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The Effects of Spatial Contextual Familiarity on Remembered Scenes, Episodic Memories, and Imagined Future Events

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Several recent studies have explored the effect of contextual familiarity on remembered and imagined events. The aim of this study was to examine the extent of this effect by comparing the effect of cuing spatial memories, episodic memories, and imagined future events with spatial contextual cues of varying levels of familiarity. We used real-world landmark cues that had all been previously visited by the participants, and we measured the retrieval time, detail-richness, and vividness of remembered scenes, events, and imagined future events based on these cues. Participants consistently rated scenes and events based on more familiar cues as more detailed and more vivid, and they took less time to retrieve them. When the types of details were examined, it was revealed that the effects of increased contextual familiarity carry over to non-spatial details in the case of remembered events but possibly not in imagined events. This study provides evidence regarding how episodic memory and imagination are reliant on spatial context and possibly the process of scene construction.

Keywords: episodic memory, imagination of the future, scene construction, spatial context, cue familiarity

Throughout the day, many of one's waking hours are spent thinking of a time other than the present. From remembering where the car is parked or planning what to cook for dinner, to daydreaming about last year's vacation or thinking ahead to the next one, our present is constantly filled with reminders of the past and musings of the possible future. Recent research has repeatedly shown that the ability to project oneself backward in time is closely related to the ability to project oneself forward (see Spreng, Mar, & Kim, 2009, for review). Several studies have shown that patients with impaired memory of the past are similarly deficient when asked to imagine future experiences (Addis, Sacchetti, Ally, Budson, & Schacter, 2009; Andelman, Hoofien, Goldberg, Aizenstein, & Neufeld, 2010; D'Argembeau, Raffard, & Van der Linden, 2008; Gamboz et al., 2010; Klein, Loftus, & Kihlstrom, 2002; Kwan, Carson, Addis, & Rosenbaum, 2010; Rasmussen & Berntsen, 2012; Tulving, 1985). Additionally, evidence from neuroimaging studies has further supported the similarities between episodic memory and imagination of the future by identifying a common network of brain areas involved in both abilities (Addis, Pan, Vu, Laiser, & Schacter, 2009; Addis, Wong, & Schacter, 2007; Botzung, Denkova, & Manning, 2008; D'Argembeau, Xue, Lu, Van der Linden, & Bechara, 2008; Okuda et al., 2003; Spreng et al., 2009; Szpunar, Watson, & McDermott, 2007; Weiler, Suchan, & Daum, 2010).

Further supporting the relation between memory for the past and imagination of the future are a number of studies showing that events set in the past or the future are modulated similarly by a number of factors, including temporal distance from the present (D'Argembeau & Van der Linden, 2004; Spreng & Levine, 2006), emotional valence (D'Argembeau & Van der Linden, 2004), and individual differences in emotional regulation and visual imagery (D'Argembeau & Van der Linden, 2006). In particular, several recent studies have examined how the familiarity of the context of an imagined event affects the phenomenology of the event itself. Szpunar and McDermott (2008) observed that cuing participants with more recently experienced contexts elicited more detailed and more vivid imagined events than ones based on remotely experienced or never experienced contexts. In a subsequent study, Arnold, McDermott, and Szpunar (2011) found that when asked to imagine something in the near, rather than far, future, participants were more likely to place the imaginary event in a more familiar location or context. Additionally, when asked to imagine events in familiar, common locations (e.g., library or dorm) versus unfamiliar locations (never-visited famous locations; e.g., Dead Sea, Pyramids of Egypt), the events set in familiar locations were imagined more clearly and easily. Finally, they also found that the clarity of context of an imagined event was the primary determinant of its vividness, indicating the importance of spatial context for the quality of imagined events.

Further exploring the effect of familiarity, D'Argembeau and Van der Linden (2012) reported that the familiarity of the location, people, and objects in an imagined event were significant predic-

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tors of the vividness of those events, and they found that the effect of temporal distance on vividness was mediated by location familiarity. Similarly, de Vito, Gamboz, and Brandimonte (2012) found that future events set in familiar settings contained more sensory details and were associated with stronger and clearer feelings of experiencing than events imagined in unfamiliar settings. In addition, future events in familiar settings were described with more internal, relevant details than those set in unfamiliar settings. They also found that these trends extended to atemporal events set in familiar settings, not just future events. Finally, in a different application of the concept of contextual familiarity, another study had participants imagine planning which items to bring for future events in familiar or never-experienced scenarios (e.g., planning a picnic versus planning food to pack for a trip to Antarctica; Klein, Robertson, Delton, & Lax, 2012). There were no phenomenological measures relating to the events themselves in this study, but the authors found better recall for the items planned for the familiar event than the unfamiliar event.

Taken together, the above studies illustrate that one's familiarity with the contextual elements of an imagined event has a strong effect on the richness and mental experience of that event. However, few studies have sought to delve deeper into the nature of this familiarity effect. Are events based on more familiar contextual cues richer by virtue of these elements in the event being richer, or appearing more vividly? For example, in a future event set in a very familiar context, such as one's childhood home, would only the representation of that context be more vivid or detailed thus giving the impression of a more vivid event? Or, is something about the nature of the event itself different when it is based on a more familiar context? In this case, it might not be just that the spatial context of the event was richer, but that other aspects of the event also benefit from the richer contextual cues. If so, it is possible that richer context provides a stronger or extended scaffold onto which an event can be constructed, allowing for more detail and vividness in the event itself. This yields the prediction that a weak context would usually give rise to events that are less detailed and vivid, while a stronger context can support the mental representation of events richer in detail and experienced more vividly, and critically, that these effects are separate from the richness of the context itself.

The idea that spatial context plays a crucial underlying role in the construction of mental events has been previously suggested by the scene construction hypothesis (Hassabis & Maguire, 2007, 2009). Hassabis and Maguire have suggested that an explanation for the overlap between memory and imagination stems from their shared reliance on the ability to mentally construct complex scenes since both normally involve rich visual imagery and spatial context (Hassabis & Maguire, 2007, 2009). Support for this viewpoint comes from evidence that memory-impaired patients show deficits in constructing coherent mental representations of scenes (Hassabis, Kumaran, Vann, & Maguire, 2007; Raffard, D'Argembeau, Bayard, Boulenger, & Van der Linden, 2010; Rosenbaum, Gao, Richards, Black, & Moscovitch, 2005; Rosenbaum et al., 2000) and that the network of neural areas employed in scene construction tasks is comprised of many of the same areas involved in episodic memory and imagining the future (Hassabis, Kumaran, & Maguire, 2007). While it is clear from these studies that spatial context plays an important role in both memory and imagination, the present study seeks to illuminate further the nature of that effect by varying the familiarity of the context and examining the effects of this across three tasks that involve spatial context in different ways: spatial memory, episodic memory, and imagination of future events.

The relationship between contextual familiarity and event construction also relates to Addis and Schacter's (2008) constructive episodic simulation hypothesis (see also Moscovitch, 2008). According to this hypothesis, we draw on past memories when either reconstructing an old memory or constructing a new event. This hypothesis has been supported by numerous studies showing the overlapping neural networks involved in imagination and memory, and the finding that the anterior hippocampus appears to show increased activity for future events, which may suggest more intensive construction processes for novel events (Addis & Schacter, 2012; Addis et al., 2007; Addis, Wong, & Schacter, 2008). Applying this theory to the notion of context, when contextual cues are more familiar, they are presumably associated with more, or richer, memories. If memories and future events are constructed by drawing on our past memories, then events constructed based on more familiar cues would have a richer network of source material on which to draw. Representations based on these cues would therefore also be more vivid and detail-rich by virtue of the fact that they can draw on richer sources of information and a wider network of previous memories. On the other hand, events based on less familiar cues would have fewer details and previous memories available for reconstruction and recombination, resulting in events that are less detail-rich and less vivid. Thus, findings that more familiar contextual cues lead to both richer imagined and remembered events would fit with the constructive episodic simulation hypothesis.

This hypothesis also is consistent with recent studies on the formation and role of schemas in memory (Tse et al., 2011; van Kesteren, Rijpkema, Ruiter, & Fernández, 2010; van Kesteren, Ruiter, Fernández, & Henson, 2012). According to this research, if one has an existing cognitive framework or schema relating to a certain type of information, it is easier to learn new information compatible with this schema (Lewis & Durrant, 2011). This has been demonstrated in animal studies, in which rats rapidly learned new information compatible with an existing flavor-place association schema (Tse et al., 2007). Similarly, in humans, it has been shown, using a multisensory learning paradigm, that information congruent with previous associations is better remembered than incongruent information (van Kesteren et al., 2010). Applying this research to contextual cues and memory and imagination, it could be hypothesized that increased familiarity with a contextual cue would result in a more robust schema relating to that cue. For example, one would presumably have a much richer framework of knowledge and experiences relating to a familiar context, such as one's place of work, than somewhere unknown, or known to a much lesser degree. Thus, more familiar contextual cues may be linked to a richer schematic network relating to the qualities and experiences related to those cues, and this may facilitate access to details and easier construction or reconstruction of richer remembered and imagined events, as also proposed by the constructive episodic simulation hypothesis.

These theoretical views also illustrate the importance of comparing highly familiar contextual cues with less familiar, rather than unfamiliar, cues. Many previous studies have compared events based on personally-familiar cues (e.g., your home, or friend's house) versus never-experienced cues (e.g., North Pole, tropical jungle; Arnold et al., 2011; de Vito et al., 2012; Klein et al., 2012; Szpunar & McDermott, 2008). However, it is clear that the nature of the associations to these different types of cues are likely very different. In these studies, the familiar cues used are related to personal episodic memories and first-hand sensory experience. Unfamiliar cues, however, are likely only associated with information that is semantic in nature and not derived from episodic memory or any kind of sensory experience since contexts were chosen that were never experienced. Thus, by comparing imagined events based on cues associated with personal episodic memories with events based on cues only related to non-personal, semantic type information, it is not surprising that the quality and type of events constructed are vastly different. This comparison does not allow for a meaningful understanding of the nature of the cue familiarity effects, since the comparison is between two categorically different types of familiarity (or lack thereof). Thus, a more informative comparison is between contexts or cues that are both familiar and have been experienced personally, but to differing degrees. For this reason, the present study compares public locations in the city of Toronto that have all been previously visited by the participants, but the comparison is between highly familiar contexts that have been visited numerous times and low-familiarity contexts that have only been visited a small number of times.

Using these cues of varying familiarity, we examined the effects of contextual familiarity across three different kinds of representations. In the scene condition, participants were cued with a spatial cue that was of high or low familiarity to them and asked to picture the spatial scene encompassing that cue. Since both the cue and the representation were spatial in nature, this condition probed the qualities of the representation directly relating to the cue (i.e., spatial details based on a spatial cue ranging in familiarity). In the memory condition, participants were asked to recall real events from their past based on the same types of spatial contextual cues of high or low familiarity. In this condition, we examined how a richer cue would carry over to memory representations that were not just spatial in nature. Thus, this condition tested whether the effects of a familiar spatial cue would carry over to non-spatial remembered events, rather than just purely spatial scenes. Finally, in the imagination condition, participants constructed novel future events based once again on spatial contextual cues of varying familiarity. In this condition, we tested if there were benefits of cuing with a more familiar contextual cue even when novel representations were constructed and had not been previously associated with those cues. In both the memory and imagination conditions, we were able to observe whether the increased familiarity with a spatial cue carried over to increases in non-spatial details. If that were case, it would support the notion that familiarity with context does not just revive the richly represented spatial context but recruits additional elements to create a vivid representation of the entire event.

In addition to examining the effects of cue familiarity on scene construction, on retrieval of past memories, and on imagining future events, our study may also speak more generally to the role of cue familiarity in associative memory. To our knowledge, there has been only one study on cue familiarity, as measured by word frequency, on the retrieval of autobiographical memories, which found no effect of cue word frequency on the vividness or speed of retrieval of memories based on such cues (Williams, Healy, & Ellis, 1999). In contrast, research on cue familiarity effects in paired-associate memory paradigms has shown that higher frequency (more familiar) words lead to better memory for those words' associates (Clark, 1992; Clark & Burchett, 1994) and that familiar contexts facilitate memory for words in those contexts (Hockley, 2008; Hockley, Bancroft, & Bryant, 2012). Thus, this study also demonstrates whether increased familiarity with a contextual cue results in better memory of representations directly related to that cue (scenes) as well as those only associated with that cue (remembered and imagined events), using real-world memories and cues.

We predicted that the benefits of a more familiar contextual cue would not be limited to representations or elements of representations directly involving that cue. We hypothesized that the increased richness of a spatial contextual cue would extend not only to better memory for spatial scenes but also to richer recollections of personal memories based on that cue and to novel imagined events based on that cue. By comparing high- and low-familiarity cues that were matched by all being real-life, previously experienced landmarks in the city of Toronto, we were able to examine the effects of contextual familiarity in a novel way across three different types of mental representations related to those cues.

Method

Participants

Fifty-six healthy young adults (16 men; mean age = 21.00 years, *SD* = 2.94, range = 18–31) participated in the experiment either for course credit or for monetary compensation ($10 per hour). All participants stated that they frequently visit the downtown area of Toronto (at least several times per month) and had lived in Toronto for at least 1 year (mean years lived in Toronto = 11.07, *SD* = 7.54), ensuring that they had a variety of old and new memories involving the landmarks featured in the study. Participants had completed an average of 14.80 years of formal education (*SD* = 2.16), were all native or fluent speakers of English, had normal or corrected-to-normal vision and hearing, and had no history of neurological illness or injury. All participants provided informed consent prior to participating in the experiment, in accordance with the University of Toronto Office of Research Ethics.

Pre-Study Questionnaire

At least 24 hr prior to the study, participants completed an online questionnaire to assess their familiarity with a variety of well-known Toronto buildings and landmarks, such as the CN Tower or Union Station (for a full list of landmarks used, see the Appendix). The questionnaire, based on the Toronto Public Places Test (Rosenbaum, Ziegler, Winocur, Grady, & Moscovitch, 2004), provided a list of the names of 112 landmarks located mostly in downtown Toronto and asked participants to estimate the number of times they had visited each of the landmarks (response options: never, 1–2 times, 3–5 times, 6–10 times, more than 10 times). Participants were informed that if they were unsure of whether they had visited the landmark, or were unfamiliar with the name, to select "never."

Landmarks visited between one and five times were considered "low familiarity," and landmarks that had been visited more than 10 times were considered "high familiarity." Only these two categories of landmarks were used as stimuli for the study in order to create a significant difference in the familiarity of the landmarks, while still ensuring that the participants had visited all the landmarks at least once. Based on each participant's questionnaire responses, a set of at least 20 low-familiarity landmarks and at least 20 high-familiarity landmarks was selected and used as stimuli in their unique version of the experiment.

Since a custom set of landmarks was used as high and low familiarity for each participant based on their responses to a survey, there was no uniform set of landmarks used as high- or low-familiarity cues. A landmark that was a high-familiarity cue for one participant was often used as a low-familiarity cue for the next, and vice versa, creating a balance of the cues being used in each condition. Of the 112 landmarks used in the study, only eight never served as a high-familiarity cue, and only five never served as a low-familiarity cue. Even among the cues that tended to be familiar to many participants and were used frequently as highly familiar cues (i.e., campus buildings), no single landmark consistently served as a high-familiarity cue in even half of the participants in the study. Any participant who failed to classify at least 20 landmarks in each of the high- and low-familiarity categories was not eligible to participate in the study.

Study Procedure

The experiment included three conditions: scene memory, episodic memory, and imagination of the future. Each condition consisted of 20 trials with 10 using high-familiarity landmarks as cues, and 10 using low-familiarity landmarks as cues. Before starting the study, participants were shown an example trial by the experimenter, and then they completed two practice trials to ensure that they understood the tasks involved in the study. Some participants completed more than one condition, but only when they were familiar with enough landmarks to use a non-overlapping set of cues for each condition. In these cases, the conditions were run as blocks, with breaks in between, and the order of the conditions was counterbalanced across participants.

Scene memory condition. Thirty-three participants completed the scene memory condition. Two participants were dropped due to failure to follow instructions, four were dropped due to inability to produce scenes in more than half of the low-familiarity trials, and three participants were dropped due to very slow reaction times (more than 2 *SD*s higher than the mean), resulting in 24 participants. In the scene memory condition, participants were asked to recall and picture visual scenes based on 10 high-familiarity landmarks and 10 low-familiarity landmarks randomly selected from their pre-study questionnaires. Participants were instructed to focus on spatial and visual aspects of the scenes that were both atemporal and impersonal rather than specific events or people that they associated with that landmark.

During the study, participants were seated in a quiet room facing a computer screen. At the start of each trial, a white screen displayed the prompt, "Picture the scene around . . . ." Two seconds later, the name of a landmark appeared on the screen, and the participants were asked to press the spacebar as soon as they could picture the scene including that landmark, providing a measure of retrieval time. If no scene was retrieved before a maximum of 10 s, the trial was discarded. Following this retrieval phase was a 20-s elaboration phase in which they were asked to visualize the scene and to conjure as many details as possible. After 20 s, participants were presented with three rating scales and were asked to assess the scene in terms of amount of detail (1 = *not very detailed* to 5 = *very detailed*; or 0 = *no event*); vividness (1 = *not very vivid* to 5 = *very vivid*; or 0 = *no event*) and length of time since their most recent visit to the landmark (0–no event, $<$1 month, 1–6 months, 6–12 months, $>$1 year, $>$5 years). Between each trial there was a 3-s fixation cross. The structure of one trial from the scene memory condition is shown in Figure 1.

Episodic memory condition. Fifty-five participants completed the episodic memory condition. Two participants were dropped due to failure to follow instructions, 15 were dropped due to inability to produce memories in more than half of the low-familiarity trials, and three participants were dropped due to very slow reaction times (more than 2 *SD*s higher than the mean), resulting in 35 participants in the memory condition. Participants were asked to recall past personal episodes occurring at or around 10 high-familiarity landmarks and 10 low-familiarity landmarks randomly selected from their pre-study questionnaires. Prior to starting the trials, participants were instructed that they should recall events both specific in time and in place (i.e., no longer than one day in duration and occurring in close proximity to the landmark in question).

The episodic memory condition followed the same format as the scene memory condition, except that the task was to recall past personal episodes occurring at or around the landmark cue, rather than scenes. Participants were instructed that they should recall events both specific in time and in place (i.e., no longer than one day in duration and occurring in close proximity to the landmark

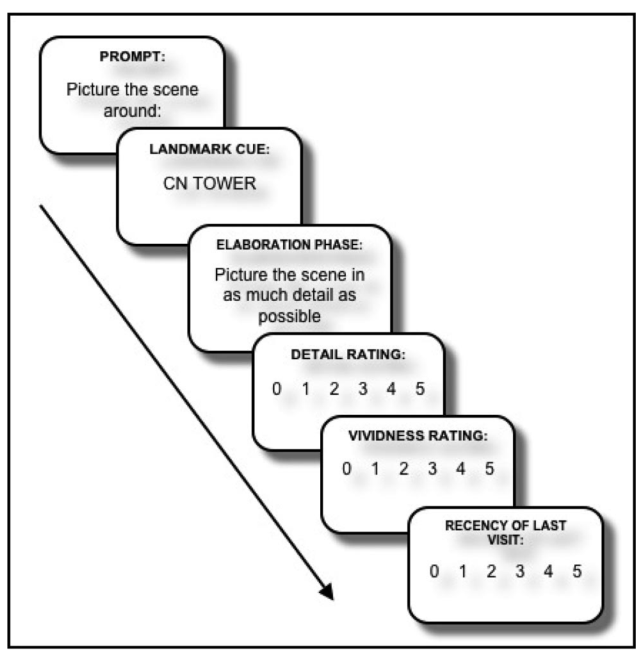

Figure 1. Representation of the structure of one trial in the scene memory condition of the experiment.

in question). In addition, participants were asked to recall only events that had occurred at least 1 month prior to the study, in order to avoid the inclusion of very recent memories, such as those from the previous day. During the trials, participants were prompted by "recall an event involving . . ." followed by the name of a landmark. They then had a maximum of 10 s to indicate the retrieval of a memory by pressing the spacebar. If no response was made, the trial was discarded. This was followed by the same 20-s elaboration phase, in which participants attempted to remember as many details as possible about the selected memory. Finally, the participant was presented with three ratings scales to assess detail, vividness, and the length of time since the event actually occurred (0–no event, <1 month, 1–6 months, 6–12 months, >1 year, >5 years).

Imagination of the future condition. Thirty-two participants completed the imagination condition. Five participants were dropped due to inability to produce an imagined event in more than half of the low-familiarity trials, and one participant was dropped due to very slow reaction times (more than 2 *SD*s higher than the mean), resulting in 26 participants. In the imagination of the future condition, participants were asked to conjure a plausible future event involving themselves and the landmark presented on the screen. As in the episodic memory condition, they were instructed to imagine events that were specific in time and place, and they were asked to conjure events distinct from any past memories involving the landmark in question. In addition, it was noted that each imagined event should differ in content from one another and not simply be the same event occurring in different settings.

As with the other conditions, an initial prompt appeared on the screen ("imagine a future event involving . . ."), followed by the name of either a high- or low-familiarity landmark. Participants were asked to press the spacebar once they had an imaginary future event in mind. If no response was made before 10 s had elapsed, the trial was discarded. Following the key-press, there was a 20-s elaboration phase in which participants were asked to envision the imagined event in their mind and conjure as many details as possible. Participants were then asked to rate the imagined event for the amount of detail and vividness on the same scales as the other two conditions and to indicate how far in the future the imagined event took place (no event, <1 month, 1–6 months, 6–12 months, >1 year, >5 years). Finally, they were asked to judge how similar the imagined event was to a past memory on a rating scale ranging from 1 (*completely different*) to 5 (*extremely similar*).

In all three conditions, if participants failed to press the spacebar indicating that a memory, scene, or imagined event was in mind, or if they chose "0–no event" for any of the rating scales, that trial was discarded from the analysis.

Post-study interviews. Following the computer trials, a short interview was conducted with each participant, in order to obtain an objective measure of detail in conjunction with the participants' subjective ratings. In the interview, two or three high-familiarity and two or three low-familiarity landmarks were selected, and participants were asked to describe in detail the scene, memory, or imagined event that they conjured based on that landmark. The interview techniques were based on the Autobiographical Interview (Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002), in which participants were first asked to freely recall and describe the scene or event, followed by some general probing (e.g., "Are there any other details that come to mind?"). No specific probing regarding particular types of details was performed. The participants were asked to describe the scenes or events in as much detail as possible.

The interviews were recorded using a digital voice recorder, and the sound files were transferred to a computer and transcribed by a research assistant, and they were later verified by a second transcriber. Transcribed interviews were then scored for the number of relevant details in each memory, imagined event, or scene. For memories and imagined events, detail scoring was based on guidelines from the Autobiographical Interview scoring manual, where relevant (or "internal") details are defined as those that are directly related to the event being recounted, whereas external details consisting of semantic or other extraneous information were not counted (Levine et al., 2002). Following this procedure, the main event in each description was identified, and any piece of information relating to the event itself, actions that occurred, the time, the place, the people involved, sensory perceptions, and thoughts or feelings felt or expressed at the time were all counted as details. Unrelated events, general background or semantic information, reflections or judgments of the memories or future events, and repetitions or similar statements were not counted. Imagined future events were coded according to the same guidelines as memories, except that uncertain statements using terms such as "probably" or "hopefully" were taken as factual statements, due to the fact that people tend to describe imagined events in more uncertain terms than actual memories.

Importantly, the interviews were also examined in terms of event-related versus spatial or scene-related details. It was found that the participants focused on describing the event-based content of the memories and imagined events and that they included very few general scene-based details in their descriptions. Any purely spatial or scene-based details were considered separately from the memory and imagined event details in order to examine the effects of spatial cue familiarity on spatial and non-spatial details independently.

These spatial details and the spatial details in each scene description were coded according to separate guidelines. For scenes, only visual or spatial information about the landmark or its surrounding area was considered as a relevant detail. Descriptions of the building itself, colors, textures, placement of windows, signs or doors, and similar descriptions of the area or buildings surrounding the landmark were counted as details. Event-specific information—such as the weather, the presence of people, or any actions or events—was not included since it is not part of the visual-spatial representation of the scene and in order to maintain the spatial/non-spatial distinctions across conditions. In addition, general knowledge or other semantic information about the scene was not counted as a detail. For sample interviews from each condition, see Table 1.

The number of relevant details was counted for each interview while the coder remained blind to whether the landmark was of high or low familiarity to the participant. A randomly selected 20% of the total number of interviews was additionally coded by a second coder to assess reliability and consistency of coding methods. An intraclass correlation for single measures .86 demonstrated high agreement between the raters and verified the consistency of the coding methodology used.

Table 1
Sample Interview Excerpts From Each Condition for Low- and High-Familiarity Landmark Cues

Condition	Landmark familiarity: High	Landmark familiarity: Low
Scene	Elgin and Winter Garden Theatre: "It's an older building but it's been renovated. The architecture is like, it's ornate, you go inside and it's ornate, there's a lot of gold leaves. Pillars, mirrors, like of ornate design. It's kind of dark inside. Outside there's the big signage that says in lights Elgin and Winter Garden. The Winter Garden Theatre has leaves hanging from the ceiling, and everything's been restored. You have a lot of lights of beaded crystals, crystal beads."	Gladstone Hotel: "It's an older building, there's a little kind of restaurant lounge. There's like, um, interesting interior design kind of thing, colorful, modern. I think that's about it."
Memory	Rogers Centre: "I just started a Master's program, and we went as a class at the very beginning of the year, the school year, and um . . . I got a chance to meet some of the faculty. And we were basically drinking beers, and the Blue Jays lost by a home run, but Jose Bautista hit two home runs which was really nice. And it was very vivid because the crowd was going really wild after he hit them, and they were getting back into the game, but they kinda fell short. I was sitting with three buddies and a prof. We took a picture from that day and we still have it. And we were just talking about, we were informing our prof about baseball because he was kinda new to the sport."	Lee's Palace: "This one was a little bit more vague, I'm pretty sure I saw a concert at Lee's Palace. I just can't really put my finger on it. I think it possibly was a like a battle of the bands kinda thing and I had a couple of buddies from my old school, who were performing in something like that. But I can't remember if it was a battle of the bands per se, but I'm pretty sure that was the venue where we went and saw them."
Imagination	Dundas Square: "I imagined going there for New Years. And so it's pretty dark, and there was a lot of people, and then there was fireworks and a live performance, and the people in the front rows all had these waving thingys. And yeah. Um, I just remember it was really crowded. There's two buildings behind it, and in my imagination, the me there remembered that I read in the newspaper how people in those buildings complain a lot about noise in Dundas Square. Oh, it was really late at night, so in my imagination you couldn't really see too much, just a lot of bright lights and the stage."	High Park: "I imagined going there with some friends, and we would go on the playscapes with the castles and pretend that we're royalty. I think that's pretty much it, just going there for fun. It was a pretty nice day, so we were trying to look at cloud animals in the sky."

Note. The two excerpts for each condition were taken from the same subject.

Finally, for the interviews in the scene condition, it was also possible to assess the accuracy of the interviews since participants were describing static, real-life landmarks. By comparing the participants' descriptions of the scenes to online images and Google Maps "street views" of the areas, it was possible to determine which details mentioned were accurate and which were not. If certain descriptions focused on the interior of the building, or provided other unverifiable details, these interviews were excluded from this analysis, resulting in the inclusion of 82% (103 of 125) of the original scene interviews in the accuracy analysis.

Statistical Analyses

Due to the non-normal distributions typical of reaction time and Likert-scale rating data, means were compared and correlations were assessed using non-parametric tests, including the Wilcoxon signed-rank test and Spearman's rho. Linear regression analyses were performed to compare the contributions of multiple predictors in modeling the dependent variables of interest.

Results

Scene Memory Condition

Retrieval time. As is evident in Figure 2a, participants had a faster mean retrieval time for scenes based on highly familiar landmarks compared to scenes based on less familiar landmarks. A Wilcoxon signed-rank test confirmed the significance of this difference ($z = -3.31$, $p = .001$, $d = 0.73$), showing that if the participant was more familiar with the landmark, it took less time to bring the image of the scene to mind.

Detail and vividness ratings. Figures 3 and 4 demonstrate a clear difference between subjective ratings of detail and vividness for scenes based on high- and low-familiarity landmarks. High-familiarity landmarks led to scenes that were rated as more detailed and more vivid, as confirmed by Wilcoxon signed-rank tests (for detail ratings, $z = -4.29$, $p < .001$, $d = 2.55$; for vividness ratings, $z = -4.29$, $p < .001$, $d = 2.89$). The recency of the last visit to the landmark also differed significantly across high- and low-familiarity landmarks, with more familiar landmarks having been visited more recently ($z = -4.17$, $p < .001$, $d = 1.62$). On the recency scale, a rating of "1" represented a visit in the past month, "2" represented visits 1–6 months ago, "3" represented visits 6–12 months ago, "4" represented visits more than a year ago, and "5" represented visits more than 5 years ago. The high-familiarity landmarks were given an average rating of 1.81, and the low-familiarity landmarks on average were rated 2.96. Regression analyses revealed that both familiarity and recency were significant predictors of ratings of detail and vividness, with familiarity as a slightly more significant factor—detail ratings: $R^2 = .727$, $F(2, 45) = 60.022$, $p < .001$; for familiarity, $\beta = .574$, $p < .001$; for recency, $\beta = -.366$, $p = .001$; vividness ratings: $R^2 = .733$,

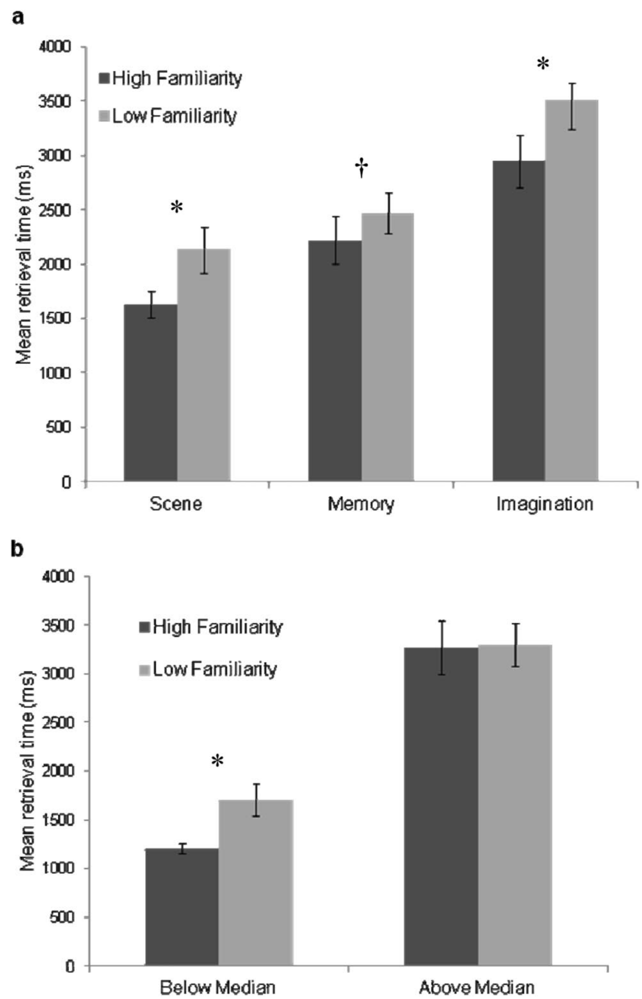

Figure 2. (a) Mean retrieval time (in milliseconds) for scenes, memories, and imagined events based on high- and low-familiarity landmarks. Error bars indicate the standard error of the mean for each group. (b) Mean retrieval time (in milliseconds) for memories based on high- and low-familiarity landmarks in the group of participants below the median retrieval time and the group above the median retrieval time. Error bars indicate the standard error of the mean for each group. † $p < .05$. * $p < .01$.

$F(2, 45) = 61.844$, $p < .001$; for familiarity, $\beta = .581$, $p < .001$; for recency, $\beta = -.362$, $p = .001$.

Interview details. The number of details in the descriptions of the scenes also differed significantly across the high- and low-familiarity landmarks, as shown in Figure 5. As with the ratings of detail, high-familiarity landmarks led to more detailed descriptions of scenes than did the low-familiarity landmarks ($z = -3.99$, $p < .001$, $d = 1.71$). The number of details in the interviews correlated significantly with the subjective ratings of detail, leading us to believe that subjects' self-ratings accurately reflected their knowledge ($r_s = .528$, $p < .001$). Finally, a regression analysis using the number of details from the interviews as the dependent factor revealed that familiarity was a significant predictor of level of described detail, whereas recency was not: $R^2 = .381$, $F(2, 45) = 13.856$, $p < .001$; for familiarity, $\beta = .556$, $p = .001$; for recency, $\beta = -.092$, $p = .546$.

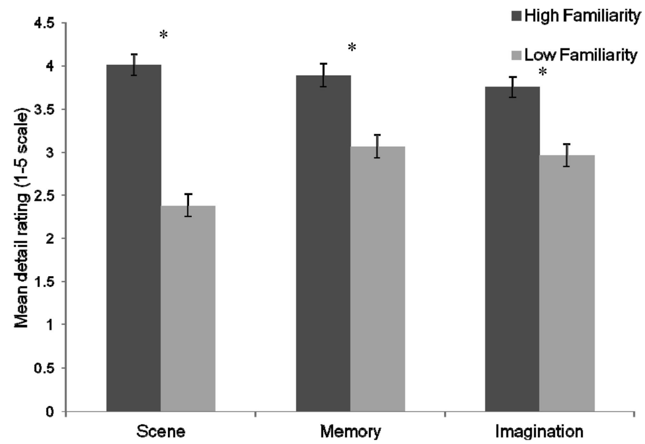

Figure 3. Mean ratings of detail (on a 1–5 scale) for scenes, memories, and imagined events based on high- and low-familiarity landmarks. Error bars indicate the standard error of the mean for each group. * $p < .01$.

For the interviews in the scene memory condition, it was possible to assess the accuracy of the details described, by comparing subjects' descriptions with images of the landmark in question. Overall accuracy was found to be very high, with an average of 92% for high-familiarity scenes, and 85% for low-familiarity scenes. The difference between the accuracy scores was marginally significant ($z = -1.96$, $p = .05$, $d = 0.43$). If only the accurate details were considered for the scene memory interviews, all findings remained the same: The number of accurate details was significantly higher for scenes based on high-familiarity landmarks versus low-familiarity landmarks ($z = -3.59$, $p < .001$, $d = 1.19$), the number of accurate details correlated significantly with the participants' subjective ratings of detail ($r_s = .465$, $p = .001$), and a regression analysis revealed that familiarity, but not recency, was a significant predictor of accurate details described: $R^2 = .327$, $F(2, 41) = 9.958$, $p < .001$; for familiarity, $\beta = .553$, $p = .002$; for recency, $\beta = -.028$, $p = .867$. Note that the above results are consistent with an alpha level of .007 per comparison, in order

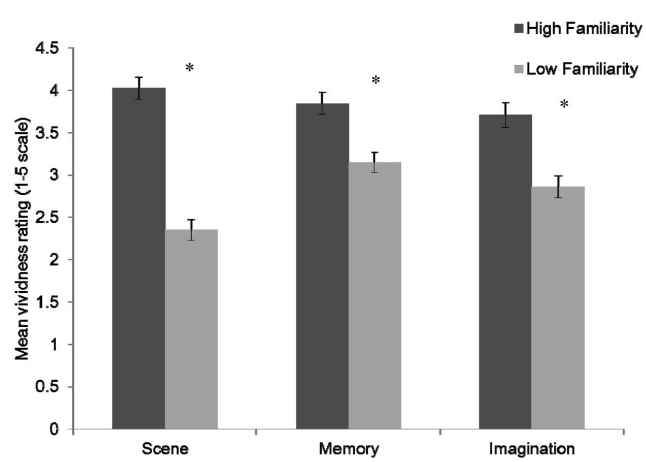

Figure 4. Mean ratings of vividness (on a 1–5 scale) for scenes, memories, and imagined events based on high- and low-familiarity landmarks. Error bars indicate the standard error of the mean for each group. * $p < .01$.

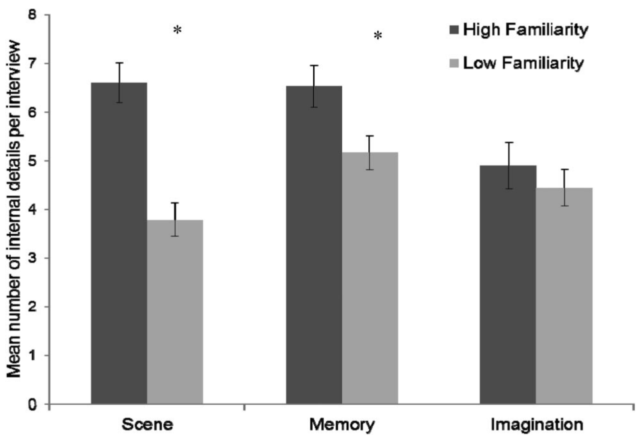

Figure 5. Mean number of internal details described per scene, memory, and imagined event based on high- and low-familiarity landmarks. For the scene condition, this included only visual-spatial details, whereas for the memory and imagination conditions, visual-spatial details were excluded. Error bars indicate the standard error of the mean for each group. $^{*}p < .01$.

to control for multiple comparisons and maintain a family-wise error rate below .05.

Episodic Memory Condition

Retrieval time. As shown in Figure 2a, in the episodic memory condition, there was a tendency for participants to take less time to retrieve a memory based on a high-familiarity landmark than a low-familiarity landmark. A Wilcoxon sign-ranked test revealed that this trend was marginally significant and that the effect size was small ($z = -2.11$, $p = .035$, $d = 0.28$). Note that if the alpha level is set at .006 following the Bonferonni correction for multiple comparisons (to maintain family-wise error rate of .05), this tendency is no longer significant.

However, a median-split of the retrieval time data revealed very distinct trends across participants who tended to be faster on this task and those who were in the slower half of participants. Participants whose retrieval times were below the median showed a significant difference between mean retrieval times for memories based on high-familiarity versus low-familiarity landmarks, with high-familiarity landmarks allowing for significantly faster memory retrieval ($z = -3.05$, $p = .002$, $d = 0.79$; see Figure 2b). Participants with retrieval times above the median, however, showed no significant difference in retrieval time across the high-familiarity and low-familiarity landmarks ($z = -0.17$, $p = .87$, $d = 0.03$). Further examination of the data revealed that the disparate results shown by the median-split are likely due to a consistent reverse trend (i.e., slower retrieval times for memories based on high-familiarity landmarks) shown only by the participants with the slowest reaction times. In just the five participants with the slowest reaction times, this reverse effect exhibits a trend toward significance, despite the very low number of participants in the sample ($z = -2.02$, $p = .043$, $d = 1.02$).

Importantly, it was found that only the reaction times differed between the two median-split groups and that there were no differences between these groups in terms of any of the other effects observed in the study. Therefore, the total participant sample was used for all subsequent analyses.

Detail and vividness ratings. Detail and vividness ratings made by the participants were also significantly different for memories based on high-familiarity versus low-familiarity landmarks. As shown in Figures 3 and 4, a memory based on a highly familiar landmark tended to be rated as significantly more detailed and more vivid than a memory based on a less familiar landmark (for detail ratings, $z = -4.23$, $p < .001$, $d = 0.93$; for vividness ratings, $z = -3.97$, $p < .001$, $d = 0.84$). Memories based on highly familiar landmarks also tended to be of events that had occurred more recently than memories for events based on less familiar landmarks ($z = -3.05$, $p = .002$, $d = 0.61$). On average, memories based on high-familiarity cues were given a rating of 3.04, and memories based on low-familiar cues were given a rating of 3.46 on the recency scale, where "3" represents 6–12 months in the past, and "4" represents 1–5 years in the past. However, a regression analysis revealed that the familiarity of the landmark was the most significant factor in predicting the level of detail of the memory, even when recency was also included as a predictor in the regression: $R^2 = .260$, $F(2, 67) = 11.780$, $p < .001$; for familiarity, $\beta = .395$, $p = .001$; for recency, $\beta = -.220$, $p = .051$. The same results were also found when predicting the level of vividness based on familiarity and recency—$R^2 = .232$, $F(2, 67) = 10.092$, $p < .001$; for familiarity, $\beta = .350$, $p = .003$; for recency, $\beta = -.236$, $p = .040$—demonstrating the importance of cue familiarity on the phenomenology of memories.

Interview details. The number of non-spatial, event-related details described in the interview portion of the experiment was also significantly higher for memories based on highly familiar landmarks, thus showing the same pattern as the subjective detail ratings ($z = -3.72$, $p < .001$, $d = 0.78$; see Figure 5). The number of details described in the interviews was significantly correlated with the subjective ratings of detail, indicating good agreement between subjective and objective measures of detail ($r_s = .426$, $p > .001$). Also similar to the detail ratings, a regression analysis revealed that the familiarity of the landmark was the most important predictor of the number of details described for the memories, whereas recency was revealed not to be a significant predictor of detail in the interviews: $R^2 = .109$, $F(2, 67) = 4.102$, $p = .021$; for familiarity, $\beta = .343$, $p = .006$; for recency, $\beta = .171$, $p = .165$. The number of spatial details described in the interviews was counted separately. This number was very low (an average of <1 detail per memory described, $M = 0.817$, $SD = 0.694$) and did not differ between the high- and low-familiarity cue conditions ($z = -0.85$, $p = .90$, $d = 0.08$).

Imagination of the Future Condition

Retrieval time. As in the other two conditions, it took less time to produce an imaginary experience if that event was based on a highly familiar landmark versus a less familiar landmark. This impression was confirmed by a Wilcoxon sign-ranked test ($z = -2.86$, $p = .004$, $d = 0.64$) and is shown in Figure 2a. Similar to the scene memory condition, this effect was consistent regardless of overall speed of retrieval, and no median-split analyses were necessary.

Detail and vividness ratings. Following the same patterns as the memory and scene conditions, imagined experiences were rated as more detailed and more vivid if they were based on a highly familiar landmark, and less so if they were based on a less familiar landmark (see Figures 3 and 4). These differences were verified with Wilcoxon sign-ranked tests (for detail ratings, $z = -4.08$, $p < .001$, $d = 1.08$; for vividness ratings, $z = –3.86$, $p < .001$, $d = 1.10$). Interestingly, the ratings of how close or far in the future the events were imagined to occur also differed across the high- and low-familiarity landmark cues. If the cue was a more familiar landmark, participants tended to place the imaginary event in the nearer future, whereas imagined events based on less familiar landmarks tended to be imagined further away in time ($z = –2.65$, $p = .008$, $d = 0.62$). Events based on high-familiarity landmarks were given a mean timeline rating of 2.72, where "2" represents 1–6 months, and "3" represents 6–12 months into the future, and events based on low-familiarity landmarks were given a mean rating of 3.11 ("4" represents more than 1 year but less than 5 years in the future). If alpha levels are set at a more conservative level of .007 to control for multiple comparisons and maintain the family-wise error rate at .05, this trend becomes marginally significant.

For imaginary events, a measure of similarity to past memories was also collected. Imagined events based on high-familiarity landmarks tended to be slightly more similar to past memories than events based on low-familiar landmarks ($z = -2.15$, $p = .032$, $d = 0.52$), but this trend does not reach significance if alpha levels are set at a more conservative level of .007.

Regression analyses were performed to determine the predictive power of the familiarity of the landmark, the proximity in the future of the event, and the similarity to past memories on the ratings of detail and vividness of the imagined events. Both analyses yielded significant models, showing familiarity as the most significant factor in predicting both the level of detail and vividness of the imaginary event, whereas future proximity neared significance as a predictor, but similarity to past memories was not a significant predictor—detail ratings: $R^2 = .344$, $F(3, 48) = 8.380$, $p < .001$; for familiarity, $\beta = .456$, $p = .001$; for future proximity, $\beta = –.247$, $p = .055$; for similarity to past memories, $\beta = .014$, $p = .912$; vividness ratings: $R^2 = .324$, $F(3, 48) = 7.665$, $p < .001$; for familiarity, $\beta = .437$, $p = .002$; for future proximity, $\beta = –.225$, $p = .083$; for similarity to past memories, $\beta = .047$, $p = .720$.

Interview details. As shown in Figure 5, when event-related, non-spatial details described in the interviews were compared, there was a trend in the interviews to describe imagined events based on highly familiar landmarks in slightly more detail than those based on less familiar landmarks. However, unlike in the other conditions, this trend did not reach significance, and the effect size was small ($z = -1.37$, $p = .17$, $d = 0.28$). In addition, the correlation between interview details and subjective ratings of detail was smaller in magnitude and failed to reach significance ($r_s = .239$, $p = .088$). Finally, a regression analysis based on the complete data set failed to produce a significant model when predicting interview details based on familiarity, similarity to previous memories and proximity in the future: $R^2 = .091$, $F(3, 48) = 1.606$, $p = .200$. In contrast, when the spatial details described in the imagined events were compared, the difference between the high- and low-familiarity cue conditions trended toward significance ($z = –2.11$, $p = .035$, $d = 0.49$), even though the number of spatial details included were still very low (spatial details described per imagined event based on a high-familiarity cue, $M = 0.936$, $SD = 1.167$; spatial details described per imagined event based on a low-familiarity cue, $M = 0.442$, $SD = 0.651$).

Discussion

The goal of the present study was to determine the effect of the familiarity of a spatial contextual cue on remembered scenes and events relating to that cue, as well as on novel imagined events based on that cue. We collected subjective and objective measures of the detail richness and vividness of these mental representations through self-ratings and coded interviews, as well as measures of retrieval time for how quickly they were brought to mind. Overall, we found that the familiarity of a spatial cue affected the quality and accessibility not just of scene memories but also of remembered episodes and possibly imagined future events. We review these findings below and examine the implications for theories on the relation among scene construction, memory for the past, and imagining the future.

The Role of Landmark Familiarity in Cuing Memory for Scenes, Past Events, and Future Imagined Events

As is evident in Figure 2a, participants took less time to retrieve scenes, memories, and imagined events based on highly familiar landmark cues compared to low-familiarity cues. This suggests that a more familiar cue makes the representations based on it more accessible, whether they are being retrieved from memory or imagined for the first time. The scene memory condition additionally demonstrated that, once retrieved, the scenes based on more familiar spatial contextual cues are richer in detail and more vividly experienced. A remembered scene based on a more familiar spatial contextual cue was perceived as more detailed and more vivid and was described with a larger number of spatial details than a remembered scene based on a cue of lesser familiarity (see Figures 4, 5, and 6). This is not surprising since it is expected that the benefit of increased familiarity with a context would carry over to representations of that context. If one has many more memories of a certain location, it follows that their memory for that location would be improved.

It is important to note, furthermore, that the scene condition in the present study allowed for an assessment of accuracy of reported details. In most studies involving episodic-like memory for information originally acquired outside of the laboratory, it is very difficult, or even impossible, to determine the veracity of reported memories based on individual experiences. This condition allowed us to determine not only that accuracy was very high for scene memories but also that all the observed effects of contextual familiarity were still shown when only accurate details were considered. This gives us more confidence in the accuracy of subjects' memories overall and in the validity of the findings from the present study and others on the topic of remote, episodic memory (Addis et al., 2008; Gilboa, 2004; Levine et al., 2002).

Figures 3 and 4 illustrate that scenes, memories, and imaginary events were consistently rated as more detailed and more vivid if they were based on more familiar landmark cues. These effects were shown to be independent of the effects of recency or future proximity of the event or last visit to the scene. As we noted, when we examined the number and types of details described in the interview portion of the study, it was found, as expected, that increased familiarity with a spatial cue resulted in an increase in spatial details when describing the scene encompassing that cue. More interestingly, we found that memories cued with more familiar spatial contexts were experienced in more detail and more vividly and were described with more event-related details than memories based on less familiar cues. We found that these descriptions contained very little spatial information, and the spatial details did not differ in number across the high- and low-familiarity cues. Thus, it was not the case that a more familiar cue simply resulted in increased spatial content in the memory, giving the illusion of a richer event representation. In fact, according to our data, it seems that the memory for the event itself was enriched by virtue of the more familiar context in which it was experienced. In summary, when describing a remembered event based on a spatial cue the benefits of increased contextual familiarity extend beyond the spatial content of the representation.

This finding adds to previous research on contextual familiarity (Arnold et al., 2011; de Vito et al., 2012; Klein et al., 2012; Szpunar & McDermott, 2008) by showing not only that more familiar contextual cues lead to richer memories based on these cues, but that the benefits actually extend beyond the nature of the cue, in this case to the non-spatial aspects of the memories. Furthermore, these robust effects were shown by contrasting cues that were all personally-experienced and varied in degree of familiarity, rather than by comparing familiar to novel, unfamiliar cues unrelated to any previous personal experiences (Arnold et al., 2011; de Vito et al., 2012; Klein et al., 2012; Szpunar & McDermott, 2008). By showing that more, or richer, associations with a contextual cue allow for richer memories to exist in association with these cues, this study relates to the theories of scene construction (Hassabis & Maguire, 2007), the constructive episodic simulation hypothesis (Schacter, Addis, & Buckner, 2007), and the role of schemas in memory (van Kesteren et al., 2012), as all three of these theoretical accounts would predict this association. The present study does not address whether these effects occur at encoding, which relates more closely to the schema and scene construction accounts, or at retrieval or memory re-construction, which relates more to the constructive episodic simulation hypothesis. Future research is needed to probe these questions further.

A more general question that the memory condition addresses is whether increased cue familiarity benefits memories associated with those cues, not just those directly relating to the cue. As discussed previously, research on cues in paired-associate memory tasks suggests that more familiar cues should enhance memory for their associates (Clark, 1992; Clark & Burchett, 1994; Hockley, 2008), but the only study, to our knowledge, exploring this in autobiographical memories found no effect of the frequency of the word cue on any of the attributes of the autobiographical memories associated with those cues (Williams et al., 1999). Contrary to that finding, the present study shows that the autobiographical memories retrieved based on more familiar cues were richer in detail, more vividly experienced, and for the most part, easier to access from memory. It is possible that these results diverge from the previous findings since the cues were real-world, personally-relevant locations, and the cue familiarity was determined on an individual basis rather than on linguistic norms, as in the case of word frequency.

Thus, it appears that under some conditions, particularly those in which the cue captures the context in which events occurred, as was the case in our study, there is a relationship between cue familiarity and the ease and quality of recall of autobiographical memories associated with that cue. This is the major finding of our study and is consistent with the idea that scenes or spatial context provide a framework against which events unfold and within which memory for events is embedded, consistent with scene construction theory (Hassabis & Maguire, 2009). In the remaining part of the discussion, we note auxiliary findings that, on the one hand, place constraints on this general conclusion and, on the other, extend it to other theoretical and empirical domains.

Possible Differences Between Recalling Memories for Past Events and Imagining Future Ones

In the future imagination condition, the same tendencies were shown as in the scene and memory conditions, but the effects were much weaker and did not reach significance in the interview portion of the experiment. This suggests possible differences between the processes involved in recalling the past and imagining the future. As in the other conditions, participants rated their novel imagined events based on more familiar spatial contextual cues as more detailed and more vivid than those based on less familiar cues. However, in the interviews, it was not found that participants described imagined events based on more familiar cues in significantly more detail than those based on less familiar cues. In fact, the only difference between the interviews appeared to be in the number of spatial details that were described, where a trend to report more spatial details for events based on high-familiarity cues approached significance. These results may indicate that unlike the memory condition, a more familiar cue in the imagination condition confers a richer spatial representation on which to base the imagined event, but that there is less of an effect on the content of the event itself. This would explain why participants still rate the events as more detailed and more vivid, since the richer spatial contexts in the high-familiarity condition may give the appearance of increased detail and vividness of the event itself which participants may not separate from the spatial context in which it occurs when providing the ratings, despite there being smaller differences in the richness of the actual imagined events when separated from the spatial contextual information by the experimenter.

These results from the imagination of the future condition were not expected and may seem to be at odds with the constructive episodic simulation hypothesis (Addis & Schacter, 2008). This hypothesis states that imagined events are based on the recombination and reconstruction of past memories. Following this, we predicted that remembered and imagined events based on more familiar spatial contexts would be richer in detail and vividness since they could draw on a larger set of memories associated with the familiar, compared to the unfamiliar, landmark. Our data support this hypothesis in the case of remembered events, where the larger and more interconnected networks of previous memories may have been the reason for better recall and richer re-experiencing, but the effects appeared to be absent, or at least much weaker, in the imagination condition. Although extensive research supports the overlap of episodic memory and imagination of future events, both in terms of behavior and neural substrates (see Schacter et al., 2007, for review), some recent studies have begun to indicate differences between future imagination and memory for the past (Cooper, Vargha-Khadem, Gadian, & Maguire, 2011; Hurley, Maguire, & Vargha-Khadem, 2011; see Klein, 2013, for review).

Our results, though not definitive, may also suggest that the processes involved in the construction of an imagined future event differ from those involved in memory. During cued recollection of actual events, participants may draw on a set of related memories more closely related to the cue. In comparison, since the imagined events were being constructed for the first time and participants were encouraged to make them different from past memories, it is possible that the participants drew from a wider set of memories than just those related to the contextual cue. In trying to construct something novel, perhaps the participants used the cue as the setting, but then constructed an event based on the recombination of unrelated memories. Thus when constructing a new event, participants did not use the same, smaller, related set of memories as when recollecting, or may have even inhibited them in order to create something novel. This would explain why the benefits of increased contextual familiarity had an absent, or much reduced, effect in the imagination condition. This explanation fits with the finding that there is increased anterior hippocampal activity during future imagination tasks compared with memory tasks, a neural correlate which has been thought to represent more intensive or effortful construction processes (Addis & Schacter, 2012; Addis et al., 2007, 2008) based on novel and schematic representations, compared to familiar, detailed ones (Poppenk, Evensmoen, Moscovitch, & Nadel, 2013). Since imagining a novel event would represent drawing material from a wider array of source memories, perhaps it requires additional, more schematic, hippocampal processing to form these new connections between previously unrelated content in memory (Rosenbaum, Gilboa, Levine, Winocur, & Moscovitch, 2009).

Another possible explanation for the divergent findings in the imagination condition also relates to the role of schemas in memory formation, but in a more nuanced way. Research has demonstrated that the presence of a cognitive schema facilitates new learning relating to that schema (Lewis & Durrant, 2011; Poppenk et al., 2013; Tse et al., 2007; van Kesteren et al., 2010), and that the application of such schemas is associated with activity in the anterior hippocampus, whereas recovery of detailed memories depends on the posterior hippocampus. In the context of the present study, it is possible that having more elaborate schemas related to a particular contextual cue allowed for richer encoding of events occurring at that location. Thus, the differences in spatial and episodic memories cued by high- and low-familiarity contexts would have been established at the encoding of those memories. If one is already very familiar with a given landmark and experiences a new event there, it is possible that the existing schema allows for better encoding of these events, leading to more detailed and vivid recall later on. This explanation is again consistent with our observations that a more familiar cue leads to more detailed and vivid scene and episodic memories relating to that cue, since they would have been encoded in the context of a richer schematic representation.

This account could also explain why imagined events, which had not yet occurred, were not found to differ as much in terms of amount of detail since they were being conceived for the first time and thus did not benefit from richer encoding processes. In fact, perhaps the higher subjective ratings of detail and vividness for the imagined future events reflect that the participants were experiencing and encoding the novel events set in more familiar contexts in a richer way, even though they did not differ significantly in terms of event details at that time. We did not test later recall for the imagined future events in the present study, but a subsequent study examining this question could test this possibility. If the schema relating to the contextual cue does facilitate encoding, it would be predicted that the future events based on high-familiarity cues may not differ at the time of conception, but should be remembered later in more detail and more vividly than those based on the low-familiarity cues, as in the episodic memory and scene memory conditions (Martin, Schacter, Corballis, & Addis, 2011).

It is also important to note that the results in the imagination condition may be related to the fact that the number of details described in the imagination condition was lower, on average, than in the other two conditions (as shown in Figure 5). There were a number of aspects of our study that may have led to the production of memories and imagined events with fewer details than observed in previous work using similar methodologies, where the average, per interview, ranges from 15 to 50 (Addis et al., 2008; Gaesser, Sacchetti, Addis, & Schacter, 2011; Levine et al., 2002; St-Laurent, Moscovitch, Levine, & McAndrews, 2009). First, cuing the events with a specific landmark was a more constrained technique than a free recall or cue-word procedure. Especially in the low-familiarity conditions, participants had a finite number of experiences with the landmarks in question but still had to describe an event or scene relating to the cue, even if it was of impoverished quality. This cuing procedure may have made the task more difficult as a result, as suggested by the number of subjects who failed to complete enough trials to participate in the experiment, especially in the memory condition. Second, we used a free recall interview technique with limited general probing, no specific probing, and no minimum time for each interview. This allowed participants to describe the events and scenes to the best of their ability but did not press them for additional details. Finally, we also used a more conservative coding technique, by only counting spatial details in the case of scenes, and only non-spatial event details for the remembered and imagined events, whereas previous studies included all details.

For these reasons, the number of details across all three conditions may be lower than in previous studies, yet they were still especially low in the imagination condition. This, paired with the fact that the self-ratings of the imagined events still showed that participants thought their imagined events were vivid and rich and detail, may suggest that participants were simply less verbose in the imagination condition. This could also explain the attenuated difference between the high- and low-familiarity cuing conditions if participants were not providing as exhaustive descriptions as possible, perhaps owing to the more abstract nature of imaginary events. Future studies could employ more extensive probing to examine this possibility. One possible counterpoint to this is the fact that the spatial details described in the imagination condition were marginally different across the high- and low-familiarity conditions, despite being very few in number. This may provide evidence that the difference in the imagination condition was due to the nature of the details, not the number of them.

The Relation Between Recency and Familiarity

Another finding of note in the present study was that in all three conditions, the effects of cue familiarity on the detail-richness and vividness of scenes, memories, and imagined future events were additionally found to exist independently of any effect of the recency of the last visit to the scene, the recency of the memory, or the proximity or remoteness of the imagined event. Previous studies have reported that more recent memories and events imagined closer in time in the future are more detailed and are pre- or re-experienced more vividly (D'Argembeau & Van der Linden, 2004) and, similarly, that events based on more recently experienced contexts also lead to more detailed and vivid imagined events (Szpunar & McDermott, 2008). This study demonstrates that the cumulative experience one has with a cue is as important a factor, if not a more important one, than recency in terms of the detail-richness and vividness of memories, scenes, and imaginary events. Though recency was still shown to be a significant factor in some cases, the overall familiarity of the participant with a cue exerted a greater effect across all three tasks and should be taken into consideration in future studies using cued memory paradigms. These results may differ from previous studies since, in the present study, the low-familiarity cues were still locations that had been personally experienced by the participants at least once or twice. In previous studies that compared familiar contexts or cues with unfamiliar ones, the effects were not equivalent since in those studies, the unfamiliar context was never experienced. Thus, in those studies the comparison is between familiarity and the absence of familiarity, whereas the present study focuses on the comparison between degrees of familiarity.

In addition, in this study we had participants report their most recent visit to the landmark in the scene condition, but in the memory and imagination conditions, we collected information about the recency or future proximity of the event itself, not the most recent visit. It is possible that the recency of one's most recent visit to a landmark may have a larger effect on the qualities of the events based on this landmark than the age of the events themselves. If this is the case, it would explain why the recency effects appeared to be larger in the scene condition but would also reinforce the notion that the quality of the spatial representation is a crucial factor in determining the quality of the remembered and imagined events. If the recency of one's experience with the spatial context of an event has more of an effect on its quality than the memory's actual age, it would add support to the importance of the role of spatial context in memory. Further research will be needed to examine these possibilities.

Our findings regarding recency and familiarity effects are in line with the construal level theory (Liberman & Trope, 2008), which predicts that the level of detail of a mental representation follows from its "psychological distance." Objects or events that are "farther away" in terms of temporal, spatial, or social distance are thought of in less detailed terms, and "closer" objects and events tend to be conceived of in more detail. Our study suggests that the familiarity of a cue is another dimension of psychological distance and a more salient one than the temporal, since even when recency is included as a covariate, more familiar landmarks led to more detailed representations, and less familiar landmarks led to less detailed representations, across memories of scenes and events, and to some extent, imagined future events, too.

Another interesting finding relating to this psychological distance effect was that imagined future events based on less familiar cues tended to be placed further away in the future than imagined events based on more familiar cues. This same relationship was shown in the inverse direction by Arnold et al. (2011), who demonstrated that imagined events in the near future were more likely to be set in familiar locations than events in the far future. In their paradigm, participants were told the timeline of the event but free to choose the location, whereas in the present study, the location was the cue but the timeline was chosen freely. This result also fits with the ideas from construal level theory, which states that different dimensions of psychological distance should be associated with one another (Liberman & Trope, 2008). In this case, the events that are "farther away" in terms of familiarity of the cue were placed farther away in time as well. Thus, these results coincide well with idea that familiarity is another dimension of psychological distance, according to Liberman and Trope's (2008) framework.

The associations between dimensions of psychological distance may, however, have a simple explanation, though not inconsistent with construal level theory. Highly familiar locations are visited more often, and, therefore, are likely to have been visited more recently than unfamiliar locations, thereby increasing the likelihood of describing "recent" events for both the past and the future. Likewise, when given time as a cue, one may be more likely to come up with a familiar location for recent events and a less familiar location for a remote event since more familiar locations are likely visited more frequently, and it may be more realistic for events to occur there in the near future.

The Fan Effect for Autobiographical Memories

Finally, though not related to the main purpose of the study, these results may also be relevant to research on the fan effect. The fan effect refers to the reduction in memory accuracy and or efficiency as the number of stimuli or events associated with a specific cue is increased. The reason this effect occurs is that each individual fact or piece of information becomes harder to retrieve due to interference with the other items (Anderson & Reder, 1999). Because more events are associated with a familiar, than an unfamiliar, landmark, one would have predicted that retrieval times would have been longer, and the quality of the memory worse, if memory were cued by a familiar landmark. For the large majority of participants, we found the exact opposite—more familiar cues led to better success in retrieving cues, faster retrieval times, and more detailed memories, and, in the case of scenes, more accurate ones. Since a landmark is static and unchanging over time, we believe that even multiple encounters with a certain landmark do not cause interference. In fact, this may strengthen the mental representation of the scene associated with it, and thus, make it more easily accessible, as we observed. Less familiar landmark cues were less effective cues, especially in the case of memories, not just in terms of speed of retrieval but also retrieval success in general. Thus, it is possible that the fan effect does not apply when considering highly distinguishable, real-life episodic memories that are widely separated in time, and complex cues such as scenes, since it has been traditionally tested in paradigms using narrow temporal intervals and simpler cues.

Having said this, we note that for a small minority of participants (five), the ones who took the longest to retrieve memories showed the opposite effect compared to the majority of the participants in the study. This led us to speculate that in the majority of cases, participants likely viewed the cue, quickly tried to think of a memory associated with it, and pressed the button once they had one in mind, as instructed. If the cue was more familiar, a memory would be more accessible and come to mind more quickly, whereas if it was less familiar, it would take a little bit more time to bring a memory to mind. The slowest participants, however, were perhaps employing a different search method, causing more familiar cues to lead to slower reaction times, thus creating a fan effect. When the cue appeared, it is possible that these participants attempted to call to mind many memories that were associated with that cue, and then once they had done so, selected one from the group, and then pressed the button. This strategy would explain not only why they took longer in general, since they were attempting to retrieve a larger number of memories instead of just a single one, but also why more familiar cues would actually slow down retrieval instead of facilitating it. A third alternative is that these participants did not press the button until they were satisfied that the memory they retrieved was indeed detailed, with more details to review in the case of memories associated with familiar landmarks, leading to longer response times. Of course, these are speculations based on the pattern observed in a small number of participants. Further research is needed to determine whether these differing search strategies are in fact employed and whether they can explain the differing effects of familiarity observed in this study. However, it is important to note that regardless of the retrieval time, the memories that were produced did not differ from one another in terms of detail, vividness or recency of occurrence, which supports the notion that what differed was retrieval strategy, and not factors relating to the content of the memories. Thus, if there is something like a fan effect that is operating, it occurs only in a small number of participants, and it affects only retrieval time, not the quality of the memory itself.

Conclusion

Using real-world spatial landmarks as cues enabled us to test predictions derived from various models about the role of contextual familiarity in scene construction, and its relation to recovering the past and imagining the future. We found that greater cue familiarity was associated with better memory and retrieval times for scenes, past events, and—to some extent—imagined events. In addition to elucidating further the processes and mechanisms that determine the effectiveness of familiar spatial contextual cues, and more closely examining the possible differences between remembered and imagined events, future studies would also inform us as to whether similar principles apply with respect to other cues, such as people or objects, in recovering remote memories and imagining fictitious ones.

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Appendix

A Complete List of Toronto Landmarks Used in the Study

No.	Landmark
1	1 Spadina Circle (old Knox College)
2	Air Canada Centre
3	Allan Gardens Conservatory
4	Art Gallery of Ontario
5	Atrium-on-Bay
6	Banting Institute
7	Bata Shoe Museum
8	Bloor Cinema
9	Canada's National Ballet School
10	Canon Theatre (Pantages Theatre)
11	Casa Loma
12	CBC Broadcast Centre
13	Chinatown Centre
14	City Hall (Nathan Phillips Square)
15	City TV Building (MuchMusic)
16	Clarke Institute (Centre for Addiction and Mental Health)
17	CN Tower
18	College Park
19	Commerce Court
20	Convocation Hall
21	Dundas Square
22	Eaton Centre
23	Elgin and Winter Garden Theatre
24	U of T Exam Centre
25	First Canadian Place (Toronto Stock Exchange)
26	Flatiron Building (Gooderham Building)
27	Flavelle House (Law Library)
28	Four Seasons Centre for the Performing Arts
29	Four Seasons Hotel (Yorkville)
30	Gladstone Hotel
31	Graduate House
32	Greyhound Bus Terminal
33	Hart House
34	Health Sciences Building
35	Hilton Hotel (University and Richmond)
36	Hockey Hall of Fame (BCE Place)
37	Holt Renfrew on Bloor
38	Honest Ed's
39	Hospital for Sick Children
40	Hudson's Bay Company (Yonge and Queen)
41	Koffler Student Services Building

(*Appendix continues*)

Appendix (*continued*)

No.	Landmark
42	Lash Miller Chemical Laboratories
43	Lee's Palace
44	Leslie L. Dan Pharmacy Building
45	Manulife Centre (Bay and Bloor)
46	Maple Leaf Gardens
47	MaRS Centre
48	Massey College
49	Massey Hall
50	Medical Sciences Building
51	Metro Toronto Convention Centre
52	Mount Sinai Hospital
53	OCAD Building (Sharp Centre for Design)
54	Ontario Institute for Studies in Education building
55	Old City Hall
56	Old Toronto Stock Exchange Building (Design Exchange)
57	Osgoode Hall
58	Planetarium (Children's Own Museum)
59	Princes' Gate
60	Princess Margaret Hospital
61	Princess of Wales Theatre
62	Queen's Park (Parliament Buildings)
63	Queen's Quay Terminal (Harbourfront Centre)
64	Redpath Sugar Museum
65	Ricoh Coliseum
66	Robarts Library
67	Rogers Centre (Skydome)
68	Roy Thomson Hall
69	Royal Alexandra Theatre
70	Royal Bank Plaza
71	Royal Conservatory of Music
72	Royal Ontario Museum
73	Royal York Hotel
74	Sandford Fleming Engineering Building
75	Scotia Plaza (King and Bay)
76	Scotiabank Theatre (Paramount)
77	Second City Theatre
78	Sheraton Centre
79	Sidney Smith Hall
80	Silvercity Yonge-Eglinton Theatre
81	Sony Centre for the Performing Arts (Hummingbird/O'Keefe Centre)
82	St. George Subway Station (St. George Street entrance)
83	St. James Cathedral
84	St. Lawrence Market
85	St. Michael's Hospital
86	St. Patrick's Church
87	Steamwhistle Brewery/Roundhouse Building
88	The Brunswick House
89	The Drake Hotel
90	The Madison Avenue Pub
91	Toronto Dominion Centre
92	Toronto General Hospital
93	Toronto Island Ferry Terminal
94	Toronto Police Museum and Discovery Centre
95	Trinity College
96	U of T Athletic Centre
97	Union Station
98	University College
99	U of T Students' Union Building (Louis B. Stewart Observatory)
100	Varsity Stadium
101	Victoria College
102	Westin Harbour Castle Hotel

(*Appendix continues*)

Appendix (*continued*)

No.	Landmark
103	Woodsworth College Residence
104	Miles Nadal Jewish Community Centre (Spadina and Bloor)
105	Christie Pits Park
106	Riverdale Park
107	Metro Toronto Zoo
108	Ashbridges Beach
109	Ontario Place (entrance)
110	High Park
111	Ontario Science Centre (entrance)
112	Old Mill Inn

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