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Factors shaping vividness of memory episodes: Visitors' long-term memories of the 1970 Japan World Exposition

David Anderson
University of British Columbia, Vancouver, Canada

Hiroyuki Shimizu
Kobe Gakuin University, Kobe, Japan

This study investigated how visitors' psychological and behavioural factors, identified in the literature, shaped their vivid long-term memories of their experiences of the Japan World Exposition, Osaka, 1970 (Expo '70) as a context. In this study, 112 memory episodes were identified from the long-term memories of 48 participants; they were rated in terms of their *memory vividness* and on a set of factors including *affect*, *agenda fulfilment*, *intentionality*, and *rehearsal*. The influence of these factors on the vividness of episodic and/or autobiographic memories of experiences that occurred 34 years ago was examined in two stages. First, the relationship between *memory vividness* and individual factors was investigated separately. Second, the relationship between *memory vividness* and all factors was examined through a multiple regression analysis, and the relative importance of these factors on *memory vividness* identified. Stage one analysis showed that all factors except *intentionality* were related to *memory vividness* in individual analyses, and curvilinear relationships between *memory vividness* and the factors found. Stage two analysis, in which all factors were included in a multiple regression analysis, found that *rehearsal* was positively related to *memory vividness* and all other factors not significant in the presence of *rehearsal*.

In the Museum and Visitor Studies[1] fields there is an increasing demand for research that demonstrates and better understands the long-term impact of visitors' experience in leisure-time settings such as museums, science centres, zoos, art galleries, theme-parks and, also, at one-time events of national and international significance like Olympic Games and World Expositions. However, there are but a handful of studies that have investigated such impacts in terms of the memories arising from experience in such settings, and most consider the longitudinal impact only over relatively short time frames—weeks and months after the visitors' experiences. Notwithstanding, there are several key studies (Anderson, 2003; Anderson & Piscitelli, 2002; Fivush, Hudson & Nelson, 1983; Hudson & Nelson, 1986; Medved, Cupchik & Oatley, 2004; Medved & Oatley, 2000; Stevenson, 1991) that have begun to shed light on the nature of visitors' memories of experience in such leisure-time settings.

[1] There are several major associations and professional groups dedicated to the research of visitor learning, behaviour, and experience in informal, leisure-time settings; i.e., Visitor Studies Association (VSA) (www.visitorstudies.org) and American Association of Museums (AAM) (www.aam-us.org).

Address correspondence to: Dr David Anderson, University of British Columbia, Department of Curriculum Studies, 2125 Main Mall, Vancouver, BC V6T 1Z4, Canada. E-mail: david.anderson@ubc.ca

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REVIEW OF THE LITERATURE

Rehearsal, visitation frequency, and other key variables influencing long-term memory

There is evidence from several studies that visitors' experiences in museums and theme parks can be recalled in vivid detail (Falk & Dierking, 1990; Fivush et al., 1983; Hamond & Fivush, 1990; Hudson & Nelson, 1986; Medved & Oatley, 2000; Stevenson, 1991). Stevenson (1991) investigated the long-term memories of visitors' experiences of the Science Museum in London. In this study, 109 family groups were interviewed immediately following their gallery visit, and received written questionnaires a few weeks after the visit. A subsample of 79 individual family members was also interviewed 6 months later. The study concluded that most visitors could recall, in vivid detail, much of what they did and the episodes that occurred at various exhibits within the museum gallery. Furthermore, they were able to describe how they felt and what they thought about their exhibit experiences. In addition, the vast majority of visitors in the study indicated that they had discussed, and hence reflected on, their experiences at the museum with others in the weeks and months following the visit.

In another study, Medved and Oatley (2000) interviewed 39 visitors to the Ontario Science Centre immediately upon their exiting a gallery as well as 1 month following their experiences. Medved and Oatley concluded that the richness and details of visitors' episodic recall of the gallery and the exhibits remained stable over the course of the month. As in Stevenson's (1991) study, visitors reported engaging in conversations with friends, family, and colleagues about their experience at the science centre following their visit.

Hamond and Fivush (1990) examined children's memories of their visits to Disneyworld at 37 or 49 months of age. Half of the children were interviewed 6 months after their trip, and the others were interviewed after 18 months. All of the children recounted a great deal of accurate information about their Disneyworld experience, although older children's reports were more detailed than younger children's, and older children tended to recall more information spontaneously than did younger children. However, it is generally accepted that older adults typically perform worse than younger adults on tests of episodic memory, such as recall, recognition, or source memory (Spaniol, Madden, & Voss, 2006). Additionally, the Hamond and Fivush (1990) study revealed that children who talked about their Disneyworld experience more frequently with their families subsequently recounted more information during their interview about the experience.

Hudson and Nelson (1986) also examined children's long-term memories and found that young children could give long and detailed accounts of novel events such as visiting Disneyland or going to the circus. They concluded that children's spontaneous recall may be prompted by a particular person, location, or time, and that children's recall of experiences included fewer details (but more general information) with increasing experience of the context. That is, the more often they visited the setting, the fewer specifics they were able to provide and the more likely they were to blend episodes.

Fivush et al. (1983) studied the sustainability of children's memories of novel events compared with children's general event representations of ''what happens'' on visits to museums and ''what happens'' on a class visit to a museum. The outcomes of the study demonstrated that children's general event reports and their specific episodic memories remained stable over a 6-week period. A measure of recall conducted a year later indicated that children recalled far less about their visit, but that there was no decrease in recognition memory over time.

Falk and Dierking (1990) investigated the earliest childhood memories of visits to museums of 12 museum professionals who were aged in their 20s and 30s. The study revealed that the social dimensions of their early visits (who they were with, what they did together, and so on) were highly memorable aspects of the experiences. Similar to Hudson and Nelson (1986), this study also found that the memories of frequent and infrequent museum visitation varied both qualitatively and quantitatively—those who claimed to be frequent visitors as children (attending museums more than three times per year) had significantly fewer recollections than did infrequent visitors.

These studies provide important insights about the variables that affect the vividness of episodic and autobiographical memory. First, there is strong evidence that memories of leisure-time experience have the potential to be rich and vivid. Second, there appears to be evidence that age influences the vividness of episodic memories, but

that its influence varies as a function of stage of life. Third, the frequency of visitation to informal settings may decrease one's ability to recall episodic detail—events that are familiar (not novel) may be more difficult to recall in detail. Finally, there is evidence that the subsequent conversations, discussions, and reflections that visitors (young and old) have about their experience positively influence the vividness of those memories. This might be seen as akin to rehearsing the experience, and appears to improve the detail of the recall of episodic and/or autobiographical memories.

The influence of rehearsal on vivid memories has also been examined in relation to theoretical characterisation of flashbulb memories. It has not been clear whether the particular vividness and permanence in such memories can be attributed to some special mechanism (that is, "Now print!" mechanisms in the brain; Brown & Kulik, 1982) or just interpreted as ordinary memories that survive because they are frequently rehearsed, and therefore reactivate events (Neisser, 1982). Similarly, the possibility that the vividness of episodic and/or autobiographical memories (other than flashbulb memories) may stem from the frequently rehearsed events should be taken into account. The effectiveness of rehearsal on long-term recall of verbal materials in laboratory settings has been studied, and it is well known that information is more likely to be transferred from short-term store to long-term store as a function of the number of rehearsals (Atkinson & Shiffrin, 1968). However, subsequent studies by Medved and Oatley (2000) showed that more frequent rehearsal does not necessarily lead to more accurate recall (Craik & Watkins, 1973), but rather, rehearsal sometimes becomes less effective for long-term retention as the number of rehearsals increases (Shimizu, 1987). These findings suggest that some effect of rehearsal on vividness of long-term memories would be observed in leisure-time life experiences such as visits to World Expositions.

The influence of affect on long-term memory

Several studies suggest that the emotional aspects of visitors' experiences appear to be responsible for encoding the memories in ways that influence the quality (richness) of recall of those memories. Medved et al. (2004) studied visitors' memories of artworks at the Art Gallery of Ontario. Their investigation explored how the autobiographical memories and associated emotions of 57 visitors developed in thematic integration of the "artworks memory" over a 5-month period since visiting the gallery. The study revealed that when autobiographical memory was recalled, the artwork memory was more likely to be integrated, and the memories that became more integrated over time were those associated with emotional responses to the artworks. The Medved and Oatley (2000) study, reported earlier, also undertook a qualitative analysis of their interview data concerning visitors' memories. This analysis revealed that visitors' discourse about their experiences was primarily connected with sharing emotional responses (affect) to the exhibits such as enjoyment, curiosity, frustration, and anger.

Anderson and Piscitelli (2002) investigated the memories of 75 parents of young children concerning their own childhood memories of school field trip visits to museums. The study demonstrated the powerful influence that the affective dimensions of experience had on parents' early museum experiences. More than 80% of the parents could describe in some detail their very early museum memories, and more than half of these described the experiences as being highly positive. The other half described their experiences in terms of negative attributes such as the visits being too rushed, having to deal with teacher-rules or teacher-directed tasks, and being dull or sometimes scary experiences. A study by Scott and Ponsoda (1996) that examined flashbulb memories[2] found no significant differences on the cardinal features of flashbulb memories for events of negative versus positive affect. Thus, both negative and positive affect associated with events has the capacity to code memory with equal saliency.

The relationship between emotion and episodic memory is complex, but generally emotion tends to increase the likelihood that an event will be remembered later and that it will be remembered vividly. Flashbulb memories are one example of this. Our most vivid autobiographical memories tend to be of emotional events, and research has revealed that emotional events are more likely to be recalled than more neutral events (Reisberg & Heuer, 2004). Clearly, the emotional affect associated with experiences in

[2] Flashbulb memory is generated as a function of heightened arousal or strongly emotional events.

leisure-time settings is a key influence on the long-term recall of episodic and autobiographical memory.

Visitors' agenda (intentionality) and long-term memory

A small number of studies in the field of informal learning suggest that the agendas visitors hold prior to visiting a museum setting play an important role in shaping the subsequent experience in and beyond that setting. For example, Briseno's (2005) qualitative study of adult family members' learning in aquarium contexts demonstrated the strong influence of pre-agendas (the set of planned expectations visitors hold before a visit) on shaping the kind of experiences (and memories) that develop. Moreover, follow-up interviews 3 weeks after the visit demonstrated that initial visitor agendas influenced subsequent learning following the visit. There was also strong evidence that unfulfilled or frustrated agendas were well remembered and arose frequently as issues for comment in the post-visit interviews with participants. Falk, Moussouri, and Coulson (1998) conducted pre- and post-interviews with 40 randomly selected adult visitors to the Smithsonian Natural History Museum. They concluded that visitors' pre-agendas, including their stage of life, significantly influence how, what, and how much individuals learned during their visit. Although these studies demonstrate the influence of agenda on learning in museum settings, there are no known studies that provide evidence of the influence of this factor on richness of visitors' long-term memories of their experiences in leisure-time settings.

These studies attest to the fact that memories developed from leisure-time experience appear to sustain rich episodic detail over time. Visitors' memories of their leisure-time experiences also appeared to be connected to their emotional (affect) responses to the episodes they recall. Several studies provide strong evidence that visitors do rehearse memories of their museum experiences as they discuss and relive the details of their visit with others, and this may have a beneficial effect on the detail of their recall of the experience. Furthermore, visitors' agenda (intentionality) and the extent to which they are frustrated (or perhaps fulfilled) may influence the richness of subsequent episodic recall. Notwithstanding the evidence for these claims among the small number of studies examining visitors' memories, the ways that affect, intentionality, agenda fulfilment, and rehearsal influence visitors' memories of their experience in such leisure-time settings has not been explored to date.

Previous research on memories of World Expositions

Memory research on visitors' experiences at World Expositions is almost non-existent, with the exception of the work of Anderson (2003). In this study the episodic and autobiographical memories of 50 visitors who attended either Expo '86 or Expo '88 were probed through in-depth, face-to-face interviews. The study identified three themes concerning visitor memories of these events. First, memories of the social context of the visit were the most dominant and vivid of the memories the participants held years later. Second, the socio-cultural identities of visitors at the time of the experience were the critical factor that shaped memory of the expo experience. The study also showed that socio-cultural identity acted as a powerful enabler permitting visitors to see, perceive and, ultimately, remember aspects of the expos that others in different cultural groups could not. In short, socio-cultural identity largely determined what visitors were able to see and perceive and, ultimately, recall after the experience. Third, visitors' recalled agendas (intentionality to see or do something at expo), at the time of the experience, influenced memory. Specifically, visitors' agendas, co-mediated and defined by their cultural identity at the time of the experience, defined what governed their attention and behaviour at the time of the experience and, ultimately, defined the impact of the experience in terms of recall years later. Anderson (2003) also found that the frequency of visitation of participants to the expositions bore no correlation to the qualitative richness of their reported memory episodes years later. Anderson's (2003) study represents the only such study to date that has considered the long-term memories of leisure-time experience with such long baselines, and adds to the understanding of the impact of visitor experiences through the consideration of visitor agendas and their influence on memories.

Since Tulving (1972) claimed that a dichotomy existed between episodic memory and semantic memory, many empirical studies have reported on memories of personal experiences. Studies on

episodic and/or autobiographical memories, including flashbulb memories, in natural settings have been developed with methods using diary, interview, or questionnaire (e.g., Linton, 1982; Rubin & Kozin, 1984; Wagenaar, 1986; Winograd & Killinger, 1983). Episodic and/or autobiographical memories are well known to be characterised as, or influenced by, aspects such as emotionality and surprise. Rubin and Kozin (1984) pointed out that flashbulb memories are not fundamentally different from other vivid memories. They showed that participants rated several personally important events (e.g., graduation from high school, or an early romantic experience) as having flashbulb clarity, and the vividness of these memories was also related to rated values for surprise, emotionality, and consequentiality. Their findings indicate that differences between flashbulb memories and other vivid autobiographical memories are not so clear.

The literature on long-term memories and visitor experiences does provide some tantalising insights into the roles of emotional affect, intentionality, agenda fulfilment, and rehearsal, and their impact on the development of memories. However, there appears to be a lack of research investigating how these variables influence and shape vivid memories.

PURPOSE OF THE STUDY

This study sought to understand the psychological and behavioural factors identified in the literature that shape visitors' vivid long-term memories, and aimed to model statistically how these factors influenced vivid episodic and/or autobiographical memories using visitors' recalled experiences of the Japan World Exposition, Osaka, 1970 (Expo '70), 34 years previously, as a context. Four factors were included in the study: *affect*, *agenda fulfilment*, *intentionality*, and *rehearsal*. Two research questions were formulated as follows:

(a) How was each of the individual factors related to memory vividness?
(b) How were these four factors related to memory vividness when they were in a single model?

The study did not employ an experimental design (cf. Campbell & Stanley, 1963), but rather an interpretive approach (Erickson, 1986; Gallagher & Tobin, 1991; Schwandt, 1998), in that qualitative interview data were coded and interpreted in quantitative ways (cf. Shapiro, 2006) in order to model statistically how these factors influence the vividness of memory episodes. The context of visitors' memories of Expo '70 was selected for several reasons. First, Expo '70 was a significant world event and highly significant to the nation and national consciousness of Japan. The exposition was a spectacle and largely regarded in very positive terms by the citizens of Japan for the technological wonders it portrayed in its displays and exhibits. For instance, the United States Pavilion displayed the ''Moon Stone'' brought back by the Apollo 11 mission just 8 months earlier. The exposition attracted more than 64 million visitors over the 6 months that the event was staged; hence it was not difficult to find participants for the study—a difficulty sometimes experienced in studies of long-term memory, especially ones considering memories of the distant past. Additionally, the use of Expo '70 as a research context for the examination of long-term memory was useful since it represented a defined marker in time for which the chronological distance since the event could be certain for all participants, thus countering the threat to validity that might arise through examination of events with varying chronological distance.

The authors adopted an epistemological view that the nature of episodic and autobiographical memory would likely remain stable over time, and hence it would be easy to probe through interview methods (Ericsson & Simon, 1993). Additionally, the authors were of the view that memories of personal experiences construct and reconstruct longitudinally, and that what was reported by participants might not be an entirely accurate version of the experience that originally produced the memories (Bruner, 1994; Freeman, 1993; Neisser & Fivush, 1994). However, the focus of the study was to investigate the factors that shape vivid long-term memory, and hence concern about the accuracy of self-reported experience was not an issue, but rather the focus was on why the memory is vivid today (34 years later at the time of the study). Hence, the reliability and accuracy of the participants' memories was not what was being studied—rather, the qualitatively rich memories they described were considered their ''current reality'' of the recalled events, which may or may not be entirely representative of the original constructed reality.

METHOD

Participants

Data were collected in the summer of 2004 from a total of 48 Japanese participants who had visited Expo '70 and volunteered to take part in the study; a total of 112 memory episodes were examined. The study took place in the Kansai Region in the city of Akashi, Japan, not far from the site where Expo '70 was staged and where several significant architectural elements of the exposition still remain today. Participants were recruited to participate in the study by means of advertising posters placed in the Social Clubs in Akashi. Social Clubs are centres of social activity in Japanese towns and cities where locals gather for arts and crafts, singing, and other community-based events. The Social Clubs were seen by the research team as ideal venues to recruit participants because they attract a broad cross-section of the populace who would likely be willing to volunteer their time to participate in such a study. The advertisement cited the objectives of the study and called for participants of a diversity of ages who had visited the Exposition at least once. To help reduce complication of the study by self-selection of prospective participants due to their self-perception of memory quality, the advertisement stressed that participants need not have a highly detailed memory of the event in order to take part in the study.

Participants were individually interviewed face-to-face about their memories of their visit(s) to Expo '70 34 years previously. All interviews were conducted by the researchers in the Japanese language, and all 48 participants were Japanese nationals. The sample comprised 18 males (37%) and 30 females (63%), who spanned a range of ages. Table 1 shows the distribution of participant ages at the time of their visits to Expo '70, and that they were predominantly adults then. Table 2 shows the distribution of participants' frequency of visits to the exposition, which was dominated by those who visited only once or twice.

Procedure

All 48 participants were interviewed individually face-to-face using a semi-structured interview protocol (see Appendix). Interviews were of 30 minutes duration on average, and sometimes as much as 45 minutes depending on the willingness of participants to continue to freely discuss their memories of their visit(s). The interviews were conducted in a relaxed conversational manner, in a quiet room within the various Social Clubs. Participants sat opposite the interviewers (authors) at a small desk. The interviews were semi-structured in nature in that specific open-ended questions were asked of all participants, but participants' responses to these pre-planned questions often prompted follow-up probing questions. The interviews commenced with the collection of key demographic data from participants, such as name, date of birth, and the number of times they claimed to have visited Expo '70. The key issues probe centred on the following:

1. Spontaneous recall of Expo memories (participants were given the chance to talk about what came to mind about their Expo, experiences without any cueing or probing from the interviewer).
2. Episodic and autobiographical memories of events, occurrences, and happenings surrounding their visit(s).
3. Salient memories.
4. Spontaneous recall following focused stimuli such as sounds and images from the Expo, including scenes of exhibitions, and inside and outside views of various pavilions, all of which were displayed on a laptop computer.
5. Social aspects of their visit, including stories and events recalled from their social context.

TABLE 1
Age of participants at the time of their visit to Expo '70

	Age of participant					
	7 years	*10–19 years*	*20–29 years*	*30–39 years*	*40–49 years*	*50–54 years*
No. of participants	1 (2%)	7 (15%)	7 (15%)	17 (35%)	13 (27%)	3 (6%)

TABLE 2
Frequency of participants' claimed visits to Expo '70

	Frequency of visits					
	Once	*Twice*	*Three times*	*Four times*	*Five times*	*>Ten*
No. of participants	23 (48%)	10 (21%)	8 (17%)	2 (4%)	3 (6%)	2 (4%)

6. Sensory experiences and emotions of participants' visits to Expo '70: tastes, smells, sounds, emotions/feelings, and affect (both positive and negative).
7. Events and incidents since Expo '70 that caused them to think about their experiences at the exposition.
8. Socio-cultural identity of the participant in 1970, including their stage of life, interests, and occupations.
9. Views about the meaning and impact of Expo '70 on Japan.

Coding

Episodic memory and/or autobiographical memory were defined in this study as a sub-category of declarative memory: the recollection of events including the self in time, place, and associated emotions. All video recordings of each of the 48 participant interviews were reviewed by members of the research team, and the transcripts were read several times in order to immerse and familiarise each member with the memory episodes discussed by the participants. Two to three memory episodes were identified and selected from each of the 48 participant cases, resulting in a total of 112 memory episodes that were examined. These episodes were selected by the team for statistical analysis on the basis that (1) the episode was in keeping with our definition of episodic memory, and/or autobiographical memory, and (2) it had at least some degree of qualitative detail (richness). Table 3 details some exemplars of the kinds of memory episodes the team identified.

Consistent with outcomes reported in the literature, four factors inherent to the memory episodes were identified as strongly influencing and shaping the vividness of participants' memories: *affect*, *agenda fulfilment*, *intentionality*, and *rehearsal* (see Table 4 for descriptors). With these factors in mind, each of the 112 episodes was independently rated on Likert scales by the members of the research team on these dimensions, in addition to a fifth dimension, that of *memory vividness*. The Likert scales were developed with ranges that permit the finest level of discrimination that could be realistically determined by members of the team. In the case of *memory vividness*, a 4-point scale was employed where 1 = low, 2 = moderate, 3 = high, 4 = extreme as a function of the qualitative richness of the recalled episode based on the richness of descriptive evidence within the interview transcript. In the case of *affect* and *agenda fulfilment*, a 7-point scale was employed because a 3-point differential (three points: positive, neutral, and three points negative) was deemed to be the finest level of discrimination that could be realistically determined by members of the team. Likewise, the ranges of the Likert scales for other factors were justified on the capacity for discrimination. The averages of the independent assessments were compiled to represent the team rating for factors associated with each memory episode.[3] The inter-rater reliability (Pearson correlation coefficient) for each of the factors was as follows: *memory vividness*, 0.685 ($p < .01$); *affect*, 0.904 ($p < .01$); *agenda fulfilment*, 0.808 ($p < .01$); *intentionality*, 0.881 ($p < .01$); and *rehearsal*, 0.667 ($p < .01$). Table 4 details the descriptors and means of determining each of the five dimensions, in addition to the number (fraction) of memory episodes that could be determined or assessed based on the interview data for each dimension by the research team.[4]

[3] Because independent assessments were averaged, this had the effect of increasing the discrimination capacity of the scales.

[4] Not all memory episodes could be assessed in all five dimensions. For example, evidence of intentionality or agenda fulfillment could not be detected in every memory episode based on the interview data.

TABLE 3
Exemplars of 112 memory incidents identified by the research team

Exemplar	*Participant descriptors*	*Participant sample quote from interview*
Memory of the Kenyan Coffee	*Participant #*: 8 *Name:* Mr Miki *Gender:* Male *Visits to Expo:* 3 *Age:* 16 years (in 1970) *Social Context:* Visited with school, friend, and family.	*The Kenya pavilion was very small, and inside there was one person pouring Kenyan Coffee into paper cups, and he was selling it. There were some exhibits about the people of the nation. The coffee was pretty delicious. The smell made an impression on me.*
Memory of visiting the Japanese Garden at Expo '70 with husband	*Participant #*: 20 *Name:* Mrs. Fujimoto *Gender:* Female *Age:* 48 years (in 1970) *Visits to Expo:* 1 *Social Context:* w/ husband	*In the Japanese garden it was very relaxed. I have a clear memory of my husband and I with the Bonsai trees, we visited in the evening when there were less people. There were many sophisticated Bonsai trees* [on display]*... I can see my husband wearing a white shirt with short sleeves, without a necktie. He was very happy, and on the way to and from Expo we were talking a lot. On the way home from the Expo* [that evening on the train] *was when my husband began talking about all the Bonsai trees we saw.*
Memory of crowds and failure to see the moonstone	*Participant #*: 25 *Name:* Mrs Tsukahara *Gender:* Female *Age:* 44 years (in 1970) *Visits to Expo:* 1 *Social Context:* w/husband+son (grade 9) and daughter (grade 7)	*We were all looking forward to going* [to Expo]*. On the day we went, there were so many people! Because of the long lines while we were waiting we were overwhelmed by all the people. That was the negative thing of the day. But so was everyone else* [having to suffer the long line ups]*, and finally we could get in* [to the Expo site]*. Next we wanted to go to such places as the American pavilion but with so many many people we said to ourselves where should we go and what should we do? We said to ourselves, if we go to the American pavilion we can see the moonstone – that's the reason we were looking forward to going to the Expo, but because of the people and the time to wait we couldn't get in, that was too bad.*

Data analysis

In order to examine the relations of the four factors and memory vividness individually and together, this study was conducted using regression analyses in two stages: (a) the relation of each individual factor and memory vividness was explored using both linear and curvilinear regression analyses, and significance tests on R-squared change were used to examine the model fit; (b) the relation between memory vividness and all factors was examined through a multiple regression analysis and the relative importance of these factors on memory vividness discerned using R-Squared Partition and relative Pratt Index (Pratt, 1987; Thomas, Hughes, & Zumbo, 1998). It is reasonable to assume that memory vividness should likely present non-linear relationships with some psychological and behavioural factors, given that ever-increasing strength in the factors should not logically result in ever-increasing vividness of memories. Therefore we included both linear and curvilinear functions in the models to find the best approximation of the relationships between memory vividness and the factors under this study. The first stage analyses, which were exploration analyses, were also a necessary focus of this study because the likely curvilinear relationship between memory vividness and individual

TABLE 4
Dimensions used for memory episodes and number rated

Dimension	*Descriptor of dimension and means of determination*	*Number rated*
Memory vividness	Defined on a 4-point Likert scale (*1 = low, 2 = moderate, 3 = high, 4 = extreme*) by the qualitative richness of the recalled episode based on the richness of descriptive evidence within the interview transcript, the voice and tone of interview excerpt, and non-verbal gestures and body language of the participant as they described their memories of the episode.	112/112
Affect	Defined on a 7-point Likert Scale (*−3 = very negative, −2 = moderately negative, −1 = slightly negative, 0 = neutral, +1 = slightly positive, +2 = moderately positive, +3 = very positive*) by the associated emotional response, positive or negative, to an episode that participants described as having occurred as part of their visit to Expo '70.	112/112
Agenda fulfilment	Defined on a 7-point Likert Scale (*−3 = very unfulfilled, −2 = moderately unfulfilled, −1 = slightly unfulfilled, 0 = neutral, +1 = slightly fulfilled, +2 = moderately fulfilled, +3 = highly fulfilled*) by the associated degree of fulfilment of a planned or intentionalised agenda associated with an episode that occurred at Expo '70.	92/112
Intentionality	Defined on a 3-point Likert scale (*1 = low, 2 = moderate, 3 = high*), defined as the degree to which participants demonstrated evidence in their interview of the fact that they had intentionalised plans to do or see something at Expo '70.	84/112
Rehearsal	Defined on a 4-point Likert scale (*1 = minimal evidence, 2 = moderate evidence, 3 = strong evidence, 4 = very strong evidence*), defined as the degree to which visitors demonstrated evidence in their interview of the fact that they had reflected back on the episode they discussed since their visit to Expo '70.	81/112

factors might disappear when the model included one or some other factor(s) that had strong correlation with memory vividness. Moreover, this approach enabled an interpretation of the whole data structure that subsequently led to more detailed characterisation in the process of stage 2 data analysis.

RESULTS

The stage 1 analyses demonstrated: (1) a curvilinear relationship of *memory vividness* with *affect* as well as with *agenda fulfilment*; (2) a linear relationship was likely the best model between *memory vividness* and *rehearsal*; however, (3) *intentionality* was not correlated with *memory vividness*. The stage 2 multiple regression analysis, which included all factors, demonstrated that only *rehearsal* was positively associated with *memory vividness*, and that other variables were not related to *memory vividness* in the presence of *rehearsal*. The effect of frequency of visitation, age, and gender on *memory vividness* was not significant as identified in the previous research. The detailed results of the two-stage analyses are reported in the following sections: Influence of individual factors on memory vividness and Relation between all factors and memory vividness.

Influence of individual factors on memory vividness

Memory vividness as a function of affect. There was a non-linear relationship between the *memory vividness* of the participant's memory episodes and the *affect* associated with the specific memory episode. A total of 112 cases were plotted, as represented by the curve estimation in Figure 1. Table 5 and Figure 1 indicate that the relationship between *affect* and *memory vividness* was best approximated by a curvilinear regression model. Comparing linear and curvilinear regression models, R^2 change was statistically significant, R^2 change $= .226$, $p < .0001$, indicating that the quadratic function ($y = 0.136^2 - 0.003x + 2.089$) better described the relationship between *memory vividness* and *affect*. The relation indicated that at the extremes of affect (highly negative or highly positive) the memory episode was vivid for the participant, and at neutral levels of *affect* the *memory vividness* was weakest.

Memory vividness as a function of agenda fulfilment. There was a non-linear relationship between the *memory vividness* of the participants' memory episodes and the degree to which they recalled their plans associated with that episode being either fulfilled or frustrated (*agenda fulfilment*). A total of 84 cases were

plotted, as represented by curve estimation in Figure 2. Table 5 and Figure 2 indicate that the relationship between *memory vividness* and *agenda fulfilment* was best approximated by a curvilinear regression model. Comparing linear and curvilinear regression models, R^2 change was statistically significant, R^2 change $= .106$, $p < .05$, indicating that the quadratic function ($y = 0.0843x^2 - 0.0553x + 2.3667$) better described the relationship between *memory vividness* and *agenda fulfilment*. The relation indicated that at the extremes of *agenda fulfilment* (highly fulfilled agendas or highly frustrated agendas) associated with a memory episode the episode itself is vivid for the participants, and at neutral levels of *agenda fulfilment* the *memory vividness* was weakest.

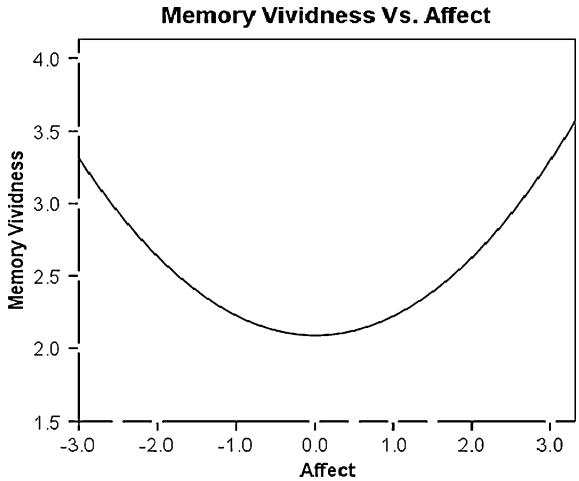

Figure 1. Memory vividness as a function of affect.

Memory vividness as a function of intentionality. Table 5 indicates that there was no relationship between the *memory vividness* of the participants' memory episodes and the degree to which they recalled their plans associated with that episode having *intentionality*.

Memory vividness as a function of rehearsal. A linear relationship was found between *memory vividness* and evidence for *rehearsal* of the specific memory episode since the time of episode. A total of 81 cases were plotted and estimated using both linear and quadratic functions as represented by Figure 3. When quadratic function was included in the regression model, R^2 change was statistically significant (R^2 change $= .03$, $p < .01$) and the coefficient estimates for both linear and quadratic functions were statistically significant. However, the inclusion of quadratic

TABLE 5
Regression model examining the relationships between individual factors and memory vividness

	Model	*Parameter estimates*		*t*-test	*Sig.*	*R-squared*	*R-squared change*
Affect	Linear	Intercept	2.748	34.412	.000	.003	.226***
		Affect	.019	.539	.591		
	Quadratic	Intercept	2.088	15.298	.000	.229	
		Affect	−.003	−.088	.930		
		Affect * Affect	.136	5.654	.000		
Agenda fulfilment	Linear	Intercept	2.735	29.331	.000	.007	.106*
		Agful	−.034	−.771	.443		
	Quadratic	Intercept	2.367	16.019	.000	.114	
		AgFul	−.055	−1.309	.194		
		AgFul * AgFul	.084	3.120	.003		
Intentionality	Linear	Intercept	2.477	15.242	.000	.029	.012
		Intentionality	.141	1.650	.103		
	Quadratic	Intercept	2.605	12.847	.000	.041	
		Int.	−.142	−.504	.616		
		Int.* Int.	.092	1.054	.295		
Rehearsal	Linear	Intercept	1.751	10.279	.000	.401	.030*
		Rehs.	.641	7.269	.000		
	Quadratic	Intercept	1.478	6.872	.000	.431	
		Rehs.	1.091	4.568	.000		
		Rehs.* Rehs.	−.137	−2.024	.046		

* $p < .05$, ** $p < .001$, *** $p < .0001$.

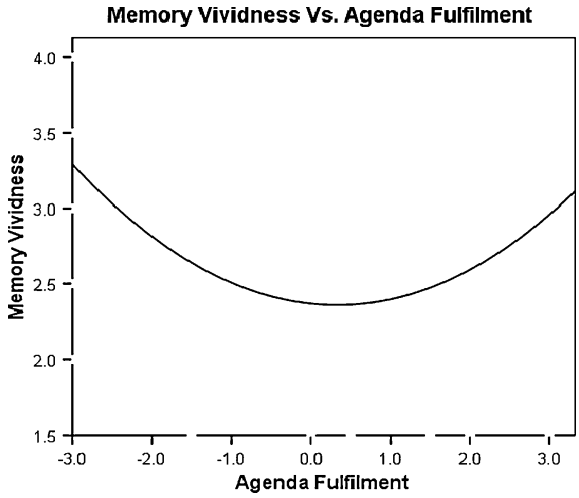

Figure 2. Memory vividness as a function of agenda fulfilment.

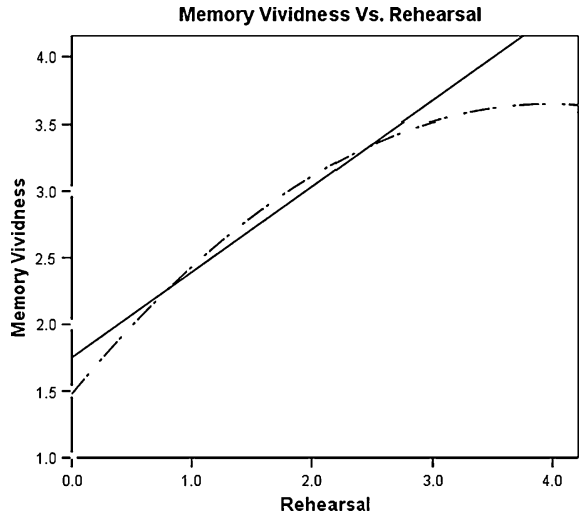

Figure 3. Memory vividness as a function of rehearsal.

function into the model caused the problem of collinearity: The value of Variance Inflation Factors (VIF) was raised to 7.636 and the correlation between the linear and quadratic functions was as high as 0.93. Therefore the quadratic function was excluded from the multiple regression model.

Relation between all factors and memory vividness. An analysis of all variables in a multiple regression analysis, shown in Table 6, demonstrated that only the parameter estimate of one variable, *rehearsal*, was statistically significant. Although they were demonstrated to have influence on *memory vividness* in individual models, the relationship of *affect* and *agenda fulfilment* to *memory vividness* no longer existed when all factors were included in a single model. To help understand the relative importance of these four factors on memory vividness, Table 6 also shows R^2 partition and relative Pratt Indices for each variable. The R^2 partition for each independent variable in the multiple regression analysis, including linear and quadratic functions, was *Affect*Affect* = 0.041, *Agenda fulfilment* = 0.002, *Agenda fulfilment*Agenda fulfilment* = 0.012, and *Rehearsal* = 0.479. The relative Pratt Indices showed that *rehearsal* explained 85.9% of the variance in *memory vividness*.

CONCLUSION

As attested by the review of relevant studies in the literature, the dimensions of *affect*, *agenda fulfilment*, *intentionality*, and *rehearsal* seem important factors in the development of vivid long-term memories, yet there appears to be little research available to demonstrate how these variables influence and contribute to the formation of vivid long-term memories of experiences in leisure-time settings.

The R^2 values for the curve estimates of the various individual analyses of *memory vividness* as a function of *affect*, *agenda fulfilment*, and *rehearsal* (stage 1 analysis) indicate that all independent variables are related to *memory vividness*, with the exception of *intentionality.* However, the multiple regression analysis, with all factors, indicates that only *rehearsal* is positively associated with *memory vividness*, and other variables are not significantly related to *memory vividness* in the presence of *rehearsal*. This multiple regression analysis demonstrated that *rehearsal* accounted for 85.9% of the variance in *memory vividness*.

Stage 1 of the analyses demonstrates how *affect* and *agenda fulfilment* vary as quadratic functions of the vividness of long-term memories, while *rehearsal* (based on these data) likely varies linearly. However, in the case of this latter relationship, a quadratic function that has a plateau would tend to provide a more plausible explanation, given that ever-increasing amounts of *rehearsal* should not logically result in ever-increasing amounts of *memory vividness*.

The influence of affect on memory vividness appears to be generally consistent with the

TABLE 6
Multiple regression analysis including affect, agenda planning, agenda fulfilment, and rehearsal

	Unstandardised coefficients					
Factors	*B*	*Std. error*	*t*-test	*Sig.*	*R-squared partition*	*Relative Pratt Index*
Intercept	1.191	.260	4.580	.000		
Affect	−.062	.058	−1.068	.291	0.008	0.014
Affect * Affect	.025	.038	.670	.506	0.041	0.074
Agenda Fulfillment	−.011	.067	−.170	.866	0.002	0.003
Agful * Agful	.008	.037	.213	.832	0.012	0.022
Rehearsal	.793	.141	5.640	.000	0.479	0.859
Agenda Planning	.068	.113	.602	.550	0.015	0.027

Dependent variable: Memory vividness.

literature; that is, the *memory vividness* of memory episodes increased with increasing levels of *affect* (positive or negative) associated with the memory episode. Visitors' recalled agendas at Expo '70, which were only partially or totally unfulfilled (*agenda frustration*), are represented by the higher scores in the left end of the curves in Figure 2. That is, agenda frustration occurs in the cases where participants did not fulfil their agenda in spite of higher intentionality. According to the Zeigarnik effect (the psychological tendency to more vividly remember an uncompleted rather than a completed task; Zeigarnik, 1927, 1967), the memories under agenda frustration conditions would be predicted to be more vivid than in cases where the participants had not planned or had satisfactorily fulfilled their agendas, hence our findings are reasonably accounted for in terms of this phenomenon. Additionally, one would expect that a frustrated agenda would be one that develops an associated negative affect, which also results in enhancing the *memory vividness* of the episode. The greater contribution of *rehearsal* to *memory vividness* than the other factors, if depicted as a quadratic function, seems consistent with the finding that *rehearsal* sometimes becomes less effective for long-term retention as the number of rehearsals increases in the laboratory setting (Shimizu, 1987). Thus, in the natural setting of experience at Expo '70, excessively frequent *rehearsal* may also be redundant to the vividness of autobiographical memories; rather it may lead to false memories.

An analysis of all variables in a multiple regression analysis in Table 6 demonstrates that only *rehearsal* is significantly correlated with *memory vividness*. Although they were demonstrated to have influence on memory vividness in individual models, the relationship of *affect* and *agenda fulfilment* to *memory vividness* no longer existed when all factors were included in a single model.

One might readily lean towards the Yerkes-Dodson law for an explanation of the characteristic relationships seen in the plots of *affect* and *agenda fulfilment* as a function of *memory vividness*. However, it is important to realise that memory episodes of visitors' experiences of Expo '70 are not highly traumatic, as is the case in many studies that employ the Yerkes-Dodson law for explanation. Moreover, naturalistic studies (such as this) interpret participants' emotional condition from their long-term recall, as opposed to experimentally setting conditions of emotion or stress. Finally, the data from studies that interpret retrospective reflection of long-term memories as a principal method have rarely, if at all, leaned towards traditional Yerkes-Dodson law for explanation. To this end, it does appear that for these kinds of naturalistic memory events, at the extremes of *affect* and *agenda fulfilment*, memories are perceived as quite vivid. The explanation for strong memory vividness of episodes at extremes of *affect*, *agenda fulfilment* and *rehearsal* are inter-related. The authors speculate that memory episodes that had a strong associated affect and/or agenda fulfilment as they occurred, 34 years past, are likely influencing the degree to which they are later rehearsed through life. Hence, this combination of factors ultimately incites memories to become rehearsed (the principal factor shaping memory vividness), thus plausibly accounting for high levels of *memory vividness* many years later.

There were no significant relationships detected by the variables of frequency of visitation,

age, or gender. This lack of significance in terms of frequency of visitation might be accounted for in that the sample contained only a small variance in visitation frequency—i.e. most participants only visited once or twice—and hence is not comparable to the outcomes reported by Hudson and Nelson (1986). However, this outcome is consistent with Anderson's (2003) study, which examined memories of Expo '86 and Expo '88 held by participants with a broad spread of visitation frequency. The apparent lack of significant relationship between memory vividness and frequency of visitation may be indicative of long-term memory of leisure-time events in the very distant past. That lack of significance was a function of age might be explained by the fact that the bulk of the sample were adults at the time of their visit to Expo '70, and hence, like the frequency of visitation variable, there may be insufficient variance in the sample (i.e., a lack of children and the very elderly) to account for significant differences in memory vividness of events as might be expected.

The study reveals insights concerning the factors that shape vivid long-term memories and, moreover, how these factors statistically model the influence on vivid episodic and autobiographical memories. The appreciation of these factors and their influence on shaping vivid memories provides some insights for those who are concerned with the design of leisure-time experiences, such as exhibition developers at museums and other institutions, and indeed those who plan for visitor experiences at events like World Expositions.

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APPENDIX

Long-term Memories of Large-Scale Exhibitions: Recollections of World Expositions

Administration Time: 30 Minutes

1. Name: ———————— 2. Gender: M F 3. DOB:——— 4. No. of times Visited:————

1) What are your immediate memories of Expo? Tell me about your visit to Expo, what kinds of events, occurrences, and happening do you remember? What were the most memorable experiences of Expo '70? Why do you think they were so memorable?

2) What comes to mind when you look at these pictures of Expo (interview to show a variety of photographic images of Expo.)?

3) Which pavilions do you remember visiting? What did you see inside these pavilions? Why were these memorable?

4) With whom did you visit Expo? What kinds of aspects, stories, and events do you remember about your social settings and the social settings of others?

5) Describe to me the sensory experiences and emotions that come to mind when you think about your visits to Expo – tastes, smells, sounds, emotions/feelings and affect (both positive and negative).

6) Do you think Expo '70 had an effect/meaning on/for the Nation?

7) Describe who you were in 1970 (34 years ago) . . . what was your stage of life, what were you doing?