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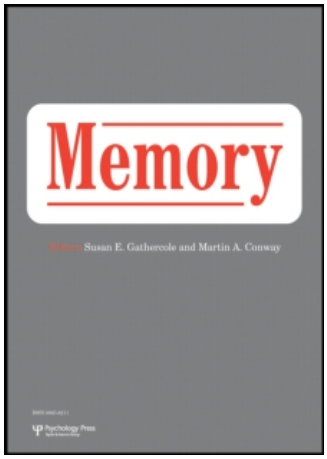

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Ageing and autobiographical memory for emotional and neutral events

Peggy L. St. Jacques and Brian Levine
Rotman Research Institute, Toronto, ON, Canada

We investigated age-related effects in recall of emotional and neutral autobiographical memories. Protocols were scored according to episodic and non-episodic detail categories using the Autobiographical Interview. Young adults recalled a greater number of episodic details compared to older adults, whereas older adults recalled more semantic details, replicating previous findings. Both young and older adults' emotional memories contained more overall detail than neutral ones, with the enhancement from emotion-specific to episodic details, but this did not alter the effect of age group on the pattern of episodic and semantic details. However, the age effect on episodic details was attenuated for neutral autobiographical memories. The findings suggest that age differences for emotional autobiographical recollection might reflect a more general pattern of age-related changes in memory, with impaired recall of episodic components and relative sparing of semantic aspects of autobiographical memory in older adults when compared to young adults.

Autobiographical memory entails processing of experiences from one's personal past (Brewer, 1986; Conway & Pleydell-Pearce, 2000; Svoboda & Levine, 2003), and is typically considered within the domain of episodic memory, or memory for a specific time and place (Tulving, 1983). Autobiographical memory is not solely episodic in nature; it also involves the integration of semantic or factual information not tied to a specific place or time (Conway & Pleydell-Pearce, 2000; Tulving, Schacter, McLachlan, & Moscovitch, 1988). For example, an autobiographical memory may contain episodic details relating to the specific event (e.g., ''the flowers were red''), as well as semantic information long-standing in nature (e.g., ''red is my favourite colour'').

The characterisation of episodic and semantic components in autobiographical memory has important implications for ageing. Reductions in ageing are particularly evident on episodic memory tasks, whereas on semantic memory tasks, older adults frequently perform within the young adult range (Craik & Jennings, 1992; Park, 2000). This pattern of age-related memory decline has been extended to investigations of autobiographical memory recall (Holland & Rabbit, 1990; Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002; Piolino, Desgranges, Benali, & Eustache, 2002), where older adults showed greater declines on episodic components of autobiographical memory, but preserved or enhanced recall on semantic components.

Autobiographical memories usually involve a rich emotional context that predicts autobiographical memory experience (Talarico, LaBar & Rubin, 2004), contributes to the organisation of events across the lifespan (Berntsen & Rubin,

Address correspondence to: Brian Levine, PhD, ABPP, Rotman Research Institute, Baycrest Centre for Geriatric Care, 3560 Bathurst Street, Toronto, ON M6A 2E1, Canada. E-mail: levine@psych.utoronto.ca

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2002; Rubin & Berntsen, 2003; Schulkind & Woldorf, 2005), and is important for self, social, and directive functions (Bluck, 2003; Conway, 2003). In young adults emotion enhances episodic memory (see Cahill & McGaugh, 1998; Ochsner, 2000; Schooler & Eich, 2000) either as the result of the modulation of encoding and consolidation in the hippocampus via the amygdala (for review see LaBar & Cabeza, 2006) or due to increased rehearsal and attention (for a review see Christianson & Engelberg, 1999; also see Talmi & Moscovitch, 2004). Several autobiographical memory studies (Conway & Bekerian, 1988; D'Argembeau, Comblain, & Van der Linden, 2003; Destun & Kuiper, 1999; Larsen, 1998; Rubin & Kozin, 1984; Schaefer & Phillippot; 2005; Wagenaar, 1986; White, 1982) and some flashbulb memory studies (salient memories for important public events; Brown & Kulik, 1977) have found that emotionally arousing events are more vivid and detailed. These studies suggest that emotion should enhance episodic components of autobiographical memory.

On the other hand, emotion has been shown to have a detrimental effect on the retrieval of specific details in autobiographical memory (for a review see Christianson & Safer, 1996; Schooler & Eich, 2000). For example, patients with emotional disorders, such as depression, often have difficulty recalling specific details in autobiographical memories and tend to recall over-generalised memories (e.g., "I always received red flowers"; for review see Williams, 1995). The over-generalised recall of emotional autobiographical memories could be due to reactivation of emotional responses during retrieval, which disturb the generative recall process for specific details (e.g., Conway & Pleydell-Pearce, 2000; see also Schaefer & Philippot, 2005). In a study that controlled for emotional response during retrieval, Schaefer and Philippot (2005) found that emotional autobiographical memories contained more semantic or schema-relevant details than neutral autobiographical memories, although emotional memories were also more vivid than neutral ones. These studies suggest that emotion might decrease specific episodic components of autobiographical memory and benefit semantic components possibly via increased organisational and binding mechanisms (e.g., Talmi & Moscovitch, 2004).

To summarise, there are controversies regarding which components of autobiographical memory are affected by emotion. Some of these discrepancies could be the result of methodological differences (e.g., retention interval; see Christianson, 1992) or differences in the types of components surveyed. It is well known that the central details associated with an emotionally arousing event are better recalled than peripheral ones (for a review see Safer, Christianson, Autry, & Oesterlund, 1998) and, in the weapon-focus effect (Loftus, Loftus, & Messo, 1987), participants in eyewitness memory studies recall the weapon involved in a crime (e.g., gun) better than other types of details (e.g., the face of the perpetrator). Thus, discrepancies could arise due to how event details are evaluated. Many of these studies assessed autobiographical memories via participant ratings, and autobiographical memory components (e.g., place, time, multiple or extended events, etc.) were not always explicitly examined. Indeed, autobiographical information is typically recalled across different levels of specificity (e.g., general events, event-specific knowledge; Conway & Pleydell-Pearce, 2000) that dictate how a particular component should be allotted, but these nuances might be difficult to detect via participant ratings. The bases of participant ratings, such as vividness, are not obvious. For example, vividness could reflect the amount of sensorial details specific to an event, such as when a memory of a sunset involves more visual than auditory information compared to a memory of a concert (Rubin, Schrauf, & Greenberg, 2004), or more generic components that are activated by emotional schemas (e.g., Schaefer & Philippot, 2005). An analysis of the properties of memories as well as the content might be necessary to tease apart the effects of emotion on components of autobiographical memory (Rubin et al., 2004).

While the effect of emotion on older adults' autobiographical memory has been studied in the context of emotional regulation and biases (Kennedy, Mather, & Carstensen, 2004; Pasupathi & Carstensen, 2003), few studies have attempted to quantify cognitive elements of emotional memories in older adults. Older adults should also benefit from emotion, but it is unclear whether the enhancement from emotion would be sufficient to eliminate the age-related effect on memory performance—prior episodic memory studies have yielded conflicting results (Charles, Mather, & Carstensen, 2003; Comblain, Van der Linden, & Aldenhoff, 2004; Denburg, Buchanan, Tranel, & Adolphs, 2003; Kensinger, Brierley, Medford, Growdon, & Corkin, 2002; Mather & Carstensen, 2003). Most studies examining age-

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related effects of emotion in personally relevant memories have focused on flashbulb memory. There is some evidence that age-related effects are minimised for flashbulb memories (Davidson, Cook, & Glisky, 2006; Davidson & Glisky, 2002; Gerdy, Multhaup, & Ivey, 2004; Otani et al., 2005). Memory characteristics associated with flashbulb memories might not be susceptible to age-related differences, although flashbulb memories might occur less frequently in older adults. In one study, only 42% of older adults had a flashbulb memory for the resignation of British Prime Minister, Margaret Thatcher, compared to 90% of young adults, but the memory attributes for older adults who did meet the criterion of having a flashbulb memory were no different than those of young adults (Cohen, Conway, & Maylor, 1994).

In a study of non-flashbulb emotional events, Comblain, D'Argembeau, and Van der Linden (2005) asked participants to recall two each of positive, negative, and neutral autobiographical memories from the last 5 years that were subsequently self-rated based on the Memory Characteristic Questionnaire (MCQ; Johnson, Foley, Suengas, & Raye, 1988). Both age groups rated emotional memories as containing more sensorial and contextual details than neutral memories. Older adults rated negatively valenced memories (but not positively valenced and neutral memories) as more vivid than young adults. These results were interpreted as reflecting older adults' re-appraisal of negative events in a more positive manner (see Carstensen, 1993), as evidenced by their higher ratings of positive feelings for these negative events relative to those of young adults.

One criticism of these studies is the use of measures that involve high retrieval support, obscuring age-related effects in recall for an emotional event (e.g., Craik, 1983). Most studies of flashbulb memory rely on structured questionnaires surveying specific information concerning the event. While the MCQ interrogates many facets of autobiographical memory, it does so through participant ratings of subjective experience, which are an indirect measure of mnemonic characteristics that may be influenced by other group factors, such as different subjective baselines. Neither the MCQ nor the flashbulb memory questionnaires distinguish between episodic and semantic details to determine which elements of autobiographical memory are affected by emotion.

The Autobiographical Interview (Levine et al., 2002) derives separate measures of episodic and semantic autobiographical memory using a standardised, reliable system for categorising details from participants' transcribed autobiographical protocols. It also manipulates retrieval support through different levels of probing. Using this instrument, Levine and colleagues (2002) found that young adults recalled more episodic autobiographical details and fewer semantic autobiographical details than did older adults at both high and low levels of retrieval support. The Autobiographical Interview has also been shown to be sensitive to differential effects of amnesia and dementia on episodic and semantic autobiographical memory. (McKinnon, Black, Miller, Moscovitch, & Levine, 2006; Rosenbaum, McKinnon, Levine, & Moscovitch, 2004; Steinvorth, Levine, & Corkin, 2005). The purpose of the present study was to examine age effects on episodic and semantic components of autobiographical memory recall for emotional events using the Autobiographical Interview. Use of the Autobiographical Interview (Levine et al., 2002) led to several advantages in the present investigation. Compared to other measures of autobiographical memory (e.g., MCQ; Johnson et al., 1988), the Autobiographical Interview includes a condition with minimal retrieval support, especially in the modified version employed in the present study, which might be more sensitive to age-related changes (e.g., Craik, 1983). Moreover, the Autobiographical Interview directly distinguishes between episodic and semantic components in autobiographical memory recall, allowing us to test specific hypotheses regarding the effects of age on emotional episodic and semantic recall. Furthermore, the Autobiographical Interview elaborates on episodic and semantic components to investigate more specific details (e.g., time, place, extended, tangential events, etc.) that could be differentially affected by emotion.

While the evidence presented above suggests that there is some controversy regarding which components of autobiographical memory are affected by emotion, the majority of both laboratory and autobiographical memory studies suggest that emotion has a selective influence on episodic details. Use of the Autobiographical Interview will help us to directly investigate this prediction, as well as to resolve whether certain episodic components are more affected than others. The data are unclear as to the presence or absence of these effects in older adults, but

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given the differential effects of ageing on episodic and semantic autobiographical memory, the separation of these components with the Autobiographical Interview may also help to resolve this question. There is extensive research documenting age-related changes in episodic memory, and preserved or even enhanced semantic memory (for review see Balota, Dolan, & Duchek, 2000; Craik & Grady, 2002; Craik & Jennings, 1992; Zacks, Hasher, & Li, 2000), as well as some studies showing this effect in autobiographical memory (Holland & Rabbit, 1990; Levine et al., 2002; Piolino et al, 2002). Thus, we predict that episodic components of emotional autobiographical memories should be attenuated in older adults compared to young adults. In contrast, older adults should recall a greater number of semantic components than young adults regardless of emotion.

METHOD

Participants

Participants were 16 young (ages 21–33 years; $M = 26.19$, $SD = 4.49$) and 16 older (ages 69–88 years; $M = 78.19$, $SD = 5.80$) healthy adults (8 male and 8 female in each age group), recruited from the Rotman Research Institute volunteer database and the University of Toronto. There was no difference in education between the groups—young adults: $M = 15.60$, $SD = 2.53$; older adults: $M = 14.00$, $SD = 2.89$; $t(28) = 1.62$, $p = .12$; education level is missing from one young and one older adult. All participants were screened for a history of neurological or psychiatric disease, substance abuse, and medical conditions or medication usage that affect cognitive functioning.

Design and procedure

In general, the procedure followed the Autobiographical Interview method described in Levine et al. (2002). Participants were asked to provide a detailed description of events that were personally experienced and that occurred at a specific time and place. For example, whereas identifying that one had played the piano as a child would not be sufficient, describing a specific recital at which one performed would constitute an appropriate event. Whereas in the previous study participants selected one event from each of five life periods, in this study participants selected two each of positive, negative, and neutral specific events that had occurred in the past 5 years, excluding the past 6 months (e.g., Comblain, D'Argembeau, & Van der Linden, 2005; see Appendix A for instructions). The order of the emotional cue was counterbalanced. Examples of positive, negative, and neutral events were provided. Participants selected the six events prior to the first recall (see Appendix B for a list of titles), and provided approximate dates of when the event occurred to ensure that instructions to recall events within the specific time period were followed.

In order to examine facilitative effects of retrieval support on memory, we manipulated the level of structure available to participants across two conditions: recall and general probe (the structured interview condition of specific probe was not administered). For recall, participants spoke about the event extemporaneously without any interruption from the examiner, continuing until it was evident that they had reached a natural ending point. After an event was recalled, general probes were used to clarify instructions and to encourage greater recall of details. General probes were administered according to instructions specified in the Autobiographical Interview Manual (available on request from B.L.). Participants who produced an event specific in time and place during free recall were asked if there were any more details. The remaining participants were reminded of the instructions to produce an event specific in time and place if they produced mainly factual or semantic information in free recall, asked to focus on a single event if they described multiple events during free recall, or given the opportunity to select another event if they produced a severely impoverished recollection during free recall. Once the event was established for these participants, there was additional request for more details. To ensure consistency of general probing across groups and memory types, the examiner (P.S.) was extensively trained on the administration of general probes by the developer of the Autobiographical Interview (B.L.).

Although general probing does not provide the same level of retrieval support as other interviews (e.g., MCQ; Johnson et al., 1988), or the specific probe phase of the original Autobiographical Interview (which was not administered in this study), this probing did augment the number of details recalled and affected the pattern of results.

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This contrasts with our earlier study, where there were few differences between free recall and general probe (Levine et al., 2002). This difference is accounted for by the relative recency of the memories in this study (the previous study covered lifespan autobiographical memory) and the emphasis on emotional memories. We therefore treated general probe separately from the free recall in this study.

Finally, the participants were asked to rate the memory on six items: visualisation of the event (1 = vaguely/not at all, 6 = extremely clear); change in emotional state at the time of the event (1 = no change, 6 = tremendous change); amount of emotion (−6 = negative, 0 = neutral, +6 = positive); personal importance at the time of the event and at the time of testing (1 = not important, 6 = very important); and the amount of rehearsal since the event took place (1 = never, 6 = more than once per week).

Protocol preparation and scoring

Following transcription, each memory was segmented into informational bits or details. A detail was defined as a unique occurrence, observation, or thought, generally expressed as a grammatical clause. Each detail was then classified according to the standardised Autobiographical Interview procedure outlined in Levine et al. (2002; see Table 1, and Figure 1 for scoring example). Details were defined as ''internal'' or episodic and assigned to one of five categories (event, place, time, perceptual, and emotion/thought) if they related directly to the main event described, were specific to time and place, were of limited duration (i.e., a few hours), and conveyed a sense of episodic re-experiencing. Otherwise, details were considered ''external'', and primarily consisted of semantic facts (factual information or extended events that did not require recollection of a specific time and place), as well as repetitions and other metacognitive statements or editorialising. Details pertaining to tangential or extraneous autobiographical events were also coded as external; thus the external detail category is composed of all information external to the main event, including semantic facts, extraneous events, and other statements.

Details were tallied for each category and summed to form internal and external composites, which were the main variables of interest in the present study. The internal/external dimension will be referred to as the *detail type* factor. Individual detail categories (event, perceptual, etc.) will be referred to as the *detail category* factor. Scoring was done separately for recall and general probe, but scores were analysed cumulatively, with general probe details added to details from recall, following participants' natural discursive tendency. This method of scoring precluded a direct statistical comparison of free recall and general probe, which were dealt with in separate analyses. Qualitative experimenter ratings for each category were also tallied (see Levine et al., 2002, for method), but these will not be reported, as findings from their analysis did not differ from the analysis of the detail scores.

TABLE 1
Autobiographical Interview Scoring Categories

Detail Type	*Detail Category*	*Description*
Internal	Event	Happenings, individuals present, weather, physical/emotional actions/reactions in others.
	Time	Year, season, month, day of week, time of day.
	Place	Localisation of an event including the city, street, building, room, part of room.
	Perceptual	Auditory, olfactory, tactile, taste, visual and visual details, body position, duration.
	Thought/ Emotion	Emotional state, thoughts, implications.
External	Semantic	General knowledge or facts, ongoing events, extended states of being.
	Repetition	Unsolicited repetition of details.
	Other	Meta-cognitive statements, editorialising.
	Extraneous Events	Tangential events to the main event recalled.

All memories were scored by P.S. following training, and assessment of inter-rater reliability was statistically evaluated against a standard set of 20 previously scored memories (Levine et al., 2002). Reliability coefficients were 0.87 or higher for all composite indices (as assessed by the intraclass correlation coefficient, two-way, random effects model; Shrout & Fleiss, 1979). For reference, the cut-off for ''excellent agreement beyond chance'' is 0.75 (Fleiss, 1981, p. 218).

Detail scores were averaged across the two memories in each condition (positive, negative, neutral). Mixed-design ANOVAs were conducted to determine the effect of age group and emotion

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on detail type, the main internal and external detail composite scores. Detail scores were further analysed according to detail category, the individual categories. The Greenhouse-Geisser correction was used to adjust for violations in the repeated measure assumptions for the latter analyses. Post hoc comparisons were made using the Bonferroni procedure. Participant ratings were analysed using the non-parametric Mann-Whitney test and the Wilcoxon-Sign test. An alpha level of .05 was used for all statistical tests. Although positive and negative memories were initially analysed separately, we found that these had similar enhancing effects on autobiographical recall, suggesting that valence was not an important factor for the variables of interest in this study. We therefore report analysis of positive and negative memories combined to create a single emotional memory score. The term ''emotional'' will be used henceforth to connote both positive and negative memories.

Ancillary analyses were conducted to assess potential confounding age effects for the types of positive, negative, and neutral events selected by young and older adults, and for the age of events selected. To assess differences in event types, all events were pooled and categorised according to the main event recalled (e.g., celebration, death/loss, etc.) per emotion condition. The proportion of events that young vs older adults selected from each positive, negative, and neutral category was then assessed by Fisher's Exact Test (Fisher, 1922). To assess the effect of event age, we analysed event dates provided by participants according to emotion condition and group using mixed-design ANOVA with follow-up comparisons corrected by the Bonferroni procedure.

RESULTS

Event type and age of event

There was substantial overlap in the types of events selected in each group. For positive events categories consisted of: celebrations (25% in both groups); new experiences (13% in both groups); accomplishment (16% young, 38% old); travel (6% young, 19% old); and family and friendship (19% young, 28% old). Negative events consisted of: death and loss (31% in both groups); illness and discomfort (22% young, 38% old); arguments (25% young, 22% old); accidents (16% young, 9% old); and exams (6% young). For neutral events, event categories consisted of: shopping (9% young, 13% old); physical activity (19% young, 16% old); leisure activity (34% young, 41% old); work and school (19% young, 9% old); social events (19% young, 9% old); and miscellaneous (e.g., car inspection, receiving a delivery, etc; 13% old). There was no difference between groups in the proportion of events allotted to positive ($p = .26$), negative ($p = .51$), or neutral categories ($p = .30$). These results suggest that young and older adults chose qualitatively similar positive, negative, and neutral events and validate the quantitative comparison below.

There was a significant effect of emotion on the age of the selected event, $F(2, 60) = 13.71$, $p < .0001$, but differences between positive, negative, and neutral events were minimal (i.e., 1 year or less). Follow-up tests indicated that negative events ($M = 2.71$, $SD = 1.10$) were older than positive events ($M = 1.94$, $SD = 0.87$), $t(31) = 3.33$, $p < .005$, and neutral events ($M = 1.63$, $SD = 0.81$), $t(31) = 5.56$, $p < .0001$. There was no difference in age between positive and neutral events, $t(31) = 1.38$, $p = .18$. There were no age group differences in the age of selected positive, negative, and neutral events, $F(2, 60) = 1.94$, $p = .15$, indicating that young and older adults chose events of equal remoteness.

Effects of age group on detail type and detail category

Across all memories, older adults recalled fewer internal details and more external details than young adults, replicating prior findings (Levine et al., 2002). The crossover interaction of age group and detail type (internal/external) was significant for both free recall, $F(1, 30) = 30.62$, $p < .001$, and general probe, $F(1, 30) = 59.38$, $p < .001$. Follow-up tests indicated that young adults produced more internal details for both free recall, $t(30) = 3.45$, $p < .001$, and general probe, $t(30) = 2.84$, $p = .004$, whereas older adults produced more external details for both free recall, $t(30) = 2.64$, $p = .006$, and general probe, $t(30) = 4.76$, $p < .001$. The main effect of age group was not significant, indicating that young and older participants generated protocols of similar lengths, $F(1, 30) = 1.54$, $p = .224$.

The detail type composite scores were further analysed by individual detail categories. For both free recall and general probe, group differences were evident across all internal detail categories,

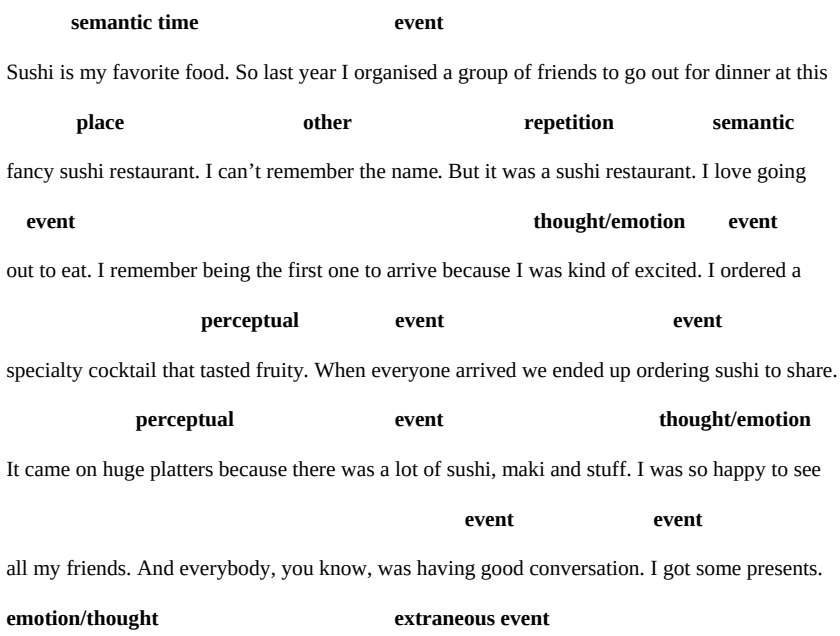

Figure 1. Scoring example using Autobiographical Memory Interview standardised coding. Event, time, place, perceptual, and thought/emotion are classified as the internal detail type. Semantic, repetition, other, and extraneous event are classified as the external detail type.

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with young adults producing more details than older adults (all ps $< .01$). Within external details, there was a significant effect for the semantic category, where older adults produced more details than young adults, ts(30) = 3.56 and 5.27, $p = .001$ and $p < .001$ for free recall and general probe, respectively (see also Levine et al., 2002). There were no other significant age effects for specific categories.

Effects of emotion on age group and detail type

As predicted, there was a significant three-way interaction between age group, detail type (internal, external), and emotion, $F(1, 30) = 5.15$, $p = .031$. Simple effects analyses of the interaction of age group by emotion were conducted for internal and external details, separately. There was a significant age group by memory type (emotional vs neutral) interaction for internal detail, $F(1, 60) = 9.87$, $p = .003$, but not for external detail. Follow-up analysis revealed a significant effect of age group for internal details of emotional memories, $F(1, 90) = 39.10$, $p < .001$, and neutral memories, $F(1, 90) = 4.57$, $p = .037$, which revealed that young adults' advantage for internal details was greater for emotional memories (young, $M = 29.25$, $SD = 14.25$; older, $M = 12.34$, $SD = 7.51$), than for neutral memories (young, $M = 15.66$, $SD = 8.98$; older, $M = 9.89$, $SD = 10.00$; see Figure 2). The emotion × detail type interaction was significant, $F(1, 30) = 4.38$, $p = .045$, with follow-up analysis indicating that emotion effects were specific to internal details, $t(31) = 4.10$, $p < .001$, although this effect is qualified by the age group difference reflected in the three-way interaction. The main effect for emotion, $F(1, 30) = 19.26$, $p < .001$, revealed that more details overall were recalled for emotional memories ($M = 33.74$, $SD = 16.46$) than for neutral memories ($M = 23.06$, $SD = 13.50$).

While the main effect of emotion continued to be significant at general probe, $F(1, 30) = 10.16$, $p = .003$, with more detail recalled for emotional memories, $t(31) = 3.22$, $p = .001$, the three-way interaction between age group, detail type, and emotion was not significant, $F(1, 30) = 0.74$, $p = .40$. There were no significant effects of emotion on detail type or age group, indicating that young adults recalled more internal details across emotional and neutral memories, whereas older adults recalled more external details (see Figure 2),

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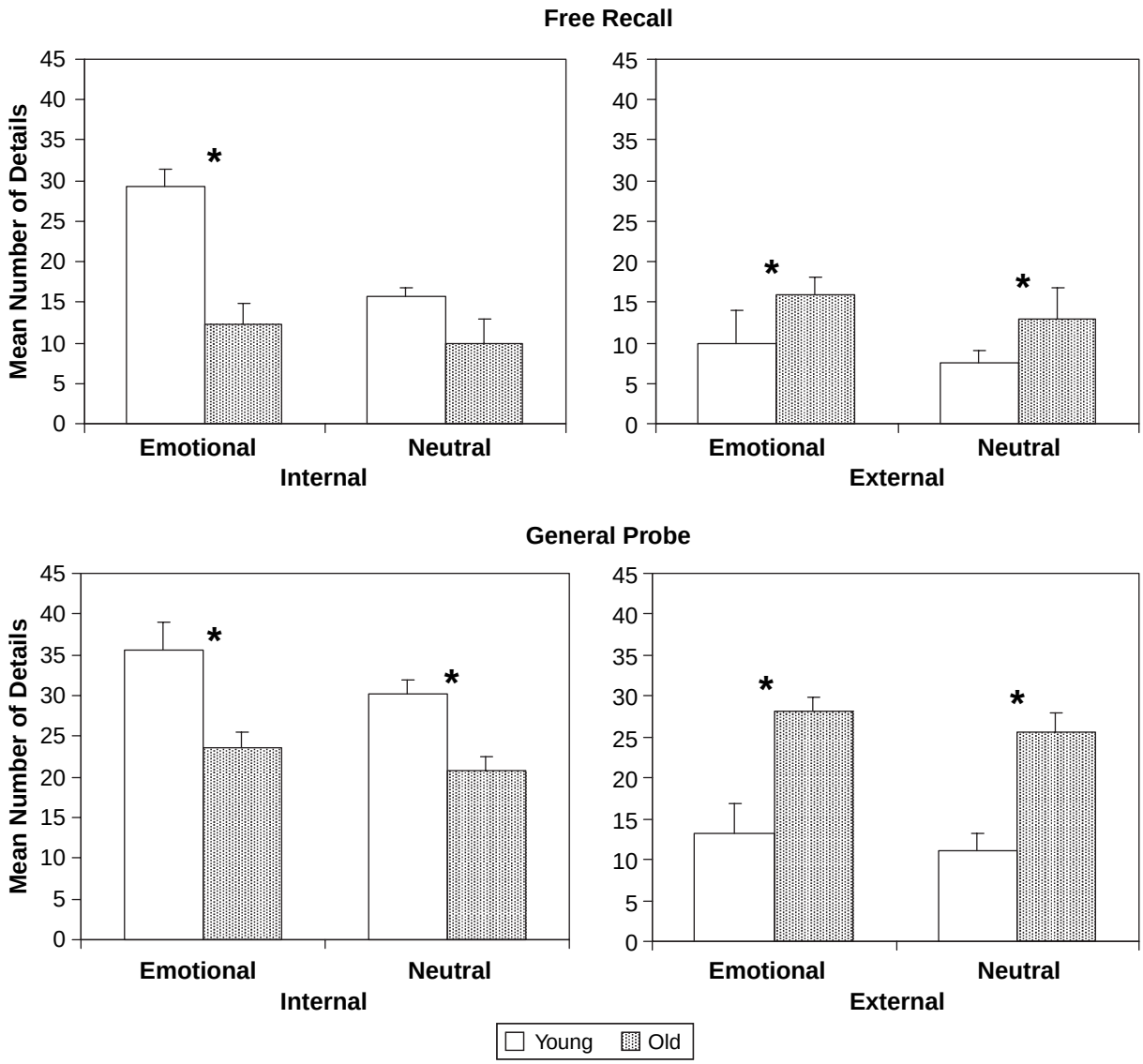

Figure 2. Mean number of internal details (left) and external details (right) for emotional and neutral memories during free recall (top) and general probe (bottom) by young and older adults. Error bars indicate standard error of the mean. Asterisk indicates a significant difference between young and older adults.

although analysis of detail categories qualifies this interpretation (see next section).

Effects of emotion on age group and detail category

As noted in the Method section, the Autobiographical Interview scoring system classifies details into the categories that are subordinate to the main internal/external distinction. There was a significant interaction between internal detail category and emotion at both free recall and general probe, Fs(1.55/1.51, 46.42/45.37) = 19.46 and 22.01, respectively ps < .001, such that emotional memories contained more event (i.e., happenings or unfolding of the story) and thought/emotion details—for event details, ts(31) = 4.71 and 5.15 for free recall and general probe, respectively, ps < .001; for thought/emotion details, ts(31) = 3.45 and 3.52 free recall and general probe, respectively, ps = .001. The significant three-way interaction for Internal Detail Category × Age Group × Emotion, Fs(1.55/1.51, 46.42/45.37) = 6.36 and 3.75, p = .01 and p = .05, for free recall and general probe, respectively, revealed that young adults were driving the effect of emotion on internal detail. Simple effects for

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the age group by emotion interaction at internal detail category was significant only for event details, Fs (1, 75/76) = 14.69 and 9.22, $p < .001$ and $p = .003$, and the effect of age group at event detail was significant for emotional memories, Fs (1, 117/116) = 35.02 and 15.36, ps < .001, with follow-up analyses showing that young adults recalled a greater number of event details for emotional memories, $t(30) = 3.37$ and 2.45, $p < .001$ and $p = .01$ for free recall and general probe, respectively (see Figure 3). There was no effect of emotion on the external detail category (e.g., semantic details, repetitions, etc.) at free recall or general probe.

Participant ratings

Overall, participants rated emotional memories higher than neutral ones for all rating categories (all ps < .05). Importantly, both young ($z = 3.33$, $p < .001$) and older adults ($z = 3.47$, $p < .005$) rated emotional memories as containing more emotion than neutral ones, suggesting that both groups were able to follow the instructions to retrieve emotional and neutral events. Young adults ($M = 4.16$, $SD = 1.15$) rated emotional memories as containing more emotion than did older adults ($M = 2.84$, $SD = 0.87$), $z = 3.25$, $p = .010$, whereas older adults ($M = 2.53$, $SD = 2.16$) rated neutral memories as containing more emotion than did young adults ($M = 1.16$, $SD = 1.15$), $z = 2.16$, $p = .015$. Older adults rated neutral memories higher for emotional change ($M = 3.84$, $SD = 1.55$) and importance at the time of the event ($M = 4.63$, $SD = 1.37$), zs = 2.71 and 2.44, $p = .003$ and $p = .007$, respectively, than did young adults (Ms = 2.34, 3.38; SDs = 1.36, 1.16 for emotional change and importance, respectively).

Because the groups differentially rated their memories, we re-analysed the data using these ratings as covariates. Only those effects no longer significant following inclusion of the covariate are reported. For free recall, statistical adjustment for ratings of emotion contained and emotional change in neutral events attenuated the Detail Type × Age Group × Emotion Interaction, Fs(1, 29) = 2.95 and 2.85, respectively, $ps = .10$. Adjustment for ratings of importance at the time of neutral events also diminished the three-way interaction, $F(1, 29) = 4.11$, $p = .052$. At general probe, the Categorical Internal Detail Type × Age Group × Emotion interaction was attenuated by ratings of emotion contained in emotional events, $F(1.51, 43.92) = 1.84$, $p = .178$.

Summary

Young and older adults selected qualitatively similar positive, negative, and neutral events that did not differ in age, validating the quantitative comparison. Results from Levine et al.

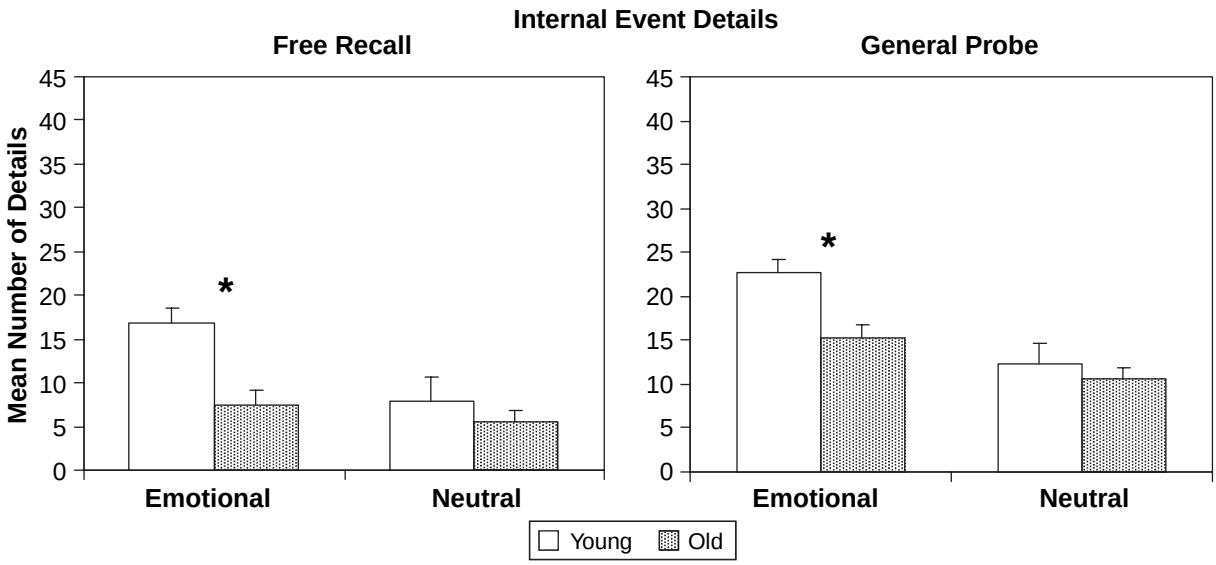

Figure 3. Mean number of details scored in the subcategory of internal event details (reflecting the happenings and unfolding of the story) for emotional and neutral memories in free recall and general probe by young and older adults. SE indicated by error bars. Asterisk indicates a significant difference between young and older adults.

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(2002) were replicated, such that young adults produced more internal details, whereas older adults produced a greater number of external details, especially semantic ones, although there were no significant group differences for overall number of details produced. Overall, emotional memories contained more internal details than neutral memories, but emotion also modulated the interaction of age group on detail type for internal details, such that age group differences were greatest for emotional memories, with young adults recalling more internal details for emotional memories than older adults during the free recall phase. While this interaction was not significant at general probe, detail category analyses revealed that young adults continued to recall more internal details for the subcategory event details in emotional memories than did older adults. Older adults continued to recall significantly more overall external details during the general probe phase than young adults. Young adults rated their emotional memories as containing more emotion than did older adults. Older adults rated their neutral memories as containing more emotion and inciting more emotional change than did young adults. The effect of age group on internal details for emotional memories fell short of significance following adjustment for these ratings.

DISCUSSION

The present study investigated age-related effects on emotional and neutral autobiographical memories using the Autobiographical Interview. Consistent with previous results using this measure (Levine et al., 2002), autobiographical recall in young adults was biased towards episodic (internal) details, whereas older adults tended to recall more semantic (external) details. For both groups, emotional (positive, negative) autobiographical events contained more details than neutral ones, as found in previous studies (see Comblain et al., 2005). The Autobiographical Interview allowed us to investigate the balance of these details across episodic and semantic categories. As predicted, the age effect for emotional memories was specific to episodic details. There was evidence of attenuation of this effect with retrieval support, although even with retrieval support the effect remained reliable for internal event details.

Emotion appeared to have a general enhancing effect on autobiographical memory. These results are consistent with evidence in young adults that emotional stimuli and events are better recalled (Bradley, Greenwald, Petry, & Lang, 1992; Cahill et al., 1996; Ochsner, 2000), and suggests that emotional memory enhancement might persist in ageing, even if it does not reduce age-related memory changes as a small number of studies have found (Comblain et al., 2004; Denburg et al., 2003; also see Yoder & Elias, 1987).

The emotional enhancement was specific to episodic details, such that a greater number of episodic details were recalled for emotional autobiographical events relative to neutral events in both young and old adults. Indeed, emotion modulates several elements contributing to the episodic quality of memory (see Talarico et al., 2004), such as conscious awareness of recollection (Dolcos, LaBar, & Cabeza, 2005; Ochsner, 2000), vividness (Reisberg, Heuer, McLean, & O'Shaugnessy, 1988) and central details (Christianson, 1992; Schooler & Eich, 2000; but see Schaefer & Philippot, 2005). In contrast, emotion did not enhance semantic components of autobiographical memory. These results suggest that emotional and neutral autobiographical memories do not differ in the amount of personal semantics that are conveyed to a listener about specific events (e.g., It was always hot when we went to the cottage; I've been married for 10 years, etc.), nor do they differ on the unsolicited inclusion of extended or repeated events. Detail category analysis revealed that the effects of emotion were specific to the episodic components of event details and emotion/thought details. That is, emotional memories contained greater detail regarding the unfolding of the story and the participant's mental state at the time of the event, but were no more specific than neutral events (also see Schaefer & Philippot, 2005). These findings support the validity of the Autobiographical Interview categories and might resolve discrepancies regarding which components of autobiographical memory are influenced by emotion.

Emotion did not eliminate age-related differences in autobiographical episodic memory. On the contrary, older adults' recall of episodic details for emotional events was significantly lower than that of young adults. These results are consistent with prior studies that found lower recall in older adults despite memory enhancement for emotional stimuli (Comblain et al., 2004; Denburg et al., 2003; also see Yoder & Elias, 1987). In contrast, evidence from the literature on ageing in flashbulb memory suggests that there

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are no age-related differences in recall for an emotionally salient memory (Davidson et al., 2006; Davidson & Glisky, 2002; Gerdy et al., 2004; Otani et al., 2005). One explanation for the discrepancy between our findings and those from the flashbulb memory literature is that the measures used in the flashbulb memory literature have high retrieval support, which attenuates age-related memory effects (Craik, 1983). It should also be noted that older adults' semantic details were elevated relative to young adults, and that this measure was not affected by the emotion manipulation. Previous findings of an attenuation of age-related effects may reflect the contribution of older adults' intact semantic processes. We would have reported a similar finding had we not separated episodic from semantic details. Additionally, we found evidence for a retrieval support effect at general probe, where the age effect for the composite score combining all categories of episodic (internal) details was not significant. When detail categories were examined individually, however, we found that the age effect persisted for event details. It appears that the additional support in the general probe phase assisted older adults in generating details related to time, place, and emotions/thoughts to a greater extent than recall of the unfolding of the story. Participants tend to produce fewer details for these categories as compared to event details (Levine et al., 2002), limiting their sensitivity to age effects.

We found that age-related differences in recall of episodic details were attenuated for neutral autobiographical memories. In contrast, a substantial body of research in which emotion was not considered suggests age-related reductions in memory (for review see Craik & Jennings, 1992; Zacks et al., 2000). Similarly, when we collapsed across emotional and neutral autobiographical memories we found age-related reductions in recall of episodic detail (also see Levine et al., 2002). Other studies of autobiographical memory have been inconsistent in this respect, with some finding age-related deficits for neutral stimuli and events (e.g., Davidson et al., in press; Davidson & Glisky, 2002) and others not (Comblain et al., 2004), possibly due to methodological differences (e.g., retrieval task).

Several explanations might account for older and young adults' greater similarity for neutral, but not emotional, autobiographical memories. Emotional events contained a greater number of details overall, consistent with prior research to this effect (Comblain et al., 2005). The effect of emotion on detail was specific to episodic qualities of autobiographical memory, while the recall of semantic information was consistent across both emotional and neutral events. Emotional autobiographical memory might be more sensitive to age differences because emotional events emphasise episodic rather than semantic aspects of memory recall, in which age effects are robust (e.g., Levine et al., 2002; Piolino et al., 2002), whereas neutral autobiographical memories contained fewer numbers of overall details in which to vary.

Alternatively, the effects could be explained by group differences in the selected events' emotional arousal or intensity, which may affect memory at long retention intervals (Burke, Heuer, & Reisberg, 1992; Schooler & Eich, 2000). Older adults rated neutral memories as containing more emotion, causing greater emotional change at the time of the event, and as more important than did young adults, possibly increasing their recall of episodic detail relative to young adults (Cohen & Faulkner, 1988) and reducing age differences in turn. Young adults rated their emotional memories as containing more emotion than older adults, possibly enhancing age differences. Indeed, interactions between age group, detail type, and emotion were no longer significant following statistical adjustment for some of these ratings. Therefore, differences in selection criteria for events cannot be ruled out as contributing to the results. However, while participants' ratings are suggestive, we note that the participants were not trained on how to make ratings, and that the ratings were not subjected to reliability and validity analyses. It is unknown if young and older participants applied similar criteria in making their ratings. Analyses incorporating these ratings should therefore be interpreted with caution.

Differences in selection criteria for neutral memories might also reflect age-related differences in cognitive processing. Autobiographical memories are organised within a hierarchical structure, with lower-level elements (i.e. episodic details) more difficult to retrieve than higher level of elements (i.e., semantic knowledge; Conway & Pleydell-Pearce, 2000; see also Cohen, 2000). Neutral autobiographical events are more semanticised, containing fewer episodic details accessible to retrieval, and may be more susceptible to age-related losses in "resolving power" or the retrieval of lower level elements (Craik & Grady, 2002). Older adults might have compensated for

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age-related cognitive processing deficits affecting their ability to retrieve truly neutral events by interpreting the task instructions to select events associated with ''less emotion'' rather than the ''no emotion'' instruction, as reflected by the greater amount of emotion contained in older adults' neutral memories compared to young adults'. However, both age groups recalled a greater amount of emotion for emotional memories compared to neutral ones, suggesting that each group was able to follow the instructions to recall emotional and neutral memories.

We did not find age-related differences in recall of autobiographical memories when emotional valence (i.e., positive, negative) was considered, as found by some studies of laboratory memory (Charles et al., 2003; for an exception see Kensinger et al., 2002). For example, Cartensen's Socioemotional Selectivity Theory (1993) suggests that perspectives of limited time, which occur with normal ageing, lead to a shift in emotional goals emphasising social interactions and better emotional regulation, which increases motivational biases for positive emotional experiences (Carstensen, Fung, & Charles, 2003), and better memory for positive stimuli (e.g., faces, Mather & Carstensen, 2003; images, Charles et al., 2003). However, longer delays between initial encoding and retrieval, as in autobiographical memory, might not reflect these age-related attentional biases for emotional valence (e.g., Denburg et al., 2003; also see Yoder & Elias, 1987). Moreover, the positive shift may be more pertinent to participants' motivation and interpretation of events rather than the quantity of episodic information recalled, as assessed by the Autobiographical Interview. For example, Comblain et al. (2005) found that older adults associated a higher degree of positive feelings to negative events as compared to young adults. This is consistent with Kennedy et al. (2004), who found that older adults are more likely to distort autobiographical memory in the positive direction.

CONCLUSION

To our knowledge, this is the first study to directly examine age effects on the content of episodic and semantic components of emotional and neutral autobiographical memories while manipulating retrieval support. Our results are consistent with other laboratory and autobiographical memory studies, which have found that young adults recall a greater number of episodic components, whereas older adults recall more semantic components. Importantly, the present study suggests that emotion modulates the age effect on episodic components, but not for semantic components. The age effect on episodic components was attenuated for certain episodic components of autobiographical memory (i.e., time, place), but not for other ones (e.g., event details), emphasising the importance of examining the content of autobiographical memories in addition to the properties of these memories.

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APPENDIX A

I am going to ask you to tell me about six events that occurred greater than 6 months ago and less than 5 years ago. The events must be ones in which you were personally involved, and you must have a recollection of being personally involved. Do not pick events that you heard about from others. They must be events from a

specific time and place. For example, describing a 3-week vacation would not be sufficient. However, a specific incident that happened on one day during your vacation would be good. I want you to provide as much detail as you can about the event.

I am going to ask you to tell me about two positive events, two negative events, and two neutral events. For example, winning a reward or a celebration are positive events associated with happy emotions. Negative events, such as an argument or an illness, are associated with unhappy emotions. Neutral events, such as going for a walk or making a purchase, are associated with less emotion, or they are not associated with any emotion at all.

You can choose any positive, negative, and neutral events you wish. I will ask you to describe the events, then I will ask you some questions about them. To help with scoring, we will be audiotaping your responses. Otherwise, your responses will be kept completely confidential and your tape will be assigned a subject number and stored in a secure place.

Our interest is not so much in which events you choose, but rather how you describe them. So do not feel pressured to pick any particular event. I want you to know that I will be asking you to give some details for these events later, so be sure to only choose events that you feel comfortable discussing in detail.

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APPENDIX B

Event titles

Young Adults

POSITIVE	NEGATIVE	NEUTRAL
Call to the Bar	Grandmother's death	Interviewing a client
Graduation day	Security Guard Incident	Studying for an exam
Graduation day	Incident at school	Art Show
Honeymoon in Costa Rica	Loss of office contract	Meeting a new friend
Valedictorian speech	Car accident	Studying for a final
Chicago marathon	Shoulder injury	Gift opening
Starting university	Leg fracture	Feeding ducks
Meeting new girlfriend	Losing personal items	Moving
Best exam	Broken sailboat	Midnights walk
Scuba diving	Death of cat	Painting apartment
Best man at wedding	Missing a flight	Finding chocolate milk
Last day of work	Failing a G1 exam	Moving
Parachuting	Cold winter night outside	Watching the night sky
New Year's Eve Party	Sudden death of a friend	First day of classes
Marriage	Car stalling in rainstorm	Reading a book
Admission to college	Break-up	Buying souvenirs
Birthday celebration	Bombing in New York	Purchasing a wardrobe
Plane trip	Turned down a job	Watching a movie
Dance party	Betrayal of trust	Shopping for a dress
Promotion	Bad day at work	St. Patrick's day
Visiting cousins	Eye surgery	Drive to Kingston
Celebration	Getting robbed	Valedictorian speech
Going away party	Organic chemistry exam	Jazz concert
Birth of nephew	Broken toe	Golf tournament
New Year's in Scotland	Broken collarbone	Sitting in nature
Meeting new boyfriend	September 11th	First day jogging
Finding money	Being locked out	Helping a neighbor
Getting a job	Death of kittens	Day at work
Party	Feeling sick	Cooking
Get-together	Confrontation with parents	Lunch in the dining hall
Nephew's birth	Confession to parents	Driving trip
Admission to a program	Argument with mom	Volunteer day

APPENDIX (*Continued*)

Older Adults

POSITIVE	NEGATIVE	NEUTRAL
Visit of Nephew	Death of brother-in-law	Son's new home
Vacation to Vancouver	Argument with daughter	Boat ride
Move to new place	Money difficulties	Walk to store
Birth of great grandson	Death of wife	Moving
80th Birthday	Gallbladder operation	Attending a play
Participation in a study	Car accident	Cancelled procedure
Vacation in Las Vegas	Broken collarbone	Watching the election
Granddaughter's article	Hospitalization of sister	Planning a project
Daughter's birthday party	Death of husband	Repairs to bathroom
Holiday cruise	Wife's heart surgery	Art Project
Christmas party	Ignored by husband	Picnic
Special lunch	Confrontation	Visit to grave in Romania
Bar Mitzvah	Death of brother	Watching parade
Ferry ride in Greece	Husband's illness	Walk with husband
World youth day	Loss of 2 friends	Skiing
Citizenship award	Revisited old family home	Waiting for a flight
Trip to British Columbia	Illness	Shopping for a new TV
Seeing Mama Mia	Driveway wrecked	Discussion with neighbor
Neighbor's help	Illness with shingles	Received flowers
Birth of great grandson	Overcharged	Lawn bowling
Visit from daughter	Death of a friend	Train ride
Boat ride	Accident with a patient	Car inspection
60th wedding anniversary	Illness	Traded car
Daughter's new house	Losing money	Engineer exhibition
Birthday party	Death of sister	Small amount won
Bar Mitzvah	Bombing in Israel	Visit to cottage
Visit to Niagara	Argument with sister	Euchre game
Falls Best day at work	Anti-Semitic incident	Discussion with sister
Grandchildren's visit	Wife's illness	Trip to Vancouver
Important decision	Illness with diabetes	Buying a pair of shoes
Aunt's 80th birthday party	Problem with heart	Retiring
Slot machine win	Illness	First piano lesson

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