Wait, But Why?

Increasing Coherence and Detail of Future Events Through Elaboration

BY

SUSHMITA SHRIKANTH
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THESIS

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Defense Committee:
Karl Szpunar, Chair and Advisor
Eric Leshikar, Psychology
Jennifer Wiley, Psychology
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LIST OF ABBREVIATIONS

M          Mean        
SD         Standard Deviation  
CI         Confidence Interval
SUMMARY

When aspects of a given future scenario are disparate, future-oriented events are simulated with impoverished coherence and detail, which may pose challenges for tasks such as making plans or attempting to solve problems. This study examined the effects of reasoning by means of elaborative interrogation on enhancing coherence and detail, as well subjects’ memory, of future events. In two experiments, this strategy was incorporated before a future thinking task that involved imagining events involving people, locations, and objects taken from disparate social contexts.

In Experiment 1, participants engaged in elaborative interrogation on a trial-by-trial basis, to reason about why a specific person and location may be present in a future scenario before engaging in episodic simulation of an event that involved that person, location, and a novel object. In contrast, Experiment 2 required participants to engage in a series of stimulus-independent elaborative interrogation scenarios (e.g., Seeing the sentence, “The skinny man was at the church,” and responding to the question, “Why will this particular man be at this location?”) as a global reasoning induction before simulating future events that involved a novel person, location, and object.

The results of Experiment 1 revealed a trend indicating that participants were more likely to integrate a novel object into the same spatial-temporal context as the person and location for a given trial following reasoning about the person and location, as compared to a line-counting control task. This effect of trial-by-trial reasoning on event coherence was further reflected in the memory data, such that there emerged a trend indicating that participants were more likely to remember all three details of an
event cue (i.e., person, location, and object) if simulation of that cue had been preceded by reasoning. Notably, the effect of reasoning on event coherence and memory was qualified by an unexpected carryover effect, such that control trials following reasoning trials also benefited in terms of event coherence and memory. There were, however, no effects of reasoning on event details.

The results of Experiment 2 revealed no significant effects of elaborative interrogation on event coherence, detail, or memory. This further suggested that reasoning specifically about cue elements related to the future simulation task may be necessary to observe any benefits of reasoning on event coherence and memory. Taken together, these results provide partial support for the hypothesis that training in elaborative interrogation can support the construction of coherent events by inducing a reasoning mindset that allowed for better integration of disparate cue details into a memorable future event. Suggested possible avenues for future research are discussed.
I. INTRODUCTION

A. Relevant Background

As evidenced by nearly a decade’s worth of research, the quality and content of episodic memory shapes the way we simulate future events (for review, see Szpunar, 2010). For instance, neuropsychological studies have demonstrated that people with episodic memory deficits are also impaired in their ability to imagine the future (i.e., Hassabis, Kumaran, Vann, & Maguire, 2007; Tulving, 1985; for recent review, see Schacter et al., 2012). These findings have been corroborated by neuroimaging data, which show that neural regions associated with episodic memory and episodic future thinking are almost completely overlapping (Addis, Wong, & Schacter, 2007; Szpunar, Watson, & McDermott, 2007; for recent review, see Benoit & Schacter, 2015). Such findings have led to the formulation of the constructive episodic simulation hypothesis (Schacter & Addis, 2007, 2009), which posits that future events are constructed based on details that are extracted from specific past experiences. Importantly, the level of memory-based detail with which a future event is simulated has been shown to have important implications for how people accomplish goals (Gollwitzer & Sheeran, 2006; Oettingen, 2012), solve problems (Madore, & Schacter, 2014), engage in pro-social behavior (Gaesser & Schacter, 2014), and maintain general well-being (Jing, Madore, & Schacter, 2016; Rivikin & Taylor, 1999). Accordingly, an important direction for research will be to identify factors that support the ability to recombine elements of episodic memory into detailed simulations of future events.
One such viable factor is the coherence with which people simulate future events. For instance, a number of studies in this line of research have reported that the spatial-temporal coherence of an event, or the extent to which participants are able to integrate details from memory (e.g., people, objects, etc.) into a scene that occurs in one place and time, is related to the level of detail of the event. Specifically, past work has shown that future event simulations that are more coherent also tend to be more detailed (Addis, Pan, Musicaro, & Schacter, 2010; Shrikanth & Szpunar, in preparation; van Mulukom, Schacter, Corballis, and Addis, 2016).

Studies that have found this pattern of results typically use a paradigm known as an experimental recombination procedure (Addis, Pan, Vu, Laiser, & Schacter, 2009). This paradigm involves randomly taking details from participant-generated lists of people, locations, and objects and recombining those details to form novel simulation cues consisting of one person, one location, and one object (Addis et al., 2009; Szpunar, Addis, & Schacter, 2012). These cues are usually not linked to any one specific episodic memory, therefore requiring one to retrieve information from different episodes and recombine those details into a future event. Taking this paradigm a step further, van Mulukom et al. (2016) explicitly manipulated whether or not a person-location-object cue triad was associated with a specific social context or not. This was achieved by asking participants to generate specific social circles (e.g., “family,” friends,” and “work”) and list people, places, and objects associated with each of those social circles. Cue triads were then formed based on elements derived either from within the same social circle (e.g., family-family-family, or same-circle trials) or from across different social circles (e.g., family-work-friends, or mixed-circle trials). The
authors were interested in participants’ subjective ratings of event coherence (i.e., how easily details were integrated into the event) and detail (i.e., level of vivid imagery). They found that future event simulations were more coherent and detailed when they were based on same-circle trials as compared to mixed-circle trials. Thus, the extent to which episodic details were associated with one another in memory (i.e., based on sharing, versus not sharing, a common social context) appeared to affect the coherence and detail of simulated events. Shrikanth and Szpunar (in preparation) extended these findings in two important ways. First, Shrikanth and Szpunar used a think-aloud protocol and asked participants to verbally describe their simulated events. In contrast to van Mulukom et al. (2016), these descriptions were coded for spatial-temporal coherence and detail by independent raters (though participant-generated ratings of coherence and detail were also collected). Second, the authors used multi-level modeling to demonstrate that higher levels of event coherence were predictive of higher levels of event detail.

B. *Reasoning Process(es) in Future Event Simulation*

Based on prior work, being able to establish spatial-temporal coherence of disparate elements in a future event appears to facilitate greater levels of detail. Why would this be the case? One plausible explanation that I will explore further is that *reasoning* about relations between elements in episodic memory leads to more coherent and detailed events. It is difficult to clearly operationalize “reasoning,” which is often characterized by both implicit, associative processes and explicit, rule-based processes (Sloman, 1996; Evans, 2003). For the purposes of this study, I will adopt Viskontas, Morrison, Holyoak, Hummel, and Knowlton (2004)’s operationalization,
wherein human reasoning was succinctly described as “depend[ent] in part on one’s ability to integrate multiple relations” (p. 581). In the context of a future thinking task that requires multiple relations (i.e., between various disparate elements) to be integrated into an event, reasoning poses itself to be an important aspect of event simulation.

Indeed, traces of this construct can be found throughout the literature on episodic future thinking. For example, the hippocampus, which is heavily implicated in the episodic reconstruction process (Maguire & Hassabis, 2011; Schacter & Addis, 2008) is also active during inferential reasoning (Zeithamova, Schlichting, & Preston, 2012). Given the overlap in regional activation in both tasks, it seems plausible that inferential reasoning is actually part of that reconstructive process (i.e., reasoning about memories in order to form inferences and insights that guide the construction of coherent and detailed future events). Additionally, it is possible that the cognitive deficits that affect older adults’ abilities to imagine vivid future events could relate to declines in reasoning ability. Viskontas and colleagues (2004) tested older and younger adults on performance on the People Pieces Analogy Task. This task calls for the ability to map “the relational structure of one situation to another situation” (Viskontas et al., 2004, pg. 582). They found that older adults had difficulty integrating multiple relations at even a low level of complexity. Relatedly, Addis et al. (2009) found that older adults who were given future event simulation cues derived from a recombination procedure generated fewer coherent and less detailed future events than younger adults. While this finding was not discussed in the context of reasoning, it is possible that the kind of cognitive decline that affects older adults’ reasoning abilities may also contribute to their impaired future thinking ability.
Although there has not been a study explicitly demonstrating that reasoning in the context of future thinking can lead to more coherent and detailed events, speculation about the role of reasoning in future thinking is clearly justifiable. Indeed, findings from the text comprehension literature further support the hypothesis that reasoning may support the ability to construct a coherent event-based scenario. For instance, causal reasoning, or thinking about how knowledge fits together into an event, is an important mechanism in maintaining narrative coherence of a story (Trabasso, Secco, & Van den Broek, 1982). One model of causal reasoning posits that when reasoning about social scenarios, people must find causal relations between actions, motivations, and relevant knowledge (Read, 1987). This appears to be similar to the task demands of recombining disparate elements together in the context of future event simulation; participants presumably need access to relevant knowledge about cue elements (see Irish & Piguet, 2013) and how those elements go together before elaborating on the event in detail. When this information is readily accessible to the participant, such as when cue elements are derived from a shared context, then simulation should proceed seamlessly and result in a coherent and detailed event representation. However, when that information is not readily accessible, such as when cue elements are derived from non-shared contexts, simulating the event becomes more difficult and results in an impoverished event representation. While the extant literature on future event simulation (Addis et al., 2010; van Mulukom et al., 2016) and my previous findings (Shrikanth & Szpunar, in preparation) support this hypothesis, it is unknown whether the coherence and detail with which a future event is simulated can be boosted by manipulations that support reasoning about the relations of the elements associated with the event.
C. **Inducing Reasoning about Elements of Simulated Events**

The objective of the present experiments was to test the effects of reasoning about elements of a future event as a means of improving the spatial-temporal coherence and detail of the mental simulation of that event. The reasoning task chosen as the main manipulation was a learning strategy known as elaborative interrogation—a strategy that involves answering "why" questions when learning new information (Stein & Bradford, 1979; Pressley, McDaniel, Turnure, Wood, & Ahmad, 1987; Stein, Littlefield, Bransford, & Persampieri, 1984). This reasoning strategy has been shown to strengthen associations between to-be-acquired knowledge and background information, and to improve comprehension and long-term retention of the newly learned knowledge. Take for instance an arbitrary fact to be learned, such as, "The biggest danger to a Western spotted skunk is a great horned owl." To learn this information using elaborative interrogation, students would answer "why" questions when learning such facts, for example, "Why would the great horned owl pose danger to a western spotted skunk?" The process of reasoning out why aspects of the fact are connected to each other forces associations to be drawn between pieces of any relevant prior knowledge (Pressley et al., 1987). Importantly, explicitly connecting prior knowledge with new information allows for new information to be acquired within the context of old information (Woloshyn, Wood, & Willoughby, 1994), thereby strengthening access to the newly learned information and leading to ease of recall on a subsequent test.

In the experiments presented below, I assessed whether forming a strong reasoning structure around elements of an event might support the ability to construct coherent, detailed, and memorable simulations of the future. According to the
elaborative interrogation literature, the effects of this learning strategy are driven by an increase in associative strength between prior knowledge structures and to-be learned information (Woloshyn, Willoughby, Wood, & Pressley, 1990) and by reducing arbitrariness of relations between aspects of a given piece of information (Stein et al., 1984). Within the context of future thinking, strengthened associations between disparate elements of a cue could be one factor that contributes to the coherence (i.e., integration of cue elements in one, central event) and detail with which an event is simulated. Therefore, by explicitly manipulating whether or not one engages in reasoning about elements of a future event, through elaborative interrogation, I can directly assess the effects of reasoning on the coherence and detail of future events.

D. **Present Study**

In the present experiments, the reasoning manipulation occurred before the main future event simulation task, wherein participants were shown a person-location-object cue and told to imagine a future event involving three disparate elements (i.e., a person, location, and object). I chose a within-subjects design to maximize experimental power. The main within-subjects manipulation was whether participants engaged in elaborative interrogation or a control task before simulating a future event. Further, the social spheres variant of the recombination paradigm was used to assess the extent to which disparate elements could be unified within the context of a future event. Notably, all trials in the present studies were mixed-circle trials (i.e., a person, location, and object drawn from distinct social circles). Because same-circle cues are already inherently associated with one another by social circle, I reasoned that mixed-circle trials would be
more likely to benefit from an elaborative interrogation manipulation (Shrikanth & Szpunar, in preparation; van Mulukom et al., 2016).

My primary dependent variables were event coherence, event detail, and memory for simulated events. Although my prior work has established a relation between event coherence and detail, participants in that study were asked to rate their subjective levels of event coherence and detail on a trial-by-trial basis and it is not clear whether such ratings might have downstream influences on subsequently simulated events. Hence, participants in the following experiments were never asked to provide subjective ratings of coherence or detail. Regarding the objective measure of event coherence, I assessed the level of spatial-temporal coherence of each simulated future event using an established measure of event coherence coding adapted from Addis et al. (2010) that scored how well the cue elements were incorporated into a central event (i.e., in one place and at one time). Reasoning about disparate cue elements was predicted to increase coherence, meaning that those cue elements in the elaboration condition would be better integrated into future events that take place in one place and at one time, compared to the control condition. Regarding detail, I used an established measure of event detail commonly used in studies of memory and future event simulation, namely the Autobiographical Interview coding procedure (Levine et al., 2002). This coding method allows for a fine-grained parsing of event details into event-specific or internal details, and external details that do not add information relevant to the central event in question. While the effects of elaboration were expected to uniquely aide the generation of event-specific details, I also wanted to pay attention to the kinds of external details provided in descriptions of events. External details can include (i)
details that are not central to the main event (e.g., when participants continue simulating events that would follow the event of interest), (ii) repetitions of previously mentioned event-specific details, (iii) commentary about the task, and (iv) semantic details that provide background information about components of the event. Given prior work on the importance of semantic memory in supporting future thinking (Irish & Piguet, 2013), as well as the fact that goals/motivation/intentions about why an event may take place are characterized as semantic in nature (D’Argembeau & Mathy, 2011), I propose that semantic information should not be discarded as extraneous or unimportant to the event. Therefore, I also assessed whether the elaboration manipulation affected the quantity and quality of relevant semantic information provided.

Lastly, I expected to find memory benefits for event simulations that were preceded by elaborative interrogation. If reasoning does in fact lead to a more coherent event simulation, it follows that events that were reasoned about would also be better remembered. This prediction also aligns with the elaborative interrogation literature, which has shown better memory for facts that were elaborated upon (Woloshyn et al., 1990; Pressley et al., 1987). To test this hypothesis, participants were asked to recall cues from the events they simulated in both a free and cued recall task at the end of the experiment. Taken together, support for my predictions in terms of coherence, detail, and memory for events would show that reasoning processes play a role in recombining details into a coherent event, via associating knowledge about disparate elements. This would shed light onto a new and important cognitive mechanism that contributes to our ability to imagine novel future events.
II. EXPERIMENT 1

In Experiment 1, participants were asked to elaborate on why some of the event cues would be in a future event *immediately* before simulating a future event containing those cues. Specifically, on each experimental trial, participants were first asked to indicate why they thought a given person would be present in a given location (as compared to control trials, which involved requiring participants to count the number of straight lines in the letters of the person and location cue). Immediately after, subjects were asked to simulate a novel event involving the person and location, and an additional object. I aimed to test the hypothesis that explicitly reasoning about why disparate cues would exist in an event together (i.e., the person and location) would boost the spatial-temporal coherence of that event such that the object would be more likely to be incorporated into the central event of the simulation. Consequently, I predicted that this reasoning induction would foster the generation of event-specific details and semantic details, as well as support memory for simulated events.

A. Methods

1. Participants

Participants were twenty-four undergraduates ($N_{female} = 14$) at the University of Illinois at Chicago. They were recruited from the Introduction to Psychology class, and were granted course credit for their participation. Sample size was determined after conducting a power analysis using G*Power 3, by including effect sizes derived from prior work that used an induction procedure targeting the level of detail in future events (Madore, Gaesser, & Schacter, 2014). Power analyses revealed that, given previously found effect sizes ($d = .70$) and an alpha value of .05, the
estimated sample size required was $N = 16$ (estimated beta = .954). Thus, to maximize the probability of finding an effect and reduce the probability of Type I error, I opted for a sample size slightly larger than what was found in prior work.

2. **Materials and Procedure**
   
a. **Design**

   A blocked experimental design was used, in which each subject completed one experimental block (i.e., elaborative interrogation block) and one control block. Each of the two blocks consisted of one practice trial and six test trials, with a five-minute distractor task administered between blocks. As will be further described, trials in the elaborative interrogation block required participants to generate reasons why a person and location would co-occur in a future event *immediately before* simulating a complete future event involving that same person and location, with an additional object. For trials in the control block, participants instead counted the number of lines (horizontal and vertical) present in the person and location dyad before simulating a future event related to the same person and location and additional object. Line counting was chosen as a control task as it only required participants to engage with surface features of the person and location dyad, rather than deeply process them in a way that might inadvertently activate prior knowledge about them. The order of the blocks presented was counterbalanced across subjects, such that half started with trials in the elaborative interrogation block and half started with trials in the control block. Given that this experiment was entirely within-subjects, all subjects were exposed to both the elaboration trials and control conditions. Following both blocks, I administered free and cued recall tests.
b. **Cue Collection Procedure.**

Upon entering the testing room, participants were shown an Excel spreadsheet and asked to name three distinct social circles in their life, which was defined as groups of people with whom participants have shared a common activity or bond (e.g., “Family”, “School”, and “Choir” as 3 social circles). They then listed six people, six locations, and six objects that pertained to each respective social circle, and typed these lists of details into the spreadsheet using a keyboard. Participants were instructed to ensure that no details were repeated, and that there was no overlap in the details provided between social circles – that is, each element of each circle was unique. For “people” cues, participants were told to simply provide first names. For “location” cues, participants were asked to be as specific as possible, and pick specific establishments (e.g., “Willis Tower”) rather than generalized locations (e.g., “Chicago” would be too vague). Along these lines, participants were instructed to list a specific street name for places with multiple locations (e.g., “Target on Jackson” rather than “Target”). “Object” cues had to be small, portable, tangible items that could easily fit into a backpack (e.g., “laptop” rather than “couch”) and that were related to activities associated with each social group.

After entering these details into the Excel spreadsheet, subjects were asked to leave the testing room. The order of the details listed in each circle was randomized within Excel and recombined into unique person-location-object triads. Each element of the cue was derived from a different social circle (e.g., a person from “Family”, a location from “School”, and an object from “Choir”). The recombination of details included every possible permutation of person, location, and object associated with
each of the three social circles (i.e., people, places, and objects for each cue could be
drawn from any of the three social circles provided, so long as no two cues came from
the same circle). A total of twelve experimental cue triads and two practice cue triads
were created. These randomized cues were entered into the ePrime program – half
were used in the elaboration block, and half in the control block.

c. **Experiment Procedure**

Subjects returned to the testing room after the ePrime program was
set up, and were then instructed on the task procedure. Each trial consisted of two
phases – (1) the cue presentation phase (where the crucial elaboration/control
manipulation occurred), and (2) the event simulation phase, comprised of two minutes
of verbal description of the future event. During the first phase, a person and location
cue randomly taken from the lists provided earlier was shown on the screen. For trials in
the elaboration block, the person and location cues were presented along with the
question “Why would you see this person in this location?” Subjects were instructed to
engage in elaborative interrogation, and to provide reasons why the person and location
would fit together in a scene. They were given fifteen seconds to type these reasons
into the ePrime program using a keyboard. This length was determined during pilot
testing, as thirty seconds provided ample time for subjects to elaborate on these
sentences. In the control block, participants were given fifteen seconds to count the
number of horizontal and vertical lines present in the words on the screen, and to enter
that number into the ePrime program with a keyboard.

After fifteen seconds of elaboration or line counting, the future event simulation
phase began. The person and location cues remained on the screen and an object
randomly taken from the lists (provided earlier) appeared on the screen alongside the person and location. Participants were told that they had two minutes to verbally describe a future event that involved the participant interacting with the specified the person in the specified location, and that somehow incorporated the specified object. They were instructed to provide as much detail about the event as possible, and to speak for as much of the two minutes as they could. Their responses were audio recorded. After simulating the event for two minutes a bell sound indicated the end of the trial and a new person and location cue appeared on the screen. Please refer to Appendix A for specific instructions provided during the testing phase.

After the instructions for the first block were given, subjects completed a practice trial (which included both the elaboration or line counting task plus a simulation). They were given the opportunity to ask questions or clarify the procedure at this point. Following the practice trial, subjects completed six consecutive trials that were audio-recorded. After completing the first block of trials, a five-minute mathematics "assessment" was administered as a distractor task. Prior work has shown that a math distractor can successfully eliminate carryover effects of an induction procedure in relation to a future event simulation task (Madore & Schacter, 2014). For this distractor, participants were told to complete as many math problems as possible. These problems involved performing basic arithmetic functions – addition, subtraction, multiplication, and division – on simple fractions. Following the distractor, participants who began with the elaborative interrogation task received instructions for, and completed, the control condition block (i.e., the line counting version of the sentence task followed by the simulation task with novel cues), and vice versa. They completed one practice trial
followed by six more trials in this block. All audio recordings of participant responses were transcribed for later coding.

d. **Memory Tests**

Following the completion of the two blocks of the experiment, participants were asked to spend approximately fifteen minutes completing an unrelated study. After the delay task, participants were tested for their memory of the events they simulated. Again, all subjects engaged in free recall of the cues first, followed by cued recall. Participants were given two sheets of paper – one for each of the memory tests – that contained twelve sets of three spaces (for each of the twelve events they simulated). They were told to try and remember the person, location, and object from each of the twelve events they simulated. Participants were first instructed to engage in free recall of the twelve events and write down the person, location, and object associated with each event. They were given five minutes to freely recall as many of the cue triads as possible. Following the free recall phase, participants were shown lists of all the people, places, and objects that were presented throughout the experiment, all listed in a random order. They were then instructed to use the lists of cues to jog their memory of the cues for each event they simulated. They were again given five minutes to write as many cue triads as possible in this cued recall phase using a new blank response sheet. All participants received the memory tests in the same order – free recall first, followed by cued recall. Once the memory tasks were complete, participants were debriefed on the background and nature of the experiment and were given participation credit. Please refer to Appendix A for more detailed instructions that were provided to participants.
3. **Scoring Protocol**

   a. **Identifying Central Event**

      Before coding events for coherence or detail, a central/main event was identified for each simulation. According to the prescriptions of the Autobiographical Interview coding procedure (Levine et al., 2002), the main event described by the participant generally should take place in a short time frame and should be the focus of the simulation (i.e., were most of the action takes place). In instances where the main event is ambiguous, or if multiple events are reported in a trial, “the event that garnered the most details was considered the main event” (Levine at al., 2002, pg. 679). Once identified, the scoring of coherence and internal/external details were made in relation to this main event for each simulation.

   b. **Coherence Scores**

      In accordance with the procedures for scoring spatial-temporal coherence described by Addis et al. (2010), event coherence was scored on whether or not the previously identified main event contained the person, location, and object specified in the simulation cue. If either the person, location, or object was missing from the central event, the response received a score of “0”. For instance, in some cases the person and location were present in the central event, but the object was absent – such cases received a score of 0. If a participant’s description integrated the person, location, and object into the central event, then the event was given a coherence score of “1”.

   c. **Event Detail**

      The Autobiographical Interview coding procedure (Levine et al., 2002) was used to further examine the use of two main categories of details – internal
or external. Internal details included episodic information related to the time of day, people involved, sensory details, actions, and thoughts/feelings. Importantly, details were only categorized as internal if they were included in the description of the previously identified main event. External details were comprised of several sub-categories, none of which added to the overall level of detail associated with the main event. These included (i) episodic information (e.g., time of day, people, sensory details, actions, and thoughts/feelings) that did not pertain to the main event (e.g., episodic information associated with a second or third event described by the participant), (ii) repeated details, (iii) meta-cognitive or miscellaneous statements, and (iv) semantic, or reason-based, details that provided background information pertaining to the main event.

As discussed earlier, though semantic/reason-based details are often relegated to the external detail category in the context of the Autobiographical Interview scoring procedure, I decided to assess the extent to which the reasoning manipulation may have affected the number of semantic details mentioned in the simulated events. In future-oriented events, semantic details typically provide information about why an event is structured in a particular manner (D'Argembeau & Mathy, 2011) and may arise as a direct result of reasoning about the relations of elements associated with a simulation cue. As such, I counted and categorized semantic details as either (a) reason-based detail that provides information about motivation, intent, or background knowledge for why an event took place (i.e. relevant semantic details), or (b) generic semantic information that is peripheral or extraneous to the central event happenings (i.e. irrelevant semantic details).
d. **Interrater Reliability**

Two study-blind independent coders scored the data for this experiment. The coders were first extensively trained on the coding procedures (including Autobiographical Interview coding and coherence coding) using old datasets. To assess consistency in coding, Cronbach’s alpha was calculated for each of the three dependent variables. Raters established Cronbach’s alpha of 1.00 for event coherence, .88 for internal (i.e., event-specific) detail, and .80 for semantic detail. Following training, each rater coded half of the participant responses for the experiment (in accordance with how the autobiographical interview is typically coded; e.g., Brown et al., 2014).

e. **Memory Tests**

Memory was tested via free and cued recall tasks that required participants to generate the person, location, and object associated with each of the twelve events they had imagined. Responses were scored correct if participants wrote down the person, location, and object from a particular event. Otherwise, responses were scored as incorrect (e.g., if the participant only recalled two of the three cue elements). After scoring memory performance, I calculated the proportion of correctly recalled events in each condition.

B. **Results**

1. **Coherence and Detail**

To assess the extent to which elaborative interrogation contributed to increased coherence and detail relative to the control task, a two (condition: elaboration/control) by two (counterbalancing order: elaboration first/control first) mixed
measures analysis of variance (ANOVA) was conducted on each of the relevant dependent variables of interest: event coherence, internal detail, and semantic detail. The main manipulation of condition was entered as a within-subjects variable, while the counterbalancing order was entered as a between-subjects variable to account for any potential carryover effects. Please refer to Table 1 for all descriptive statistics.

For event coherence, there was no main effect of condition, $F(1,22) = 0.07, p = .788$ or counterbalance order, $F(1,22) = 0.675, p = .420$. However, a significant interaction between condition and counterbalance order emerged, $F(1,22) = 6.79, p = .016, \eta_p^2 = 0.24$. Bonferroni-corrected post-hoc comparisons revealed that this interaction was driven by greater coherence in control trials that took place after elaboration trials ($M = 0.86, SD = 0.24$) than control trials that took place first ($M = 0.69, SD = 0.27$), $t(22) = 1.57, p = .065, d = 0.67$; this difference approached statistical significance. There was no such difference in coherence between elaboration trials that took place in the first ($M = 0.78, SD = 0.25$) versus second ($M = 0.80, SD = 0.16$) block of trials, $t(22) = 0.20, p = .842$. Given that the impact of elaboration training appeared to carryover onto subsequent trials, I ran a between-subjects comparison between elaboration and control trials that were free from cross-condition contamination (i.e. trials in the first blocks of each counterbalance order). This comparison revealed that elaboration trials in the first block ($M = 0.78, SD = 0.25$) were numerically more coherent than control trials in the first block ($M = 0.69, SD = 0.27$), although this difference did not approach statistical significance, $t(22) = 0.78, p = .444$. Taken together, it appears that the elaboration manipulation may have had some effect on the level of coherence in
event simulations, particularly on the control trials that followed elaboration trials. I address this pattern of results in further detail below.

A second mixed factorial ANOVA was conducted on the dependent variable of internal detail. This yielded no main effect of condition, $F(1,22) = 0.25, p = .625$, no main effect of counterbalance order, $F(1,22) = 1.31, p = .264$, and no interaction, $F(1,22) = 0.06, p = .814$. Lastly, I conducted a mixed factorial ANOVA to test the effects of elaboration on relevant semantic detail generated. Again, I found no significant main effect for condition, $F(1,22) = 0.17, p = .0679$. A small but statistically significant order effect emerged, $F(1,22) = 4.36, p = .049, \eta^2_p = 0.17$, such that more relevant semantic details were generated overall by individuals who completed the control trials first ($M = 2.60, SD = 2.08$) than those who completed the elaboration trials first [$M = 1.24, SD = 1.10, t(10) = 2.09, p = .049, d = 0.82$]. There was no interaction between condition and counterbalance order, $F(1,22) = .005, p = .946$. 
TABLE I
MEANS, STANDARD DEVIATIONS, AND 95% CONFIDENCE INTERVALS FOR MEASURES IN EXPERIMENT 1

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Block Order</th>
<th>Elaboration Trials</th>
<th>Control Trials</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M(SD)</td>
<td>95% CI</td>
</tr>
<tr>
<td>Coherence</td>
<td>A(^1)</td>
<td>0.78 (0.21)</td>
<td>[0.77 - 0.78]</td>
</tr>
<tr>
<td></td>
<td>B(^2)</td>
<td>0.80 (0.16)</td>
<td>[0.79 - .80]</td>
</tr>
<tr>
<td>Internal detail</td>
<td>A</td>
<td>37.4 (15.2)</td>
<td>[37.2 - 37.6]</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>51.0 (34.5)</td>
<td>[50.6 - 51.4]</td>
</tr>
<tr>
<td>Relevant semantic detail</td>
<td>A</td>
<td>1.15 (1.62)</td>
<td>[1.13 - 1.17]</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>2.47 (1.81)</td>
<td>[2.45 - 2.49]</td>
</tr>
</tbody>
</table>

\(^1\) Block order A = Elaboration trials first

\(^2\) Block order B = Control trials first
2. **Memory Recall**

Finally, the proportions of correctly recalled responses were analyzed using another two (condition: elaboration/control) by two (counterbalancing order: elaboration first/control first) mixed factorial ANOVA. Again, condition was entered as a within-subjects variable, while counterbalance order was between subjects. Please refer to Table 2 for all descriptive statistics pertaining to free and cued recall tests. For free recall, there was no main effect of condition, $F(1, 22) = 0.314$, $p = .581$, no main effect of counterbalance order, $F(1, 22) = 2.13$, $p = .088$, and no interaction, $F(1, 22) = 3.09$, $p = .093$. Cued recall yielded similar results, with no main effect of condition, $F(1, 22) = 3.37$, $p = .08$, no main effect of counterbalance order, $F(1, 22) = 3.37$, $p = .08$, and no interaction, $F(1, 22) = 3.82$, $p = .060$.

While a statistically significant interaction did not emerge, the memory data could nonetheless provide insight into how well participants had integrated event details into a coherent mental representation. Specifically, I was interested in assessing the possibility that the control trials that came after elaboration trials would be better remembered than the control trials that came before elaboration trials. To test this, I conducted a post hoc independent samples t-test on the control trials, with counterbalance order as the grouping variable ($N = 12$ per group). Indeed, I found a significant difference for the cued recall test, such that control trials that were in the second block ($M = 0.64$, $SD = 0.26$) were better recalled compared to control trials that were in the first block ($M = 0.35$, $SD = 0.34$), $t(22) = 2.33$, $p = .029$, $d = 0.950$. Moreover, in keeping with the between-subjects analyses of event coherence, memory for elaboration trials completed first was better than memory for control trials completed.
first, although this difference was only statistically significant for cued recall \(M_{\text{lab}} = 0.74, SD = 0.30\) vs. \(M_{\text{ctrl}} = 0.39, SD = 0.37\), \(t(22) = 2.47, p = .022, d = 1.01\), and not free recall \(M_{\text{lab}} = 0.58, SD = 0.30\) vs. \(M_{\text{ctrl}} = 0.35, SD = 0.34\), \(t(22) = 1.80, p = .086\).
### TABLE II
MEANS, STANDARD DEVIATIONS, AND 95% CONFIDENCE INTERVALS FOR MEMORY TESTS\(^3\) IN EXPERIMENT 1

<table>
<thead>
<tr>
<th>Memory Test</th>
<th>Block Order</th>
<th>Elaboration Trials</th>
<th>Control Trials</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M(SD)</td>
<td>M(SD)</td>
</tr>
<tr>
<td>Free Recall</td>
<td>A(^1)</td>
<td>.583 (.297)</td>
<td>.639 (.264)</td>
</tr>
<tr>
<td></td>
<td>B(^2)</td>
<td>.472 (.361)</td>
<td>.347 (.344)</td>
</tr>
<tr>
<td>Cued Recall</td>
<td>A</td>
<td>.736 (.321)</td>
<td>.746 (.321)</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>.543 (.403)</td>
<td>.389 (.365)</td>
</tr>
</tbody>
</table>

\(^1\) Block order A = Elaboration trials first

\(^2\) Block order B = Control trials first

\(^3\) Data represent proportion of person-location-object cues correctly recalled in each condition
C. **Discussion**

While there were no effects of condition on internal detail or relevant semantic detail generated, data from Experiment 1 nevertheless provided modest evidence pointing to benefits of elaborative interrogation on event coherence. Notably, an interaction emerged between condition and counterbalance order, indicating that control trials that followed elaboration trials were more coherent than control trials that were completed first. This unexpected pattern of results raises the possibility that training participants to elaborate on the relations between cue elements can support event coherence. As I alluded to earlier, elaboration trials that were constructed first were numerically more coherent than control trials that were constructed first, although this difference was not significant. Moreover, the interaction between condition and counterbalance order indicated that control trials were more coherent when trials came before, rather than after elaboration trials; no such order effect emerged for the timing with which elaboration trials were completed relative to control trials. This interaction further supports the notion that practice with elaboration supported event coherence. It is important to note that the mathematics distractor task was unsuccessful in preventing carryover of elaboration training on subsequent control trials (cf. Madore et al., 2014), as indicated by the interaction between condition and counterbalance order.

Importantly, the pattern of data that emerged in relation to coherence scores also appeared in the memory data. Elaboration trials completed first were significantly more memorable on a cued recall test than control trials completed first. Note also that a similar, but non-significant, pattern of data emerged in the context of free recall (see Table 2). Further, control trials completed second were more memorable than control
trials completed first. Taken together, this pattern of results suggests that training with elaboration practice supported coherent and integrated representations of future events that could be later recalled successfully. Of course, the unexpected carryover effects necessitated between participant comparisons, which resulted in underpowered analyses and increased susceptibility of Type I error. I address this point in further detail in the general discussion.

Finally, it is important to note that the elaboration induction had no apparent effects on internal or semantic detail, even when considering the between participant comparisons highlighted above in relation to event coherence and memory (see Table 1). In one sense, this finding is surprising given my hypothesis that event coherence would facilitate the generation of event detail. However, it is important to keep in mind that measures of event detail (internal or semantic) are susceptible to subject-level differences in how much participants produce that might obscure any relation between my independent variable of interest (i.e., elaborative interrogation) and event detail. I will also go into greater detail on this particular point in the general discussion.

Experiment 1 provided some preliminary evidence that an elaboration induction could foster greater spatial-temporal coherence in the context of future event simulation, as well as contribute to better memory for simulated events. While more work will be needed to replicate this pattern of results with a more highly powered design, it will also be important to assess whether the observed pattern of results could arise in the context of a more general induction that does not train participants to relate cue elements on a trial-by-trial basis, but rather encourages elaboration via cue independent stimuli.
III. EXPERIMENT 2

In order to assess whether a cue-independent induction of reasoning might also support event coherence (and perhaps detail), Experiment 2 sought to induce global activation of reasoning processes by implementing an elaborative interrogation task adapted from earlier works in the field (Stein & Branford, 1979). Importantly, this experiment differed from Experiment 1 in that participants were not told to explicitly elaborate on why the event cues would appear in a scene together. Rather, a cue-independent induction of reasoning processes was implemented, which required participants to generate rationale as to why several ambiguously posed scenarios involving a generic person and location could occur. The global elaboration induction was meant to tap into, or otherwise ramp up, the mechanism required to form associations between disparate cue elements. Assuming this mechanism indeed underlies the reasoning processes equipped during event simulation, I hypothesized that the elaboration induction, relative to a line-counting control task, would transfer to the future thinking task and yield more coherent, and perhaps detailed, simulations. If the associative processes that lead to increased coherence (and perhaps detail) can be manipulated in a cue independent manner, the results of this study would speak to the domain general nature of reasoning processes involved in simulating future events.

A. Methods

1. Participants

Participants were again twenty-four undergraduates ($N_{female} = 14$) from the University of Illinois at Chicago recruited from the Introduction to Psychology class, and were granted course credit for their participation. Given that the manner of inducing
reasoning processes in this experiment was sufficiently different from Experiment 1, I decided to adopt a similar sample size as Experiment 1.

2. **Materials and Procedure**

   a. **Design**

      As with Experiment 1, there were two blocks in this experiment – one elaboration induction block and one control block. Each block consisted of two parts – (1) the sentence task (where the elaboration/control manipulation occurred), and (2) the future event simulation task. A crucial difference in this study was that, unlike Experiment 1, the manipulation occurred separately from the event simulations, rather than immediately before event simulation. That is, trials and stimuli used in the elaboration phase were separate from, and unrelated to, trials in the simulation phase. As with Experiment 1, a five-minute distractor task was administered between the two blocks. Block order was counterbalanced across participants such that half began with the elaboration block and half began with the control block. Although the distractor task did not appear to prevent carry-over elaboration effects in Experiment 1, I wanted to keep the structure of the design in Experiment 2 as similar as possible to that of Experiment 1 in order to facilitate any cross experiment comparisons.

   b. **Cue Collection Procedure**

      This phase was identical to Experiment 1, wherein person-location-object cues were generated based on recombining details from across three different social circles. As before, each experimental cue was a mixed-circle cue – each element of the cue was derived from a different social circle. A total of twelve experimental cues and two practices cues were created.
c. **Experiment**

Once the randomized person-location-object cues were entered into the ePrime program, the participant returned to the testing room to receive the instructions for the event simulation task. Before the first block, all participants were instructed on how to complete the simulation task with the same set of instructions that had been provided in Experiment 1. Full instructions provided can be found in Appendix B. Once given these instructions, participants completed two practice simulations where the experimenter ensured that the instructions were being followed appropriately. The practice trials were set up in this way because the manipulation was not yoked to the simulation task as in Experiment 1. Additionally, since subjects in Experiment 1 completed two practice trials (one before each block), two practice trials were given in this experiment as well, the only difference being that both practice trials occurred at the outset of the experiment before any manipulations were implemented.

After two practice simulations, participants moved on to the first block of the experiment. Participants who began with the elaboration condition were presented with 10 base sentences adapted from Stein and Bransford (1979). These sentences posed ambiguous scenarios, for example, “The religious man used the saw.” To more closely match the future thinking task, an arbitrary location replaced the object in each scenario (e.g., “The religious man was at the deli”). Also, half the sentences involved a woman at a particular location, so as to not bias any one particular gender. These sentences were accompanied by a “why” question (e.g., “Why would this particular person be at this location?”), which participants were instructed to answer within thirty seconds for each sentence. This length was determined during pilot testing, as thirty seconds provided
ample time for subjects to elaborate on these sentences. The responses were entered using a computer keyboard. Those who began with the control task were shown the same sentences as in the elaboration condition, but instead counted the number of lines (horizontal and vertical) present in the words on the screen (i.e., in the sentence). The line counting task was chosen as a control as it only required participants to engage with surface features of the words in the sentence, rather than to deeply process them in a way that might inadvertently activate any reasoning processes. The order of the sentences presented was randomized for each participant, with a different set of sentences used in each block. Participants completed twelve consecutive trials for the sentence task before moving on to simulating future events.

After the sentence task, participants completed the future event simulation task as in Experiment 1; they had two minutes to verbally describe a future event that involved the participant interacting with the specified person in the specified location, and that somehow incorporated the specified object. They were instructed to provide as much detail about the event as possible, and to speak for as much of the two minutes as they could. Their responses were audio recorded as in the previous experiment. Following the first block of trials, a five-minute mathematics distractor task was administered as in Experiment 1, after which subjects were given the instructions to the second version of the sentence task (either line counting or elaboration, whichever they had not yet completed). They then completed twelve more trials for the sentence task. In the last part of the second block, they were reminded of the instructions for the future event simulation task (identical to the first block), and completed six more future
event simulations. All the audio recordings of participants’ event descriptions were transcribed for content analysis.

Following the end of the second block of simulations, the memory tests were administered after a fifteen-minute delay task that was unrelated to the study. For the memory tests, as in Experiment 1, participants had five minutes to freely recall as many person-location-object triads as possible, followed by five minutes of cued recall. After this, participants received experimental credit and were debriefed. Please refer to Appendix B for more detailed instructions that were provided to participants.

3. **Event Coding and Memory Tests**

   As with Experiment 1, two study-blind independent raters coded responses such that the main event was first identified, followed by scoring of spatial-temporal coherence and event detail (e.g., internal and external details). These were the same coders that were used in Experiment 1. Spatial-temporal coherence was coded identically to Experiment 1 – an event was given a score of “1” if the person, location, and object were present in main event, and a score of “0” if one or more cue elements were missing from main event). As in Experiment 1, event details were scored using the Autobiographical Interview (Levine et al., 2002) and parsed into internal and external details. Semantic details were also categorized as relevant and irrelevant to the main event. Memory test data were scored identically to Experiment 1 and proportions of correct responses were again calculated.

B. **Results**

1. **Coherence and Detail**
As in Experiment 1, I conducted a two (condition: elaboration/control) by two (counterbalancing order: elaboration first/control first) mixed measures analysis of variance (ANOVA) on each of the dependent variables of interest: event coherence, internal detail, and semantic detail. The main manipulation of condition was entered as a within-subjects variable, while the counterbalance order was entered as a between-subjects variable to account for any potential carryover effects. Please refer to Table 3 for all descriptive statistics. For coherence, I found no main effect of condition, $F(1,22) = 0.06$, $p = .814$, no main effect of order, $F(1,22) = 0.40$, $p = .532$, and no interaction, $F(1,22) = 1.02$, $p = .323$. For internal detail, there was also no main effect of condition, $F(1,22) = 1.14$, $p = .298$, no main effect of counterbalance order, $F(1,22) = 1.26$, $p = .274$, and no interaction, $F(1,22) = 1.96$, $p = .175$. Lastly, for semantic detail, there was no main effect of condition, $F(1,22) = 1.41$, $p = .248$, no main effect of counterbalance order, $F(1,22) = 3.93$, $p = .060$, although it did approach significance, and no interaction, $F(1,22) = 1.96$, $p = .175$. Hence, it appears that a task-independent induction of reasoning had no influence on the degree to which participants were able to integrate disparate event details into coherent or detailed simulations of the future.
## TABLE III

MEANS, STANDARD DEVIATIONS, AND 95% CONFIDENCE INTERVALS FOR MEASURES IN EXPERIMENT 2.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Block Order</th>
<th>Elaboration Trials</th>
<th>Control Trials</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M(SD)</td>
<td>95% CI</td>
</tr>
<tr>
<td>Coherence</td>
<td>A(^1)</td>
<td>0.76 (0.26)</td>
<td>[0.75 - 0.76]</td>
</tr>
<tr>
<td></td>
<td>B(^2)</td>
<td>0.57 (0.31)</td>
<td>[0.56 - 0.57]</td>
</tr>
<tr>
<td>Internal detail</td>
<td>A</td>
<td>42.2 (26.7)</td>
<td>[41.9 - 42.5]</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>45.0 (23.3)</td>
<td>[44.7 - 45.3]</td>
</tr>
<tr>
<td>Relevant semantic detail</td>
<td>A</td>
<td>1.11 (0.53)</td>
<td>[1.10 - 1.12]</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>2.17 (1.92)</td>
<td>[2.15 - 2.19]</td>
</tr>
</tbody>
</table>

\(^1\) Block order A = Elaboration trials first

\(^2\) Block order B = Control trials first
2. **Memory Recall**

As before, a two (condition: elaboration/control) by two (counterbalancing order: elaboration first/control first) mixed measures ANOVA was run on each of the memory tasks – free and cued recall. Counterbalance order was included as a between-subjects variable in these analyses to stay consistent with the analyses conducted previously. Please refer to Table 4 for all descriptive statistics pertaining to free and cued recall tests. For the free recall task, I found no significant main effect of condition, $F(1,22) = .077, p = .784$, no main effect of counterbalance order, $F(1, 22) = .278, p = .603$, and no interaction, $F(1,22) = 2.76, p = .111$.

For cued recall, there was a small but significant main effect of condition such that cues in the control condition were better remembered ($M = .74, SD = .28$) than cues in the elaboration condition, [$M = .64, SD = .31; F(1,22) = 4.53, p = .045, \eta^2 = .171$]. The main effect of counterbalance order did not emerge as significant, $F(1, 22) = .315, p = .580$, nor did the interaction between condition and counterbalancing order, $F(1,22) = .985, p = .332$. Taken together, and consistent with the results of the analyses for coherence and detail, there was no evidence that elaboration boosted memory for simulation of future events.
### TABLE IV

**MEANS, STANDARD DEVIATIONS, AND 95% CONFIDENCE INTERVALS FOR MEMORY TESTS IN EXPERIMENT 2**

<table>
<thead>
<tr>
<th>Memory Test</th>
<th>Block Order</th>
<th>Elaboration Trials</th>
<th>Control Trials</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M(SD)</td>
<td>95% CI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>M(SD)</td>
</tr>
<tr>
<td>Free Recall</td>
<td>A&lt;sup&gt;1&lt;/sup&gt;</td>
<td>.514 (.297)</td>
<td>[.510 - .517]</td>
</tr>
<tr>
<td></td>
<td>B&lt;sup&gt;2&lt;/sup&gt;</td>
<td>.653 (.270)</td>
<td>[.649 - .656]</td>
</tr>
<tr>
<td>Cued Recall</td>
<td>A</td>
<td>.583 (.322)</td>
<td>[.579 - .587]</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>.694 (.292)</td>
<td>[.690 - .698]</td>
</tr>
</tbody>
</table>

<sup>1</sup> Block order A = Elaboration trials first

<sup>2</sup> Block order B = Control trials first

<sup>3</sup> Data represent proportion of person-location-object cues correctly recalled in each condition.
III. GENERAL DISCUSSION

A. Overview of Findings and Implications

I sought to test the viability of elaborative interrogation as a means of boosting the level of coherence and detail of future event simulations. While a global, task-independent reasoning induction (Experiment 2) brought about no increases in coherence or detail, an event-specific reasoning induction (Experiment 1) did lead to events containing greater levels of spatial-temporal coherence, though no effect was found for detail.

Altogether, these results provide some preliminary support for the idea that reasoning processes play a role in constructing coherent episodic future simulations, at least when the induction of reasoning is administered on a trial-by-trials basis. Post hoc comparisons of the Experiment 1 results appeared to indicate that elaboration supported event coherence in a rather systematic fashion. Elaboration trials completed in the first block were numerically more coherent and better remembered than control trials completed in the first block. Moreover, control trials completed after a block of elaboration trials were more coherent and better remembered than control trials completed first, suggesting that the effects of the elaboration induction carried over to subsequent trials. However, this latter aspect of the findings, i.e., greater coherence and memory in control trials following elaboration trials was not something I had predicted. Why might this carry-over effect have come about?

One possibility why the control trials in the second block were influenced by the induction could be that the elaboration induction encouraged participants to enter a reasoning mindset, and that this reasoning mindset transferred to the control trials. That
is, after inducing a reasoning mindset in the elaboration block of trials, participants continued to employ the elaborative interrogation strategy during event simulation in the control condition to reason about why the cue elements fit into the event, which ultimately led to more coherent events that integrated all three elements. In this case, the elaboration trials can be characterized as “training” on a reasoning strategy that carried over to control trials. Again, the memory data supported this interpretation, since a greater proportion of person-location-object triads were correctly recalled for control trials that were completed after, compared to before, the block of elaboration trials. In sum, these data suggest that elaborative interrogation can be effective in improving coherence of future events, and that the effects of elaboration “training” can carry over to subsequent trials where subjects are not prompted to engage in elaboration.

The effects of the reasoning induction on coherence parallel the effects of an episodic specificity induction (Madore, Gaesser, & Schacter, 2014; Madore & Schacter, 2014; 2016) on detail. In contrast to elaborative interrogation, the specificity induction entailed asking participants to engage in the retrieval of episodic details based on a video they had just viewed, which subsequently resulted in increased level of internal detail of future event simulation. In prior work, this effect was characterized as inducing an “episodic retrieval orientation” (Madore, Addis, & Schacter, 2015) that transferred to a subsequent task and encouraged participants to engage in detailed retrieval. My findings suggest that it is also possible to induce a mindset that gears participants to focus on the relations between disparate cue elements, and that this reasoning mindset can have benefits on the quality of simulated events. A crucial takeaway from this experiment was that reasoning before mentally simulating the event allows for
integration of disparate elements, albeit only to the extent that one reasoned specifically about elements pertaining to the event. Because no effects were found in Experiment 2, it stands to reason that a cue-independent approach is an insufficient induction of the reasoning mindset. This may not be surprising, given that the elaborative interrogation literature employs a cue-specific approach; that is, people elaborate on the specific to-be acquired information in order to reap the benefits of engaging in this reasoning strategy (Woloshyn, Pressley & Schneider, 1992; Menke & Pressley, 1994).

B. Memory for Simulations

Up until this point, I have interpreted the memory data from Experiment 1 as support for the idea that reasoning via elaboration supported the construction of integrated mental representations of future events. However, these results could also have important implications for the study of memory for simulations. It has long been theorized that future event simulations have adaptive value as far as allowing people to prepare for the future (Suddendorf & Corballis, 1997, 2007; Szpunar, 2010; Schacter, 2012). However, simulations can only serve a future purpose to the extent that they are remembered in the future. While the idea of “memories of the future” has persisted for several decades (Ingvar, 1985) little to no work has been done on how to improve memory for future event simulations (not to be confused with future intentions; Kleigel et al., 2008). My study showed that reasoning about the relations between elements of a simulated event may serve a role in supporting the long-term associations formed between those elements in memory. While the results of Experiment 2 were not supportive of this pattern of results, the elaboration induction in that experiment was stimulus independent, and so there may be various reasons as to why control trials in
that study were more memorable. Indeed, more work will be needed to assess the extent to which stimulus-dependent inductions of reasoning processes might support long term retention of future event simulations, and any associated boundary conditions (e.g., how the induction is implemented).

Assuming that future work can replicate the stimulus-dependent support of elaboration on memory for simulated events, the technique could be of interest in contexts wherein memory for simulations is typically impoverished. For instance, prior work has shown that details of negative event simulations are not as well remembered over extended periods of time as details of positive event simulations (Szpunar, Addis, & Schacter, 2012). Given that negative simulations of events may be particularly suited to helping people solve daily problems (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001), it will be worthwhile to assess the extent to which the reasoning process studied here can be invoked to support the construction and memory for negative simulations of the future.

C. Limitations and Future Directions

My findings relating to the influence of a reasoning induction on coherence are not without their limitations. As noted earlier, the induction did not impact the overall level of internal, event-specific detail, nor did it influence the generation of relevant semantic information. If reasoning did facilitate the activation of knowledge structures that support the integration of relevant details in memory, then these kinds of details should have been positively impacted, particularly in the control trials for which I found a strong effect on coherence. It is possible that no effects of elaboration emerged for internal or semantic detail because these dependent variables are directly influenced by
participants’ verbal fluency – that is, subjects who simply speak more will likely skew the interpretability of the results. However, coherence is likely not a function of verbal fluency, but rather one’s ability to bring disparate elements together into one scene. Nevertheless, additional work is needed to replicate this overall pattern of results with a larger sample size, which may overcome possible participant-level differences in the amount of event-specific detail they are able to generate.

Another important methodological note to consider remedying is the choice of distractor task. Clearly, the five-minute mathematics distractor was not sufficient to eradicate the effects of the elaboration induction, despite its use in prior work (Madore & Schacter, 2014). This yielded favorable outcomes in these experiments, given that I saw carry-over effects of the reasoning strategy from elaboration trials to control trials despite a distractor task between blocks. However, a cleaner demonstration of this effect can be attained by simply utilizing a between-subjects design, wherein only half of the subjects engage in elaboration while the other half engages in the control task. This would prevent unwanted carry-over and order effects, and would eliminate the need for a distractor task. Indeed, as noted earlier, the data in Experiment 1 indicated a pattern in the expected direction when comparing elaboration trials that were completed first to control trials that were completed first (i.e., in a between-subjects manner). Alternatively, a within-subjects design with a longer delay between conditions (e.g., 1 day) might prove useful for overcoming issues associated with participant-level differences in verbal fluency, assuming that some effect of elaboration on event detail might arise.
Lastly, analyzing these data employing a mediated mixed-effects model (Baayen, Davidson, & Bates, 2008; Bates, Maechler, & Bolker, 2015) could further address the issue of participant-level variability in verbal fluency and better explain how the constructs of coherence, detail, and reasoning relate to one another within the context of future thinking. These models control for subject-level variability, leading to a cleaner analysis of the elaboration induction on detail. It also affords the opportunity to assess, to some degree, some causality (i.e., elaboration predicts detail and coherence). Replicating this study with a larger sample size and employing mixed effects modeling in the analyses of these data would more strongly speak to how the elaboration induction influences detail, and whether or not event coherence potentially mediates this relationship.

D. Conclusion

Ultimately, the main contribution of this work to the literature is demonstrating the role that reasoning processes play in episodic future event simulation. While some work has explored the component processes comprising episodic future thinking (D'Argembeau, Ortoleva, Jumentier, & Van der Linden, 2010; Anderson & Dewhurst, 2012), there is almost no mention in the literature of “reasoning” as one of these processes. As such, this study has taken a step in the direction of understanding how our ability to reason maps on to our ability to recombine elements of our past into a novel future event, and the findings yield several fruitful avenues for future research.
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REFERENCES (continued)


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## EXPERIMENT 1 INSTRUCTIONS

### 1. Elaboration
Each trial has 2 parts. First, you will be shown a person and location randomly taken from the lists you generated earlier. You will have 15 seconds **to think of reasons WHY you would see this person in this location sometime in the future.** Type these reasons out in the space provided until you hear a bell sound.

### 1. Control
Each trial has 2 parts. First, you will be shown a person and location randomly taken from the lists you generated earlier. You will have 15 seconds **to count the number of straight lines (horizontal and vertical) in the words you see on the screen.** Type that number in the space provided until you hear a bell sound.

### 2. Simulation (Same for Both Conditions)
Next, you will see the name of an object along with the same person and location. You will be given 2 minutes to verbally describe an event/scene taking place in the future that involves you interacting with the specified person in the specified location, and somehow incorporates the specified object. Describe the event in as much detail as you can, and use as much of the 2 minutes as you can – if you are done sooner, you must wait for 2 minutes to be up before proceeding. The bell sound means your time is up. After 2 minutes, you will hear the bell sound, which indicates the start of a new trial. You will then receive a new set of cues and go through the procedure again.

### 3. Control (After Distractor)
You will now be completing 6 more trials. Like before, you will be shown a person and location randomly taken from the lists you provided. This time, instead of coming up with reasons why the person and location could be in an event together, **you will count the number of straight lines (horizontal and vertical) in the words you see on the screen.** You have 15 seconds to count and type in this number in the space provided.

After this, an object will be added to the screen. You will describe each event including the person, location, and object in as much detail as you can for 2 minutes. Use as much of the 2 minutes as you can.

### OR

### 3. Elaboration (After Distractor)
You will now be completing 6 more trials. Like before, you will be shown a person and location randomly taken from the lists you provided. This time, instead counting the lines in the words, **you will name reasons WHY you would see this person in this location sometime in the future.** You have 15 seconds to type these reasons out in the space provided until you hear a bell sound.

After this, an object will be added to the screen. You will describe each event including the person, location, and object in as much detail as you can for 2 minutes like before. Use as much of the 2 minutes as you can.

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1 Instructions 1 and 2 were presented successively following stimulus collection/randomization. This was followed by one practice trial and six experimental trials. Instruction 3 was presented after distractor, and was followed by 1 practice and 6 experimental trials. The double line indicates a new block of trials. Bolded text represents changes in the instructions between conditions.
## Appendix B

### EXPERIMENT 2 INSTRUCTIONS

#### 1. Simulation (2 practice trials)
On each trial, you will be shown a person, location, and object randomly taken from the lists you generated earlier. You will then have 2 minutes to verbally describe an event taking place in the future involving you interacting with that person, in that location, and that somehow incorporates that object. Describe the event in as much detail as you can, and use as much of the 2 minutes as you can – if you are done sooner, you must wait for 2 minutes to be up before proceeding. The bell sound means your time is up. After 2 minutes, you will hear the bell sound, which indicates the start of a new trial. You will then receive a new set of cues and go through the procedure again. You will now complete 2 practice trials.

#### 2. Elaboration Induction
Before continuing, you will do a task known as the “elaboration” task. You will be shown a series of 10 sentences. For each sentence, **you will answer the question, “Why would this person be at this location?” Type your response to the question into the space provided.** Each sentence will be on the screen for 30 seconds, so make your response in that time. After 30 seconds, a new sentence will appear.

#### 2. Control Task
Before continuing, you will do a task known as the “line-counting” task. You will be shown a series of 10 sentences. For each sentence, **you will count the total number of straight lines, horizontal and vertical, in all the words in the sentence. Type this number into the space provided.** Each sentence will be on the screen for 30 seconds, so make your response in that time. After 30 seconds, a new sentence will appear.

#### OR

#### 3. Simulation (6 trials)
Now, you will be simulating future events like in the practice trials. Remember, you have two minutes to describe an event involving you, the person, the location, and the object that takes place in the future. Use as much of the two minutes as you can.

#### 4. Control Task (After Distractor)
Before continuing, you will do a task similar to the task you completed earlier. You will be shown a series of 10 sentences, like before. This time, instead of answering questions, you will be counting the total number of lines, horizontal and vertical, in all the words in the sentence. **Type this number into the space provided.**

#### OR

#### 4. Elaboration Induction (After Distractor)
Before continuing, you will do a task similar to the task you completed earlier. You will be shown a series of 10 sentences, like before. This time, instead of counting lines, you will be answering the question, “Why would this person be at this location?” **Type your response to the question into the space provided.**

#### OR

#### 5. Simulation (6 trials)
Now, you will be simulating future events like before. Remember, you have two minutes to describe an event involving you, the person, the location, and the object that takes place in the future. Use as much of the two minutes as you can.

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1 Instruction 1 will be presented following stimulus collection/randomization. Instruction 2 will be presented after practice trials, followed by 10 sentences. Then Instruction 3 will be presented. Instruction 4 will be presented after the distractor task, followed by 10 sentences. Lastly, Instruction 5 will be presented. Bolded lines indicate new blocks of trials.
VITA

NAME: Sushmita Shrikanth

EDUCATION:
- B.S. Cognitive Science, University of California, Santa Cruz, 2015
- B.A. Psychology, University of California, Santa Cruz, 2015

PROFESSIONAL MEMBERSHIP:
- Psychonomic Society
- Society for Personality and Social Psychology
- Association for the Psychological Sciences

PUBLICATIONS:
- Shrikanth, S., & Szpunar, K.K. (under review). The good old days and the bad old days: Further evidence for a valence-based dissociation between personal and collective cognition. Psychological Science.