). This regression revealed that the future-recast internal detail score accounted for 21.7% of the variance in divergent thinking ($F(1, 34) = 9.40$, $p = 4.23 \times 10^{-3}$). The addition of the past-recall internal detail score in Step 2 resulted in a non-significant increase in explained variance (< 0.05%, $F < 1$). Akin to our findings for internal details from imagined future events, internal details comprising recalled past events did not explain a significant amount of variance ($\beta = -0.08$, $t < 1$) over and above internal details from recast future events which were a significant predictor of divergent thinking performance ($\beta = 0.52$, $t(35) = 2.48$, $p = .02$, 95% CI = [5.47×10^{-3}, 0.06]). We did not conduct a regression analysis comparing the internal details from each of the two future tasks (future-imagine and future-recast) because they were highly intercorrelated ($r = .81$), thus avoiding issues concerning multicollinearity.

The above regression analyses revealed that the future-imagine and future-recast internal detail scores explained a significant amount of variance in divergent thinking over and above the past-recall internal detail score. It is possible that the past-recall internal detail score can explain variance in divergent thinking when entered alone as a predictor. Thus, another regression model was run where the *only* predictor was the past-recall internal detail score. The past-recall internal detail score did not explain a significant amount of variance in divergent thinking (7.4%, $F(1,34) = 2.73$, $p = .11$). Taken together, the regression analyses indicate that while divergent thinking performance is positively related to amount of internal details comprising imagined future and recast future events, this relationship is not observed for recalled past events.

Autobiographical and divergent thinking, old versus new ideas: Correlation analyses—In our next set of analyses, we tested the relationship between future autobiographical thinking and divergent thinking performance separately for each type of idea generated (i.e., old versus new) during the divergent thinking task. As is detailed in Table 2 and illustrated in Figure 3, the number of internal details generated during future events (both imagined and recast) was significantly correlated with new ideas (Figure 3B middle and right panel). There was no significant relationship with old ideas (Figure 3A)[2].

[2]We directly compared the magnitude of the correlations as a function of old and new ideas for each task. The correlation values for old versus new ideas did not significantly differ for any task (i.e., compare each panel in Figure 3A to 3B; Zs < 1.17, ps > .24). In

A hierarchical multiple regression on the new idea divergent thinking data (see Table 5) revealed that the future-imagine internal detail score accounted for 19.3% of the variance of the new idea production during divergent thinking ($F(1, 34) = 8.11$, $p = 7.41 \times 10^{-3}$). The addition of the past-recall internal detail score resulted in a nonsignificant increase (< 0.05%, $F < 1$) and was not a significant predictor of new ideas generated during divergent thinking ($\beta = 0.07$, $t < 1$). Although the beta coefficient was more than double the size, internal details comprising imagined future events was not a significant predictor ($\beta = 0.39$, $t(35) = 1.84$, $p = .075$). Given that AUT scores for old ideas during divergent thinking did not correlate with internal details from any of the autobiographical event types (Figure 3A), a regression analysis was not conducted on these data.

Consistent with the future-imagine data, a hierarchical multiple regression (see Table 6) revealed that the future-recast internal detail score accounted for 17.1% of the variance of new idea production during divergent thinking ($F(1, 34) = 6.99$, $p = .01$), and the addition of the past-recall internal detail score resulted in a non-significant increase (0.05%, $F < 1$). Although the beta coefficient for future-recast internal detail score was more than double that of past-recall (0.35 versus 0.10, respectively), internal details from neither event type significantly predicted new ideas produced during divergent thinking.

The above analyses revealed that internal details generated during both of the future events were each significantly correlated with new ideas generated during divergent thinking, and both were significant predictors of new idea generation during divergent thinking. However, the regression analyses failed to identify significant (i.e., $p < .05$) beta coefficients relating internal details from either the future-imagine task or future-recast task once past-recall internal details were entered into the model. As noted above, internal details generated across the two types of future events were highly intercorrelated ($r = .81$). Therefore, we conducted a final regression analysis collapsing across the future-image and future-recast internal detail scores to increase predictive power. A hierarchical multiple regression (see Table 7) revealed that the future internal detail score accounted for 19.3% of the variance of new idea production during divergent thinking ($F(1, 34) = 9.36$, $p < 4.31 \times 10^{-3}$). The addition of the past-recall internal detail score resulted in a non-significant increase (<1%, $F < 1$), however, the future event predictor remained significant now that it collapsed across the number of internal details comprising both future-imagine and future-recast events ($\beta = 0.55$, $t(35) = 2.52$, $p = .02$, 95% CI = [5.67×10^{-3}, 0.05]). As a final analysis, we ran an analogous regression model to assess whether future internal details, when collapsed across both future tasks, could predict old idea generation during divergent thinking. This regression model was not significant ($F(1, 34) = 3.08$, $p = .09$).

As the past-recall internal detail score was always entered in Step 2 along with the future-imagine or future-recast internal detail score, the above regression analyses leave open the possibility that internal details comprising recalled past events may, on their own, predict new idea production during divergent thinking. In a regression model where the *only* predictor was the past-recall internal detail score, it did not explain a significant amount

addition, the correlation values depicted in Figure 3B were not significantly different from one another (i.e., the correlation of new ideas and mean future internal details versus the correlation of new ideas with past internal details ideas; Z = 1.02, p = 0.31).

of the variance of new idea production during divergent thinking (10.7%, $F(1,34) = 4.07$, $p = 0.05$). Taken together, the regression analyses indicate that new idea production during divergent thinking performance is related to amount of internal details comprising imagined future and recast future events, and that a significant relationship is not observed for recalled past events.

Discussion

In Experiment 1, we found that divergent thinking performance was predicted by the number of episodic details comprising future autobiographical episodes (i.e., both simulated and recast future events). However, the number of episodic details comprising past events was not a significant predictor of divergent thinking performance, either over and above future internal details or on their own. In addition, regression analyses revealed that this relationship was present for new ideas from imagination generated during divergent thinking (internal details did not predict old ideas from memory). To further examine the relationship between divergent creative thinking and future episodic detail, in Experiment 2 we assessed whether this relationship was specific to divergent thinking as assessed in the AUT, or extends to a second measure of divergent thinking, the Consequences Task (Guilford, 1967; Torrance, 1962). This task requires participants to generate the consequences of improbable/novel scenarios that do not exist in real life (e.g., if humans could live on without death). We chose this task for three reasons. First, it is a frequently used index of divergent thinking and has been shown to be influenced by episodic processing: participants generated more novel consequences following an ESI than a control induction (Madore et al., 2016). Second, prior research has demonstrated a link between some aspects of future thinking such as problem-solving and performance in the Consequences Task (Ononye, Blinn-Pike & Smith, 1993). Third, given that the cues on this task refer to scenarios that do not involve everyday life, participants should rely less on memories from their past to perform the task than on the AUT, where everyday objects are used as cues and participants are known to draw on past experiences (e.g., Gilhooly et al., 2007). As Experiment 1 showed that new idea, but not old idea, production was positively related to future episodic detail, we chose the Consequences Task because it should elicit a higher number of new ideas relative to the AUT (see also, Madore et al., 2016). In Experiment 2, we predicted that future episodic details would be correlated with the production of new, but not old, consequences.

Experiment 2

Material and Methods

Participants—The experimental protocol was approved by the Institutional Review Board of Harvard University and informed consent was obtained prior to participation. All participants had normal or corrected-to-normal vision, no history of neurological impairment, and were not currently taking any psychoactive medications. To match Experiment 1, our aim was to collect an N of 36. Due to the COVID-19 pandemic and restrictions imposed by Harvard University to stop in-person data collection during Experiment 2, data collection was stopped at an N of 28 (mean age of 20.0 years [range 18–24], 16 females).

Stimuli and Task—The experimental procedure was identical to Experiment 1, with the exception that the AUT was replaced with the Consequences Task. Following procedures in our prior work employing this task (Madore et al., 2016), participants were visually presented 5 different, novel, and improbable scenarios, each for 5 minutes. Participants were instructed that they would be shown one improbable scenario at a time (i.e., scenarios that don't exist in the present world), and to use their imagination about all of the other exciting things that might happen if these improbable scenarios might come to be. The task was to verbally generate as many consequences as possible that would occur because of the improbable scenario. One example scenario was given before the 5 experimental trials started (e.g., 'We might ask you to generate consequences for the scenario: What would the consequences be if everyone lost the ability to read and write?'). As in Experiment 1, the experimenter transcribed the responses in real time. Following the Consequences Task, participants viewed each response generated and rated each as either 'old' or 'new', with an old idea being a previous memory or thought that the participant experienced before the study and a new consequence being a thought that came to mind for the first time during the study.

Scoring and analysis—The Consequences Task was scored in an analogous fashion to the AUT in Experiment 1 (i.e., measures of fluency, flexibility, appropriates, elaboration, and originality; for similar scoring approaches, see Madore et al., 2016). Scoring of the Consequences Task was conducted separately for consequences labeled 'old' and 'new'. A mean divergent thinking measure was separately computed for old and new consequences by averaging the z-score for each of the five aforementioned divergent thinking metrics for each type of consequence. All scoring was conducted by two raters. As in Experiment 1, we confirmed high interrater reliability (Cronbach's $\alpha > 0.90$ across the divergent thinking measures, and internal and external details).

Paralleling Experiment 1, we conducted a set of analyses to replicate the autobiographical event differences with respect to internal/external details as well as subjective ratings of vividness and difficulty. Given our a priori prediction of a positive link between new consequences and future episodic detail, the analyses of Experiment 2 were focused on correlating new consequences with the number of internal details generated for each type of autobiographical event (past-recall, future-imagine, and future-recast). We did not conduct linear regression analyses on the Experiment 2 data because the data violated assumptions of multicollinearity with VIFs > 5.

Results

Autobiographical task differences—A 3 × 2 ANOVA was conducted with factors Event (past-recall, future-imagine, and future-recast) and Detail Type (internal and external; Figure 4). As in Experiment 1, this ANOVA identified significant main effects of Event ($F(2,54) = 10.18$, $p = 1.77 \times 10^{-4}$, partial $\eta^2 = 0.27$) and Detail Type ($F(1, 27) = 277.34$, $p = 9.98 \times 10^{-16}$, partial $\eta^2 = 0.91$), with no significant interaction of Event and Detail Type ($F < 1$). Follow-up comparisons revealed that participants generated more details for recalled past events relative to both types of future events (ts$(27) > 3.60$, ps $< 1.26 \times 10^{-3}$, ds > 0.68, 95% CI =[1.78, 6.49]), with the number of details generated statistically equivalent between the two types of future events ($t < 1$). This pattern of differences across event types replicates the findings of Experiment 1.

Illustrated in Figure 5A and 5B are the difficulty and vividness ratings from Experiment 2, respectively. The overall pattern was similar to Experiment 1 in that difficulty increased as a function of event type (past-recall > future-recast > past-imagine) and that differences in vividness were greatest between recalled past events and simulated future events with a negligible difference between recalled past events and recast future events. A one-way ANOVA on the difficulty ratings revealed a significant main effect Event ($F(2, 54) = 5.11$, $p = 9.26 \times 10^{-3}$, partial $\eta^2 = 0.16$). Follow-up comparisons confirmed that imagining future events was more difficult than recalling past events ($t(27) = 3.42$, $p = 1.98 \times 10^{-3}$, $d = 0.65$, 95% CI = [0.25, 1.00]). No other comparisons were significant (ts(27) < 1.78, ps > .09). An analogous one-way ANOVA conducted on the vividness ratings also revealed a significant main effect of Event ($F(2, 54) = 4.93$, $p = .01$, partial $\eta^2 = 0.15$). As in Experiment 1, past events were subjectively experienced as more vivid than imagined future events ($t(27) = 3.39$, $p < .01$, ds = 0.64, 95% CI = [0.17, 0.70]), and did not differ from recast future events ($t < 1$). The difference in self-rated vividness for the two future event types (future-recast and future-imagine) was not significant ($t(27) = 2.03$, $p = .05$, $d = 0.38$); this latter null effect likely reflected the reduction in statistical power relative to Experiment 1.

To assess autobiographical event differences as a function of event type across Experiments 1 and 2, we conducted 3 additional ANOVAs with an additional factor of Experiment. All significant ANOVA effects reported in each individual experiment were significant when collapsed across Experiment (i.e., main effects of Detail Type, Event, Difficulty, and Vividness; Fs > 15.13, ps < 3.00×10^{-6}, partial η^2s > 0.20). In addition, the ANOVAs (i.e., on the internal/external details, difficulty ratings, and vividness ratings) failed to reveal a Detail Type by Event by Experiment, Vividness by Experiment, or Difficulty by Experiment interactions (Fs < 1.94, ps > 0.15). When collapsing across the factor Experiment, follow-up comparisons revealed that difficulty significantly differed between each event (past-recall > future-recast > past-imagine; ts(63) > 2.89, ps < 5.22×10^{-3}, ds > 0.36, 95% CI = [0.11, 0.60]). In addition, subjective vividness was greatest for past-recall events relative to the two future events (ts(63) > 3.30, ps < 1.61×10^{-3}, ds > 0.41, 95% CI = [0.15, 0.61]), with no difference in the latter two events ($t(63) = 1.90$, $p = .06$). Lastly, participants generated the most details for the past-recall events relative to both future events (ts(63) > 8.53, ps < 4.26×10^{-12}, ds > 1.07, 95 % CI = [5.27, 8.50]), whereas the number of details generated between the two future events did not significantly differ ($t < 1$).

Autobiographical and divergent thinking: Correlation analyses—Complete creativity data for the Consequences Task are listed in Table 8. As expected, and confirming the validity of the Consequences Task, approximately 68% of the consequences generated were rated as 'new', relative to the AUT in Experiment 1 where only 25% of uses were rated as 'new' (roughly consistent with our prior work, Madore et al., 2016).

For correlation analyses, due to the reduced sample size relative to Experiment 1 together with the fact that the correlations between divergent thinking performance for new ideas and both future events were significant and similar in strength in Experiment 1 (0.43 versus 0.42;

see Table 2), we averaged the internal detail score across the future-imagine and future-recast events for each participant (as in Experiment 1, the internal details scores across the future events was highly correlated, $r = 0.86$). Consistent with the results of Experiment 1, divergent thinking performance in the Consequences Task for new consequences was significantly correlated with the mean future internal detail score ($r(26) = 0.38$, $p = .047$; Figure 6, right), with the analogous correlation for the past-recall internal detail score not significant ($r(26) = 0.13$, $p = .52$; Figure 6, left). We compared the strength of the correlation between new consequences and mean future internal details to the correlation with past internal details. These correlations were significantly different ($z = 3.26$, $p = 1.12 \times 10^{-3}$; Lee & Preacher, 2013), thereby indicating that the correlation between new consequences and internal detail was specific to internal details comprising future but not past events[3]. For completeness, we report all correlations between divergent thinking in the Consequences Task for both old and new consequences and internal details for each of the three event types (Table 9).

General Discussion

In the current study, we examined whether divergent thinking is differentially associated with the ability to construct imagined future events and recast future events as opposed to recalled past events. We also examined whether different types of creative ideas (i.e., 'old ideas' from memory or 'new ideas' from imagination) underlie the linkage between divergent thinking and various types of autobiographical events. In Experiment 1, we replicated the findings of Addis et al. (2016) and found that divergent thinking performance in the AUT was positively related with the amount of episodic details comprising imagined future events but not recalled past events. We also observed a novel positive relationship between performance on the AUT and the amount of episodic details comprising recast future events. In a critical extension of Addis et al. (2016), we found that the relationship between divergent thinking and future episodic detail was only significant for new ideas generated on the AUT. In Experiment 2, we extended the findings from Experiment 1 to a different divergent thinking task, the Consequences Task.

Autobiographical task differences—Across both experiments, we observed important differences across the three types of autobiographical events. First, the event type differences are consistent with prior studies showing that compared with episodic memories, future simulations are generally less vivid (e.g., D'Argembeau & van der Linden, 2004, 2006; Addis, Pan, Vu, Laiser, & Schacter, 2009) and more difficult to generate (e.g., Arnold, McDermott, & Szpunar, 2011). Second, the number of episodic details comprising recast future events and imagined future events were similar, with participants generating the most episodic details for recalled past events. In contrast to these differences in the amount of *objective* episodic detail, when examining the *subjective* amount of detail via the self-reported vividness ratings, recast future events and recalled past events were experienced as similar, and greater in vividness relative to imagined future events. Despite the fact that future-recast events required the near-reproduction of an original event, participants

[3]As in Experiment 1, no significant correlations were observed between divergent thinking performance in the Consequences Task and the number of external details generated for any task.

produced fewer objective episodic details for recast relative recalled events. In contrast, the vividness data suggest that recast and recalled events were experienced as equally high in vividness, thus suggesting that they share similar subjective episodic content. These latter findings provide evidence that participants complied with the task instructions and that recast future events were not treated as novel events.

Autobiographical and divergent thinking—The present findings replicate and extend those of Addis et al. (2016) by showing that episodic processing, reflected by the amount of episodic detail in imagined and recast future events, is positively related with divergent thinking ability. These results add to the limited but growing body of evidence to indicate that divergent thinking is not only supported by semantic processing, but also episodic processing (see Introduction). As noted earlier, prior studies have not specified the precise episodic processes that link divergent thinking with episodic thinking. In the current study, we isolated distinct episodic processes by having participants construct different kinds of autobiographical episodes that varied as a function of temporal orientation and level of recombination. We found that divergent thinking was predicted by the ability to recast and imagine future events, with no link to recalled past events. According to the initial interpretation of Addis et al. (2016), both divergent thinking and imagining future events share a similar and low-level of cognitive-constraint, thus enabling flexible episodic future imagination and divergent creative thinking. Note that in Addis et al. (2016), divergent thinking was not predicted by the amount of episodic detail comprising imagined past events. This null finding, together with the positive relationship we observed between divergent thinking and recast future events, suggests that there may be something unique about temporal orientation to the future that links episodic to divergent thinking. One possibility is that although not explicitly instructed, when participants generate creative ideas in the AUT or Consequences Task, they may project or 'mentally time travel' (Suddendorf & Corballis, 2007; Tulving, 1985, 2002) to a plausible future state to enable divergent thinking. As the future is inherently unknown, projection to a future relative to a past mental state, may allow for a greater opportunity for flexible thought. Further support for this possibility comes from the old-new data for the two divergent thinking tasks, i.e., new ideas were correlated with future episodic detail, but old ideas were not. Because old ideas by definition are based on either specific past experiences or general knowledge (e.g., factual and abstracted knowledge drawn from previously seen movies or novels; Madore et al., 2016), when participants generate new ideas, it is likely that they disengage from a restricted and limited past experience, and project themselves to a future state to generate novel creative output.

The present findings run counter to some of our previous theorizing on how episodic processing supports divergent thinking. We have previously argued that idea generation on the AUT and Consequences Task reflects, in part, the retrieval and recombination of specific episodic details (for reviews, see Schacter & Madore, 2016; Schacter et al., 2017). This interpretation was bolstered by findings indicating that the hippocampus, a region known to support retrieval and relational processing, is commonly recruited during episodic memory, episodic simulation, and divergent thinking (Beaty, et al., 2018) and is also modulated by the ESI (Madore et al., 2015, 2017). In contrast, the present data and prior findings of Addis et al. (2016) failed to reveal evidence for a common recombination process, which would have been evidenced by a significant positive relationship between divergent thinking and both past *and* future imagined events (i.e., episodes that require the construction of a novel event using recombined episodic details). This null relationship may reflect the fact that the amount of episodic/internal details as operationalized by the Autobiographical Interview (Levine et al., 2002) are not an appropriate index of recombination-related processing (for related evidence, see Thakral, Madore, & Schacter, 2019). Regardless, our findings and those of Addis et al. (2016) suggest the existence of a common temporal orientation process, specifically to the future, that links episodic and divergent thinking (for a discussion of how temporal and nontemporal factors contribute to episodic thinking, see Schacter et al., 2012). Although beyond the scope of the current study, additional work is necessary to identify the specific processes involved in projection to the future that overlap with divergent thinking. Relevant data on this point come from fMRI studies reporting differences between episodic memory and future imagination (e.g., Addis et al., 2009, Szpunar, Chan, & McDermott, 2009; for a review, see Benoit & Schacter, 2015). These studies have shown that some regions of the core network (such as the hippocampus), as well as some “non-core” regions (such as the lateral prefrontal cortex and superior parietal cortex) are more strongly engaged during future imagining than during episodic remembering. These findings have been taken to reflect the fact that imagining future experiences not only requires novel recombination, but also requires greater control processes (e.g., attentional control and/or inhibitory processes) than episodic remembering because future simulations are more open-ended and less constrained than remembering actual past experiences. It has been suggested that these types of executive control processes may be required during both divergent thinking and future simulation to guide the generation of an idea or event, respectively, during both forms of thinking (Roberts & Addis, 2018).

Although the contents of recast future events are more constrained by past experience than the contents of imagined future events, the common cognitive act of locating these events in the future may also elicit control processes similar to those that guide divergent thinking. For instance, even when a future event is recast rather than imagined de novo, some degree of high-level reasoning is likely still required to situate the event in the future in a way that makes sense (e.g., causal reasoning to explain the event’s recurrence; Addis, 2020; Holyoak 2012). It is notable in this regard that fMRI studies of divergent thinking have consistently shown increased connectivity between the default network (which largely overlaps with what we have referred to as the core network) and executive control regions (for a review, see Beaty, Benedek, Silvia, & Schacter, 2016), and that similar increases in connectivity between the default network and control regions have been documented when people engage in complex forms of future thinking such as autobiographical planning (e.g., Gerlach, Spreng, Madore, & Schacter, 2014; Spreng, Stevens, Chamberlain, Gilmore, & Schacter, 2010). Moreover, interactions between default and control regions are greater for specific, episodic future autobiographical plans than for more abstract, semanticized autobiographical plans (Spreng, Gerlach, Turner, & Schacter, 2015). It remains to be seen whether such interactions are related to the cognitive-behavioral findings reported here, but the fMRI findings do suggest that control processes are relevant to both divergent thinking and episodic future thinking (e.g., Roberts et al., 2017).

An alternative interpretation to that proposed above is that when participants recast past events into the future, some amount of counterfactual thinking (e.g., De Brigard, Addis, Ford, Schacter, & Giovanello, 2013) may take place to allow for a past event to be imagined as occurring in the future. This possibility is particularly relevant for past events that are highly memorable and potentially locked to the past in a way that makes them difficult to imagine recurring in the same way (e.g., a specific wedding). One possibility is that when recasting such events into the future, participants may first imagine some counterfactual detail that prevents the original past event from having happened (e.g., a wedding being delayed for some unforeseen reason), and then recast the past event into the future (e.g., the same wedding that actually occurred in the past is imagined as now taking place for the first time the following year). **According to this interpretation, in order to imagine a recast future event as if it were happening exactly as it did in the past, an individual would first have to generate a counterfactual reason to explain why such a past event would happen again in the future. After generating this counterfactual, the individual could imagine the recast future event as it actually happened in the past. Importantly, a two-step process along these lines could help to explain the finding that recast future events were rated as more difficult to imagine than recalled past events (see** Figure 2A and Figure 5A)[4]. **It will be important for future research to evaluate this alternative explanation for the current data linking future episodic and divergent thinking.**

There are a number of limitations of the present experiments that deserve mention. First, the present findings are limited in that they only examined a link between divergent and episodic thinking. It is unknown whether other forms of future thinking, such as semantic simulations (Szpunar, Spreng, & Schacter, 2014), are related to divergent thinking. It might be the case that semantic forms of future thinking correlate with old idea production during divergent thinking, because these ideas are driven, in part, by prior knowledge. The current findings are further limited in that our study only investigated divergent creative thinking. Future studies should investigate to what extent convergent creative thinking (i.e., the ability to generate the single best solution to a problem; Mednick, 1962) is related to future episodic detail. One possibility is that future imagining would be negatively correlated with convergent thinking. This is because convergent thinking entails the generation of a single idea, in contrast to future imagining and divergent thinking, which entail the generation of many alternative events and ideas, respectively. Although the overall pattern of findings was largely consistent across experiments, an additional limitation stems from the lack of analytical consistency across Experiments (i.e., the same regression analyses conducted in Experiment 1 were not conducted in Experiment 2 due to issues of multicollinearity). Finally, the present study is the first to have participants recast future events. Thus, the reliability of the current findings should be examined in future work. To conclude, we demonstrate that individual differences in divergent thinking are associated with the capacity to both imagine and recast future events, and that divergent thinking is an important ingredient for future episodic thought.

4. We thank an anonymous reviewer for suggesting this interpretation.

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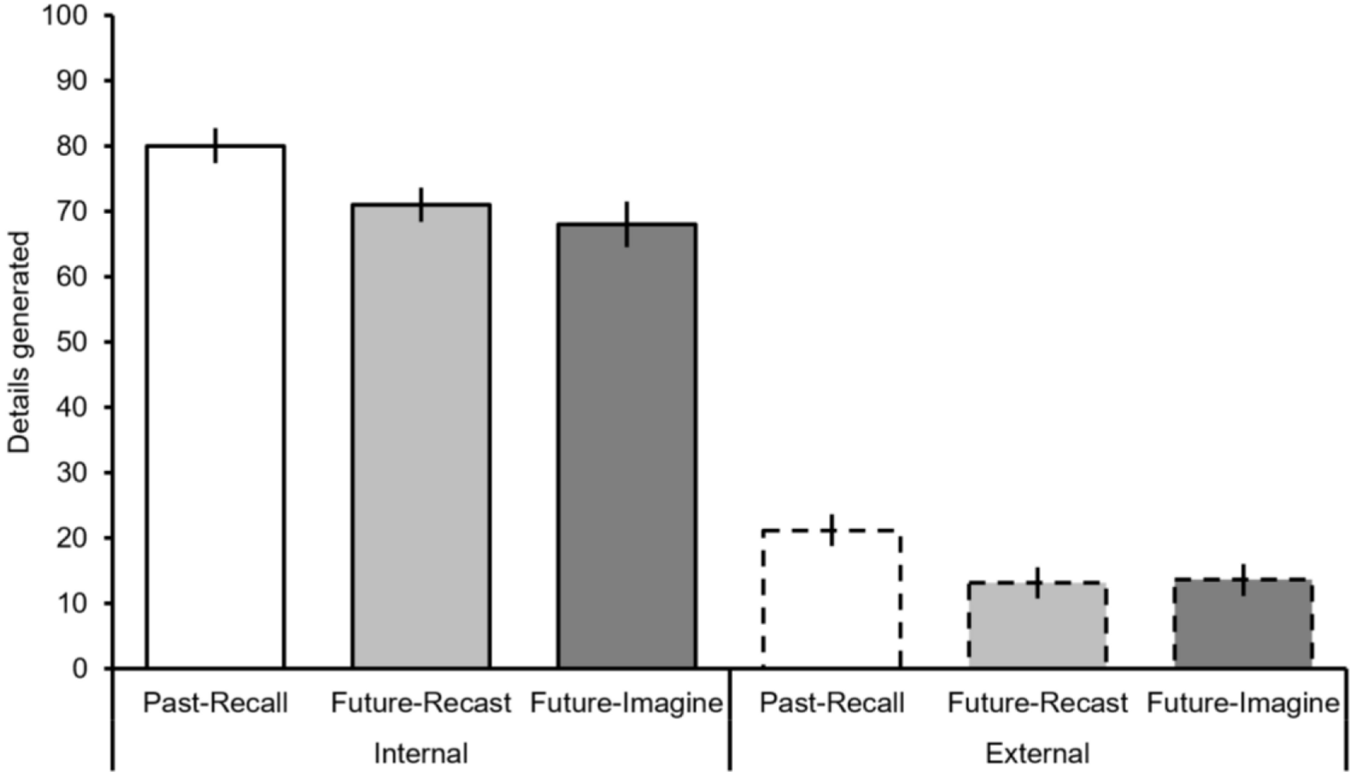

Figure 1.

Mean number (± 1 standard error) of internal and external details generated as a function of autobiographical event type (past-recall, future-recast, and future-imagine) in Experiment 1.

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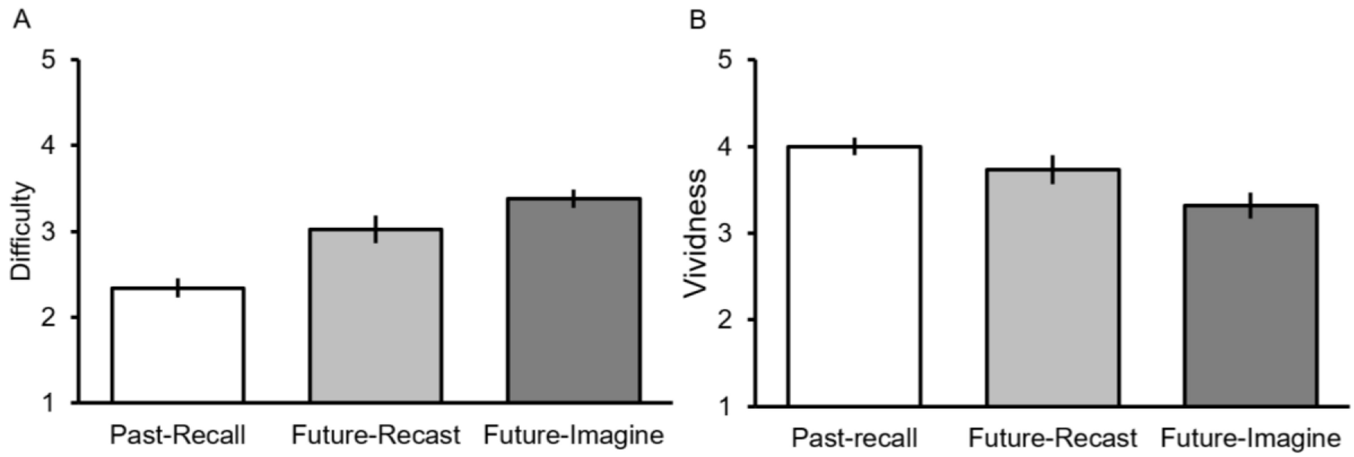

Figure 2.

Mean difficulty and vividness ratings (± 1 standard error) as a function of autobiographical event type (past-recall, future-recast, and future-imagine) in Experiment 1.

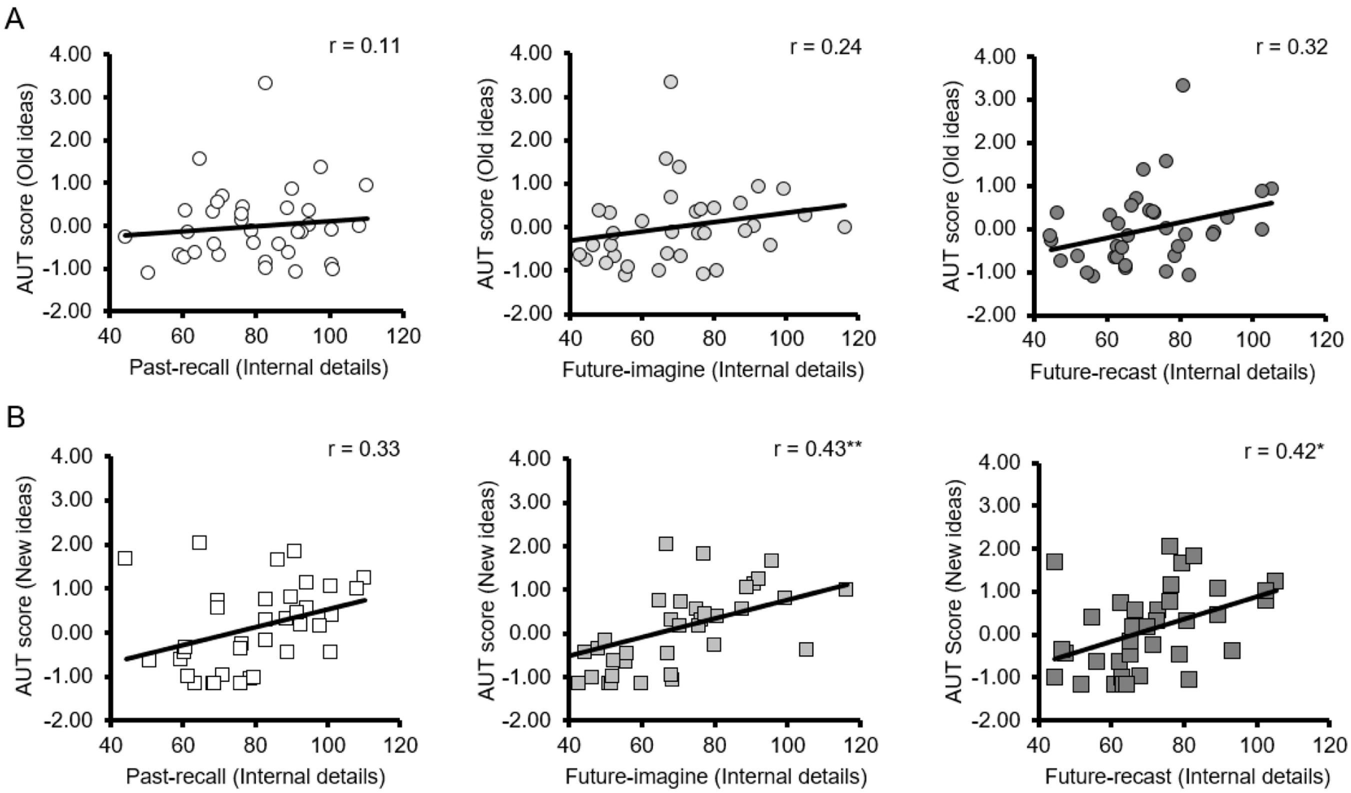

Figure 3.

Bivariate correlations between Z-scored mean divergent thinking performance in the AUT as a function of old (A) and new ideas (B) and the mean number of internal details for each type of autobiographical event in Experiment 1 (***p* < .01, **p* < .05)

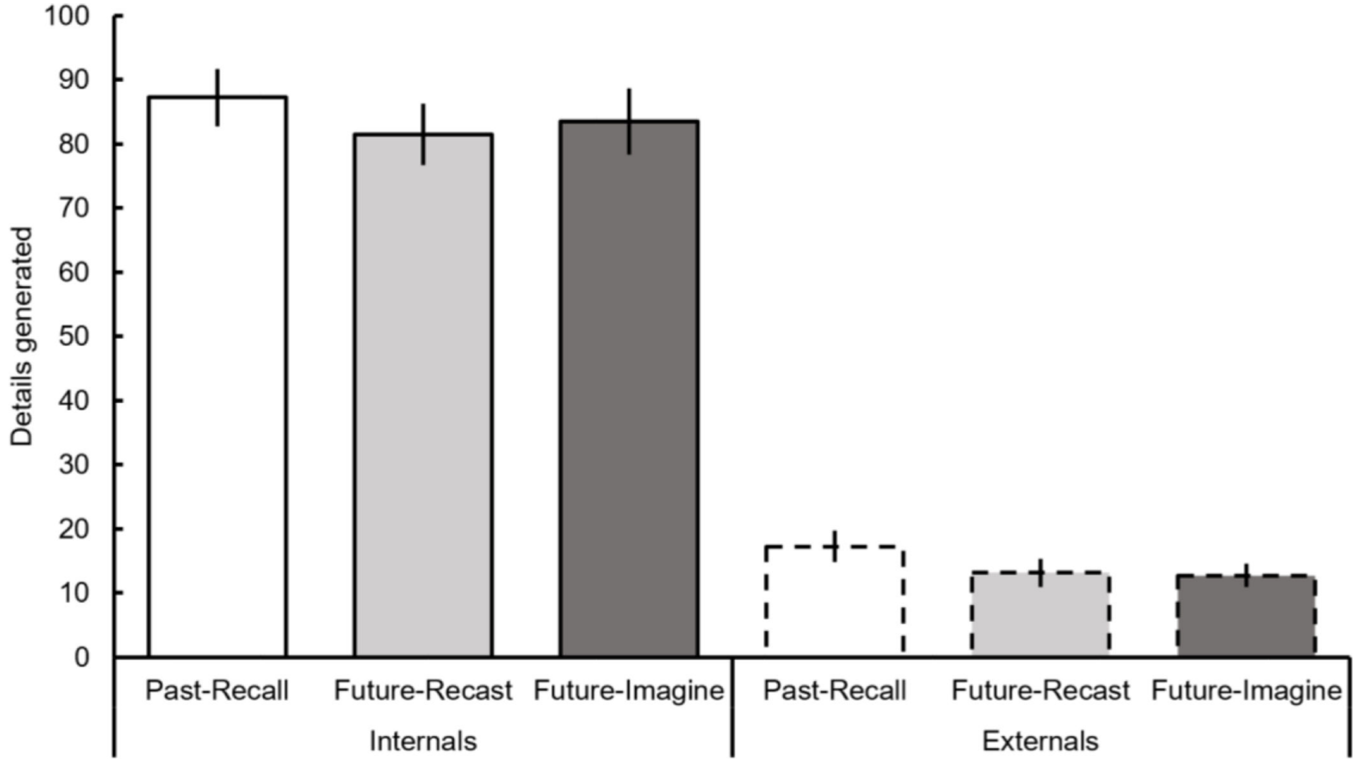

Figure 4.
Mean number (± 1 standard error) of internal and external details generated as a function of autobiographical event type (past-recall, future-recast, and future-imagine) in Experiment 2.

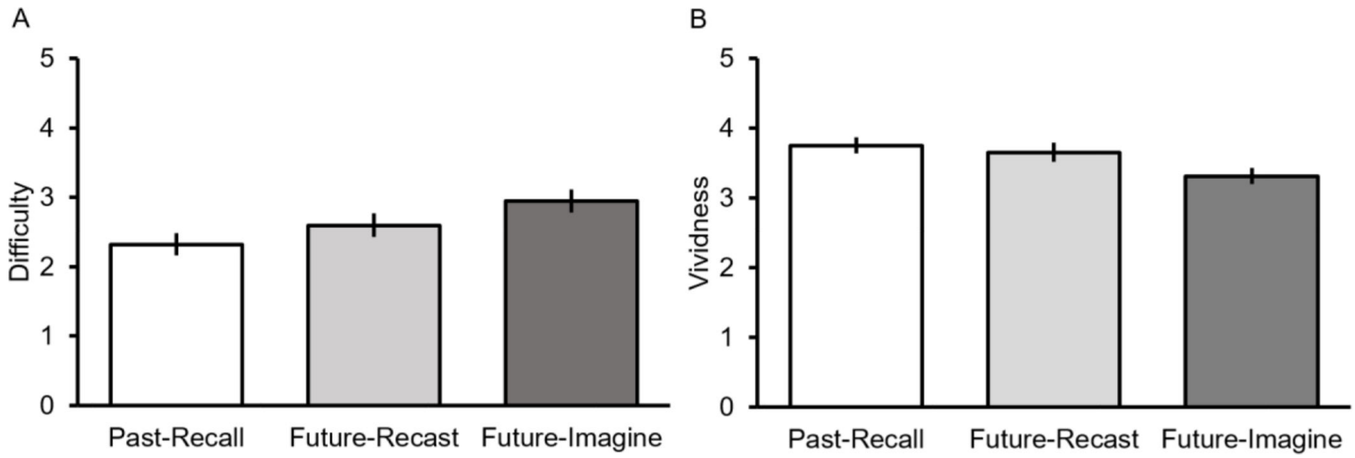

Figure 5.
Mean difficulty and vividness ratings (± 1 standard error) as a function of autobiographical event type (past-recall, future-recast, and future-imagine) in Experiment 2.

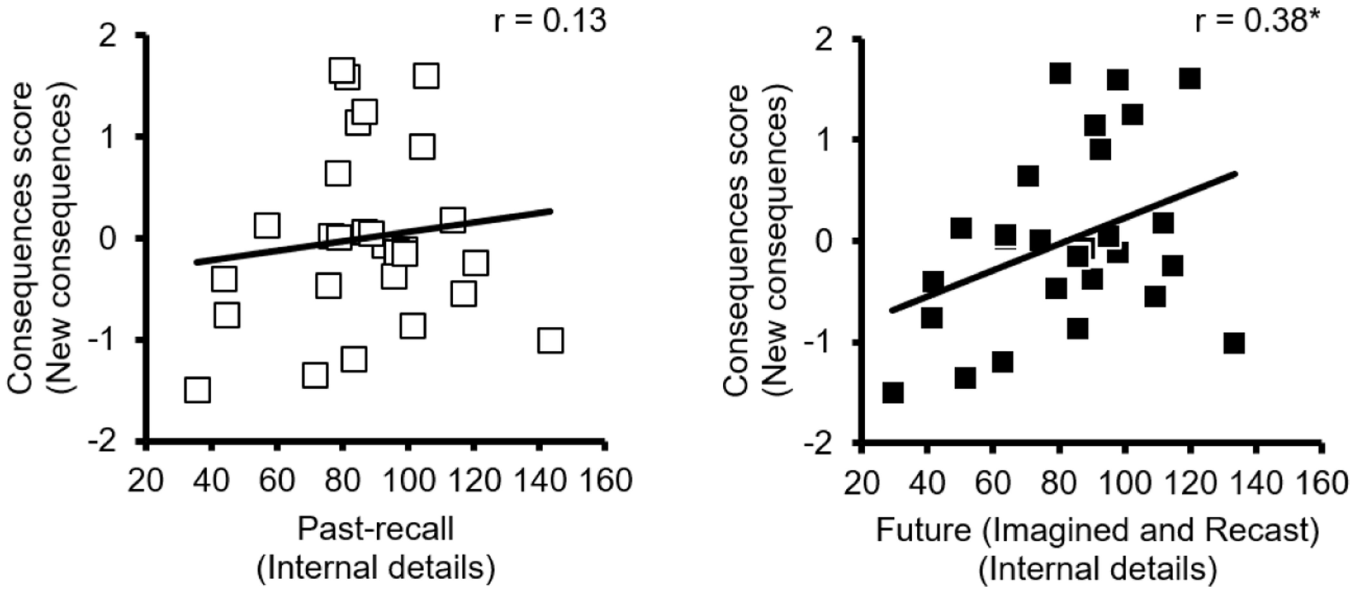

Figure 6.

Bivariate correlations between Z-scored mean divergent thinking performance in the Consequences Task for new consequences and the mean number of internal details generated in the past-recall task (left) and the future (imagined and recast) tasks (right) in Experiment 2 (*p < .05)

Table 1.

Mean (± 1 standard error) divergent thinking scores from the AUT.

AUT Score	Total ideas	Old ideas	New ideas
Fluency	6.24 (0.29)	4.70 (0.24)	1.53 (0.19)
Flexibility	3.78 (0.15)	3.32 (0.14)	2.41 (0.25)
Appropriateness	6.23 (0.29)	4.69 (0.24)	1.53 (0.19)
Elaboration	5.16 (0.50)	3.63 (0.34)	1.52 (0.25)
Originality	6.12 (0.52)	3.55 (0.33)	2.55 (0.34)

Mean (± 1 standard error) divergent thinking scores from the AUT.

Table 2.

Bivariate correlations between divergent thinking performance in the AUT and mean number of internal details for each autobiographical event type in Experiment 1.

Z-scored AUT score	Past-Recall	Future-Imagine	Future-Recast
Total ideas	.27	.43**	.47**
Old ideas	.11	.24	.32
New ideas	.33	.43**	.42*

Bivariate correlations between divergent thinking performance in the AUT and mean number of internal details for each autobiographical event type in Experiment 1

**($p < .01$,

*$p < .05$)

Table 3.

Summary of the hierarchical multiple regression analysis for internal details for the future-imagine and past-recall tasks in relation to divergent thinking.

Step	B	SE B	β
1			
Constant	−1.36	0.51	
Internal details (future-imagine)	0.02	0.007	0.43 *
2			
Constant	−1.29	0.73	
Internal details (future-imagine)	0.02	0.01	0.45 *
Internal details (past-recall)	−0.002	0.01	−0.03

Summary of the hierarchical multiple regression analysis for internal details for the future-imagine and past-recall tasks in relation to divergent thinking

* ($p < .05$). SE, standard error.

Table 4.

Summary of the hierarchical multiple regression analysis for internal details for the future-recast and past-recall tasks in relation to divergent thinking.

Step	B	SE B	β
1			
Constant	−1.91	0.64	
Internal details (future-recast)	0.03	0.01	0.47*
2			
Constant	−1.76	0.74	
Internal details (future-recast)	0.03	0.01	0.52*
Internal details (past-recall)	−0.005	0.01	−0.08

Summary of the hierarchical multiple regression analysis for internal details for the future-recast and past-recall tasks in relation to divergent thinking

*($p < .05$). SE, standard error.

Table 5.

Summary of the hierarchical multiple regression analysis for internal details for the future-imagine and past-recall tasks in relation to new ideas during divergent thinking.

Step	B	SE B	β
1			
Constant	−1.44	0.53	
Internal details (future-imagine)	0.02	0.01	0.44*
2			
Constant	−1.60	0.74	
Internal details (future-imagine)	0.02	0.01	0.39†
Internal details (past-recall)	0.004	0.01	0.07

Summary of the hierarchical multiple regression analysis for internal details for the future-imagine and past-recall tasks in relation to new ideas during divergent thinking

*($p < .05$,

†$p < .08$). SE, standard error.

Table 6.

Summary of the hierarchical multiple regression analysis for internal details for the future-recast and past-recall tasks in relation to new ideas during divergent thinking.

Step	B	SE B	β
1			
Constant	−1.74	0.67	
Internal details (future-recast)	0.03	0.01	0.41 *
2			
Constant	−1.92	0.78	
Internal details (future-recast)	0.02	0.01	0.35
Internal details (past-recall)	0.01	0.01	0.10

Summary of the hierarchical multiple regression analysis for internal details for the future-recast and past-recall tasks in relation to new ideas during divergent thinking

* ($p < .05$). SE, standard error.

Table 7.

Summary of the hierarchical multiple regression analysis for internal details for the future-imagine/future-recast and past-recall tasks in relation to new ideas during divergent thinking.

Step	B	SE B	β
1			
Constant	−1.75	0.59	
Internal details (future-imagine/future-recast)	0.03	0.01	0.47 *
2			
Constant	−1.53	0.72	
Internal details (future-imagine/future-recast)	0.03	0.01	0.55 *
Internal details (past-recall)	−0.01	0.01	−0.12

Summary of the hierarchical multiple regression analysis for internal details for the future-imagine/future-recast and past-recall tasks in relation to new ideas during divergent thinking

*($p < .05$). SE, standard error.

Table 8.

Mean score (± 1 standard error) for the Consequences Task.

Consequences Score	Old Consequences	New Consequences
Fluency	3.91 (0.37)	8.36 (0.62)
Flexibility	3.31 (0.28)	6.21 (0.37)
Appropriateness	3.16 (0.26)	8.36 (0.62)
Elaboration	3.99 (0.36)	9.33 (0.63)
Originality	3.67 (0.50)	10.49 (1.05)

Mean score (± 1 standard error) for the Consequences Task.

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Table 9.

Bivariate correlations between divergent thinking performance in the Consequences Task and internal details for each type of autobiographical episode in Experiment 2.

	Past-Recall	Future-Imagine	Future-Recast
Z-scored Consequences score (Old consequences)	−.04	−.002	−.10
Z-scored Consequences score (New consequences)	.13	.36[∞]	.37[∞]

Bivariate correlations between divergent thinking performance in the Consequences Task and internal details for each type of autobiographical episode in Experiment 2

[∞](p < 0.06)