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Michael Jackson, Bin Laden and I: Functions of positive and negative, public and private flashbulb memories

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This study examined the perceived psychosocial functions of flashbulb memories: It compared positive and negative public flashbulb memories (positive: Bin Laden's death, negative: Michael Jackson's death) with private ones (positive: pregnancy, negative: death of a loved one). A sample of $n = 389$ young and $n = 176$ middle-aged adults answered canonical category questions used to identify flashbulb memories and rated the personal significance, the psychological temporal distance, and the functions of each memory (i.e., self-continuity, social-bonding, directive functions). Hierarchical regressions showed that, in general, private memories were rated more functional than public memories. Positive and negative private memories were comparable in self-continuity and directionality, but the positive private memory more strongly served social functions. In line with the positivity bias in autobiographical memory, positive flashbulb memories felt psychologically closer than negative ones. Finally, middle-aged adults rated their memories as less functional regarding self-continuity and social-bonding than young adults. Results are discussed regarding the tripartite model of autobiographical memory functions.

Keywords: Flashbulb memory; Private flashbulb memories; Positive flashbulb memories; Functions; Age effects.

Flashbulb memories are detailed and vivid recollections of the circumstances in which one first learned of a surprising, important and emotionally intense event (Brown & Kulik, 1977). They are composed of seemingly insignificant but vivid details about the situation in which the news was received (e.g., details such as the exact time of hearing the news, the exact location or the activities one was doing at the time; Luminet & Curci, 2009). Such situational details are generally not vividly recalled for emotional events personally experienced by the rememberer (Christianson & Loftus, 1991), and they are forgotten for regular events (Brewer, 1988). This distinctive feature of flashbulb memories has led to extensive research on whether flashbulb memories

are qualitatively different from other types of autobiographical memory (Lanciano & Curci, 2012; Winograd & Neisser, 1992), and on the conditions that lead to the formation of a flashbulb memory. However, there is a dearth of research on the potential *functions* of flashbulb memories. Thus, the main goal of the current study is to explore people's beliefs about the possible functions of their flashbulb memories. Moreover, taking a lifespan developmental approach to the study of autobiographical memory (e.g., Habermas & Bluck, 2000), the current study compares young and middle-aged adults to examine age-related effects in the self-reported functions of flashbulb memories.

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Although flashbulb memories can be formed for vivid or significant autobiographical experiences, the literature has focused primarily on memory for *public* events (Rubin & Kozin, 1984), neglecting private flashbulb memories (e.g., hearing the news of a college acceptance). Moreover, most studies on flashbulb memories have focused on *negative* news events (e.g., 9/11 attacks), neglecting positive events. In order to disentangle the dimensions of valence and privacy, the current study uses a balanced design comparing the functions of positive and negative, private and public flashbulb memories.

Functional approach to autobiographical memory

The functional approach to autobiographical memory (e.g., Pillemer, 2003) centres on the question *why* people remember something over long periods of time (Bluck, Alea & Demiray, 2010). Various researchers have argued that memories are not remembered without reason, but remembered in particular contexts at particular times when needed (Bluck, 2003; Webster, 2003). The three major psychosocial functions of autobiographical remembering are (1) maintaining a sense of self-continuity, (2) social bonding and (3) directing current and future behaviours (Bluck, Alea, Habermas, & Rubin, 2005; Hyman & Faries, 1992). The *self-continuity* function involves reminiscing about personal events to establish and maintain a sense of identity over time (Bluck et al., 2005). The *social-bonding* function refers to using memories for forming and maintaining social bonds, establishing intimacy with significant others and transmitting information to others (Bluck & Alea, 2009). Finally, the *directive* function involves recalling past experiences to handle current situations and problems or to prepare for future actions (Pillemer, 2003). Although there has been much theorising about this tripartite model of functions of autobiographical memory, there is surprisingly little empirical work (e.g., Kuwabara & Pillemer, 2010).

Different to general autobiographical memories, as of yet there exists no comprehensive examination of what functions flashbulb memories might serve (Pillemer, 2009). Researchers have posited an evolutionary adaptive function of autobiographical memories in general, and flashbulb memories in particular: Recording the personal details of an event that directly happens to us (when, where, why

and how an event happens to us) has an obvious function such as directing our behaviours in similar situations in the future. In contrast, recording the details when *hearing* about an event that happened to *someone else* (i.e., flashbulb memory) seems to have no obvious function. Thus, researchers have argued that flashbulb memories may reflect the automatic usage of such an evolutionary device (which normally records personal details of personal events) that records personal details of hearing about others' events as a by-product (Brown & Kulik, 1977; Conway, 1995; Pillemer, 1984, 2003). However, flashbulb memories might also fulfil social functions, such as providing a topic for conversation, maintaining intimacy and teaching-informing others (Neisser, 1982; Talarico & Moore, 2012; Webster & McCall, 1999; Winograd & Neisser, 1992). Indeed, Rasmussen and Berntsen (2009) have shown that public flashbulb memories have a higher social than self-continuity and directive function. Unfortunately, this innovative study had the shortcomings of allowing participants to personally select their public flashbulb memories, not measuring or controlling for the emotional valence of memories, and measuring functions using single items.

Bohn and Berntsen (2007) have associated positive-valenced flashbulb memories with the pleasantness bias in memory (e.g., Matlin & Stang, 1978) and showed that, compared to negative flashbulb memories, positive flashbulb memories were higher in vividness, sense of reliving and clarity (Berliner, Hyman, Thomas & Fitzgerald, 2003), emotional intensity (Walker, Skowronski, & Thompson, 2003), rehearsal (Baker-Ward, Eaton, & Banks, 2005) and centrality to one's life story, but low in memory accuracy. We explored this pleasantness bias from a different perspective and examined the psychological temporal distance of flashbulb memories (temporal self-appraisal theory; Wilson & Ross, 2001). One way people may experience the pleasantness bias in memory is by feeling psychologically close to positive memories ("feels like yesterday") and distant from negative memories. In fact, when people are asked to rate the temporal distance between their autobiographical memories and the present, they tend to recall past positive experiences and achievements as subjectively closer than past negative experiences and losses (e.g., Demiray & Janssen, 2014). We expect that people may also place their positive flashbulb memories more closely to the present and

negative flashbulb memories more distantly into the past.

Public versus private flashbulb memories

Comparisons of memories for public versus private events are rare, unsystematic and led to mixed findings (e.g., Gibbons, Vogl, Kiefer, Thompson, & Walker, 2008). A growing number of flashbulb memory studies use self-selected, salient personal memories as control memories (Berntsen & Thomsen, 2005). These controls, however, are not appropriate, as they do not involve the context of hearing personal news, which is critical to flashbulb memories. To our knowledge, there are only three studies that compared public flashbulb memories with memories of personal circumstances of hearing private news. In their classic study, Brown and Kulik (1977) compared the memory of a personal negative shock (e.g., serious accident) with nine negative, public flashbulb memories. The limitation of this study was that the personal shock was different for each participant. Kvavilashvili, Mirani, Schlagman, Erskine, and Kornbrot. (2010) compared memories of receiving the news of 9/11 with memories of receiving staged private news (i.e., a mundane staged event of receiving a phone call from the experimenter to learn that they have not won a small prize). One shortcoming of this study is its lack of ecological validity (i.e., the private event is a staged control event that is not self-chosen by the participant). More importantly, although the private memory is about receiving news, it does not fit with most of the main criteria for flashbulb memories (e.g., it is low in unexpectedness, importance, emotionality, rehearsal; Brown & Kulik, 1977) and does not match with the intensely negative nature and high personal and national significance of the public event. In another study on memories of 9/11 (Denver, Lane, & Cherry, 2010), participants recalled self-selected flashbulb memories from the remote reminiscence bump period (i.e., heightened number of memories recalled from ages 10–30 years; Demiray, Gülgöz, & Bluck, 2009). Participants were free to recall any flashbulb memory (public or private), preventing a controlled comparison between 9/11 and a valence-matched private event.

A proper comparison of a public with a private flashbulb memory should involve a private event that (1) fits with the main criteria for being a

flashbulb memory (i.e., should be about hearing some private news, should be important, consequential, emotional, etc.), (2) matches with the public event in terms of emotional valence and intensity and (3) is the same for all participants. To our knowledge, the present study is the first to compare such private with public flashbulb memories.

Positive versus negative flashbulb memories

Most flashbulb memory studies have focused on memories of negative events, as Brown and Kulik (1977) have defined flashbulb memories as “memories for highly surprising and consequential news events” and such events tend to be negative (Berntsen, 2002; Tromp, Koss, Figueredo, & Tharan, 1995). We could find only four studies including both positive and negative flashbulb memories. Scott and Ponsoda (1996) asked participants to recall 10 positive and 10 negative public events matched for vividness and year of occurrence, but not for emotional intensity. Tekcan (2001) compared flashbulb memories for a negative public event and a positive private event, thereby confounding the two dimensions of valence and privacy. Finally, Berntsen and Thomsen (2005) compared positive and negative public flashbulb memories, but did not include any private flashbulb memories. One limitation of these three studies is that a certain emotional valence was assigned to each public event, which may or may not have been shared by all participants. Note that Tekcan classified the Gulf War as a negative event, but Scott and Ponsoda classified it as a positive event. Thus, it is imperative to collect participants’ ratings of the valence they attach to the events. Accordingly, Bohn and Berntsen (2007) examined the same flashbulb event (i.e., fall of the Berlin Wall) that was perceived as emotionally positive or negative by different groups of German participants. This feature of the design, however, prevented a comparison of the same individuals’ perceptions of positive versus negative flashbulb memories. In order to overcome these shortcomings, the current study examines four flashbulb memories in a balanced design crossing valence and privacy of the event. This design allows to us investigate whether the emotional valence of events has a

different role on the functions of private versus public flashbulb memories.

Age-related differences

From a lifespan developmental perspective, the functions of autobiographical memories should vary depending on phase in the lifespan (Bluck et al., 2010). There is limited empirical work on age-related effects in the functions of autobiographical memory in general (Alea & Bluck, 2007; Bluck & Alea, 2008, 2009) and no studies on age effects in the functions of flashbulb memories in particular. The few existing studies on the phenomenological qualities of flashbulb memories and ageing have resulted in mixed findings. Some studies have shown reliable age-related effects in the vividness or specificity of the recalled details (e.g., Denver et al., 2010; Kensinger, Krendl, & Corkin, 2006), whereas other studies have found no age differences (e.g., Conway, Skitka, Hemmerich, & Kershaw, 2009; Davidson, Cook, & Glisky, 2006; Kvavilashvili et al., 2010). The current study explores age-related effects in beliefs about the functions of public versus private flashbulb memories (positive and negative) by comparing young and middle-aged adults, an age group as of yet understudied (Staudinger & Bluck, 2001).

Specific aims of the present study

This study is the first to investigate people's beliefs about the functions of their flashbulb memories, which vary systematically in valence and privacy. The news of one's own or a loved one's pregnancy and the news of sickness or death of a loved one served as the two private flashbulb memories, and the news of Osama bin Laden's death and Michael Jackson's death as the two public flashbulb memories. The first aim of this study was to compare all four flashbulb memories in terms of the functions of self-continuity, social bonding, providing direction and their psychological temporal distance. We expected that, due to their personal relevance and significance, private compared to public flashbulb memories are rated as more functional regarding self-continuity, social bonding and directionality. In line with the pleasantness bias, we expected people to feel psychologically closer to positive flashbulb memories than negative ones (independent of their private vs. public status).

The second aim of the study was to examine the relation of subjective (i.e., perceived) memory qualities widely studied in the flashbulb memory literature (i.e., vividness, importance, consequentiality, emotional intensity, rehearsal) and objective recall of memories to the functions of these memories. In line with previous research (e.g., Rasmussen & Berntsen, 2009), we expected flashbulb memories that are rated higher in memory qualities to be perceived as more functional and psychologically closer (Demiray & Janssen, 2014). Regarding objective recall, we compared *strong* flashbulb memories that included a higher number of recalled canonical categories characterising flashbulb memories (i.e., source of information, location, time and activity when learning of the news) with *weaker* flashbulb memories that included fewer canonical categories. We predicted strong flashbulb memories with better recall of canonical categories to serve higher functions and to feel psychologically closer than weaker flashbulb memories.

Finally, taking a lifespan developmental approach to autobiographical memory, the third study aim was to examine the relation between participants' age and their beliefs about the functions of their flashbulb memories. Given that young adulthood is a phase involving many transitions and changes (e.g., starting one's career, founding a family) that challenge self-continuity as well as existing social networks, young adults should be more likely to use their autobiographical memories in order to achieve self-continuity, social bonding and directionality than middle-aged adults (e.g., Bluck & Alea, 2008). We also explored age-related differences in the psychological distance of flashbulb memories.

METHODS

Participants

Participants were recruited via Amazon's Mechanical Turk (MTurk). A total of 912 so-called workers accessed and opened the online survey (www.soscsurvey.de). Among those, 285 (31%) left the survey after reading the study description, and 627 (69%) completed the survey. To ensure data quality, 62 participants who did not follow instructions (e.g., providing job-related negative news rather than death/sickness related negative news), and those who did not complete the items properly (e.g., gave the same response to all survey items) were excluded. The final sample consisted of

TABLE 1
Demographic composition of the sample by age group ($N = 565$)

	Young ($N = 389$)	Middle-aged ($N = 176$)
Sex	220 men, 169 women	56 men, 120 women
Age	18–39 years $M = 25.20$ ($SD = 5.20$)	40–68 years $M = 50.79$ ($SD = 7.57$)
<i>Race</i>		
Caucasian (%)	79	87
Hispanic (%)	7	3
African-American (%)	4	5
Asian-American (%)	7	4
Other (%)	3	1
<i>Education</i>		
Graduate (%)	8	18
Undergraduate (%)	28	29
Associate's (%)	14	20
High school (%)	47	27
Other (%)	3	4
<i>Employment</i>		
Full-time (%)	37	48
Part-time (%)	29	18
Unemployed (%)	34	10
Retired (%)	0	24
<i>Income</i>		
Not reported (%)	22	11
Up to \$60K (%)	56	57
\$60K–\$180K (%)	8	15
Above \$180K (%)	14	17

Fifty percent of young adults and 5% of middle-aged adults are students.

$N = 565$ participants. The sample was divided into two age groups of $n = 389$ young (18–39 years) and $n = 176$ middle-aged adults (40–68 years). Demographic composition of the sample by age groups is presented in Table 1. All participants were US residents.¹ The sample reported on a 7-point scale that they were in good overall health ($M = 5.33$, $SD = 1.13$) and satisfied with their lives ($M = 5.12$, $SD = 1.32$), with no significant differences between the two age groups, $F(1, 563) = 1.55$ and 0.80

($p > .05$) for subjective health and life satisfaction, respectively.

Procedure

Pilot studies for the selection of flashbulb memories. Luminet and Curci (2009) identified the following criteria as necessary for flashbulb memories: reaction of surprise, importance or consequentiality of the event, intensity of emotional feelings and high amount of rehearsal. Two pilot studies were conducted to identify two private and two public flashbulb memories (one positive and one negative) that carry these qualities and are common in the USA.

Pilot study 1. A first pilot study with $N = 54$ American adults (aged 19–66 years; 68.5% women) recruited via MTurk was conducted in order to find out which recent news events created flashbulb memories in American adults. The 15-minute online survey consisted of four public events. Two events were from the recent past and assumed to be negative and meaningful for most Americans: Michael Jackson's death (25 June 2009) and the earthquake/tsunami disaster in Japan

¹The gender distribution of the current sample is balanced, which is an advantage over previous research that indicates an abundance of female participants in MTurk studies (e.g., Buhrmester, Kwang, & Gosling, 2011), as well as standard internet studies (Gosling, Vazire, Srivastava, & John, 2004). The current age distribution is similar to previous American MTurk samples (e.g., mean age = 36.0 in Paolacci, Chandler, & Ipeirotis, 2010; mean age = 32.8 in Buhrmester, et al., 2011). The education level of the current sample is high (56% with a degree higher than high school), in line with previous research showing that American MTurk workers' education level is higher than the general US population (Paolacci et al., 2010). The income distribution is also consistent with previous research showing that 67% of the US-based MTurk workers earn below \$60K per year, which is slightly lower than the general US population, but it tends to be closer than college samples to the general population (Paolacci et al., 2010).

(11 March 2011). In order to stay within approximately the same time frame, two events assumed to be positive were selected that occurred in 2011, namely Osama Bin Laden's death (2 May) and Kim Jong Il's death (17 December). Note that all events were related to deaths, which helped us to keep the event as constant across the valence dimension. Participants answered questions related to four canonical categories used to classify memories as flashbulb memory: source of information, location, time and activity when learning of the news. They also rated each event in terms of unexpectedness (i.e., surprise), importance, emotional valence, emotional intensity and amount of rehearsal on a 5-point scale. Results showed that Kim Jong Il's death received the highest number of "I don't remember" responses to the canonical category questions (29% for Kim Jong Il vs. 13% for Osama bin Laden), and the lowest ratings in surprise ($M = 1.94$), amount of rehearsal ($M = 1.19$) and emotional intensity ($M = 1.79$), t ranges between 2.55 and 7.63, $p < .05$, and was not perceived as a highly positive event ($M = 3.31$). Therefore, we decided to use Osama Bin Laden's death as the positive public event, which was perceived as the most positive ($M = 4.08$), important ($M = 3.78$) and surprising ($M = 3.73$) event; t ranged between 7.54 and 13.18, $p < .05$. As for the negative event, Michael Jackson's death was more appropriate, as it matches with the positive event in that it is about a specific person's death, and closely related to and relevant for Americans (rather than the earthquake/tsunami in Japan). Furthermore, participants gave fewer "I don't remember" responses to the canonical category questions about Michael Jackson's death compared to the earthquake (i.e., 15% for Michael Jackson vs. 22% for the earthquake).

Pilot study 2. A second pilot study was conducted with $N = 49$ American adults (aged 19–65 years; 69% women) in order to find out which good and bad news are most common in Americans' private lives. An 8-minute online survey was prepared and published on MTurk. We asked participants to recall an occasion when they received very unexpected negative news related to their own lives, and another occasion when they received very unexpected positive news. Participants were free to recall any type of memory and narrate them as detailed as they wished. Next, they completed the same canonical category questions and memory ratings administered in the first pilot study. The first author read all positive and negative news narratives for content coding. Results showed that

hearing about the death of a loved one was the most frequently reported bad news (36%), and "illness or accident of a loved one" was the second most frequent (32%). Thus, we combined the two categories and decided to use them as the negative private event. The most frequently reported happy news was hearing about one's own or a loved one's pregnancy (26%), and the second most frequent category was the "other" category, which included a diverse range of events (e.g., surprise visit from a relative). Therefore, we decided to use the former category as the positive private event. Analyses of variance on the memory ratings showed that positive and negative news memories did not differ in terms of their level of unexpectedness, importance or rehearsal; F ranged between 0.04 and 2.25, $p > .05$. One significant difference was that the negative news memories were emotionally more intense ($M = 4.64$, $SD = .62$) than the positive news memories ($M = 4.31$, $SD = 0.81$), $F(1, 41) = 6.16$, $p = .02$. The two events did not differ in terms of the canonical category questions.

In sum, the two private flashbulb memories are proper comparison memories for the two public flashbulb memories as they fit with the main criteria for flashbulb memories and match the public events in terms of emotional valence and intensity, and are the same for all participants.

Main study. We posted a task on MTurk that required participants to complete an externally hosted survey (www.sosicurvey.de) in exchange for \$0.25. The task was visible only to MTurk workers with an approval rate greater than 95% and who were residents in the US. Participants began by reading the detailed study description and the informed consent form. Next, they reported four flashbulb memories and answered four open-ended canonical category questions about each memory. They then rated the psychological temporal distance of each memory, their qualities (e.g., vividness) and the three functions of each memory (Thinking about Life Experiences Questionnaire; Bluck & Alea, 2011). Once a memory had been recalled and rated, the same procedure was followed for the second, third and fourth memory (counterbalanced; see description of memory task below). To ensure that participants actually read all of the items, four foil items were embedded in the survey (e.g., Please choose "Strongly agree" to this item for technical purposes). Thirty-two participants who incorrectly answered two or more foils were excluded from the study. The survey took about 15 minutes.

For the flashbulb memory task, participants were told that this was not a performance test, and that we were only interested in what people do and do not remember about these events. For the two public events, instructions were as follows:

Do you remember the personal circumstances in which you first heard the news of Michael Jackson's (Osama Bin Laden's) death? Please think for a minute, and try to bring to your mind the instance when you found out about his death.

For the negative private event, instructions read:

People receive both happy and sad news in their personal lives. Now, we would like you to focus on negative and upsetting news: Please think of a time when you found out that someone you love (e.g., partner, family member, friend) passed away, or was in danger due to a serious illness or accident.

Finally, instructions for the positive private event were:

Now, we would like you to focus on the happy news of pregnancy. If you have given birth: Do you remember the personal circumstances in which you first heard the news that you were pregnant for the first time? If you have never given birth: Please think of a time when you found out that someone you love (e.g., partner, family member, friend) was pregnant for the first time.

These four memories were counterbalanced using a balanced Latin Square design, which reduces the risk of carryover effects (Williams, 1949).²

Measures

Canonical category questions. We focused on the few categories that have been accepted as the major attributes in ascertaining the existence of flashbulb memories (e.g., Hornstein, Brown & Mulligan, 2003) and modelled four questions after questionnaires used in the literature (Conway et al., 1994; Hirst, et al., 2009): (1) How did you first learn about this

news? (i.e., source of information) (2) Where were you? (3) What were you doing? (4) When did you hear about it? Participants were asked to answer these questions by writing a few words in the appropriate textboxes. They were encouraged to write "I don't remember", if this was the case for any particular question.

A coding scheme similar to the ones in the literature (e.g., Kvavilashvili et al., 2010) was used to create a "recall score" for each event. All answers were read and assigned a score of 1 or 0 indicating recall or no-recall for each specific question resulting in a total recall score out of 4. "I don't remember" responses and responses including remarks such as "I'm not sure", "I guess", "Probably" were scored as 0. A second independent coder coded answers to a random sample of 100 memories from each flashbulb memory category (i.e., 400 memories in total). The agreement between the two coders was 94% for Michael Jackson, 94% for Osama bin Laden, 97% for good news and 98% for bad news. There was an additional question for the private events that read "What was the news that you received?" This question only served to facilitate remembering the events and was not content-analysed. Nineteen participants stated that they had never experienced such a negative event (i.e., death or threat to life) and 32 participants reported not having experienced any pregnancy news, thus were given a "Not applicable" score.

When a participant responded to all four canonical category questions in an uncertain manner (e.g., "I guess") or responded with "I don't remember" to all four questions, he or she was considered as having no flashbulb memory for that particular event (and excluded from analyses). Memories that received recall scores of 1, 2 or 3 were categorised as "weaker flashbulb memories" and those that received a score of 4 were classified as "strong flashbulb memories".³

Memory qualities. Six widely used items (Berntsen & Thomsen, 2005; Hirst et al., 2009) were used

²There were four survey conditions with four different order of memories: (1) Michael Jackson, Osama bin Laden, bad news, good news, (2) Osama bin Laden, good news, Michael Jackson, bad news, (3) good news, bad news, Osama bin Laden, Michael Jackson and (4) bad news, Michael Jackson, good news, Osama bin Laden (for the formula, see www.statpages.org/latinsq.html).

³Recent research shows that cut-off points can be set on canonical category scores (i.e., recall score) that can distinguish people who form flashbulb memories from those who do not (Curci & Lanciano, 2009; Lanciano & Curci, 2012). This work aims to conceptualise flashbulb memories as a special cluster of memories, categorically different from autobiographical memories. This was not one of our research aims; therefore, we have not conducted such a taxometric investigation of flashbulb memories. We considered memories with a recall score of 0 as non-flashbulb memories, and the rest as flashbulb memories with varying degrees of canonical categories.

to measure memory qualities. Participants were asked to rate the general *importance* of the news, *consequentiality* of the event for their lives, *intensity* of their emotions when they heard the news, *vividness* of their memory of hearing the news, the frequency of having *talked about* the news and the frequency of having *thought about* the news (the latter two were added to create a *rehearsal* score). All items were presented in random order across participants and rated on 7-point scales ranging from 1 (*not at all*) to 7 (*very much*).

Confirmatory factor analysis (CFA) was conducted in order to find out whether these five qualities are best presented as five separate factors or whether they converge into one factor symbolising the overall “significance” of the memory. Using structural equation modelling (SEM), this latent variable of memory significance was modelled as an exogenous variable predicting the three memory functions (i.e., one-factor model). Each memory function was also displayed as a latent variable composed of five observed items (see the Thinking About Life Experiences (TALE) Questionnaire below). This one-factor model was compared with a five-factor model in which memory qualities were treated as separate exogenous variables (each memory quality predicting the three memory functions). Memory qualities were not allowed to correlate in the five-factor model, as they were treated as orthogonal factors. Finally, multiple-group analyses were conducted to test measurement invariance across the four memory types (i.e., positive and negative, public and private memories). SEMs were performed using AMOS 20.0 (Arbuckle, 2011).

Results showed that the one-factor model fit the data well: $\chi^2(676) = 2191.43$, $p < .001$; confirmatory fit index (CFI) = .95, Tucker-Lewis index (TLI) = .94, root mean square error of approximation (RMSEA) = .031 (90% confidence interval: .030–.033) with invariance across the four memory types in measurement parameters (i.e., 16 item loadings). The five-factor model did not fit the data as well as the one-factor model: $\chi^2(721) = 9859.92$, $p < .001$; CFI = .72, TLI = .67, RMSEA = .075 (90% confidence interval: .073–.076) with invariance across the four memory types in measurement parameters (i.e., 12 item loadings) and regression weights (i.e., five memory qualities predicting three memory functions). Thus, the results supported the one-factor model with memory significance as a single factor predicting memory functions. This single factor has been used in major analyses. Cronbach’s alphas for this “significance” scale ranged between .81 and .87.

The questionnaire also contained three manipulation check items: Participants rated the unexpectedness (i.e., surprise) of the news as an essential aspect of a flashbulb memory (e.g., Luminet & Curci, 2009), as well as the emotional positivity and negativity of the news on 7-point scales ranging from 1 (*not at all*) to 7 (*very much*).

Memory functions. The Thinking About Life Experiences (TALE) Questionnaire comprises 15 items (Bluck & Alea, 2011) that assess the frequency of thinking and talking about recalled autobiographical events to serve three functions. (1) The *Self-Continuity* subscale includes five items that concern maintaining stability or evaluating change in terms of self, values and beliefs. (2) The *Social-Bonding* subscale centres on social bonds such as developing new relationships and nurturing existing ones. (3) The *Directive* subscale concerns using the past to guide current actions and set future goals. Participants rated how often they think back about/talk about their four memories to serve these functions, using Likert-type scales ranging from 1 (*not at all*) to 7 (*very much*). The original TALE instructions guide individuals to rate how they use autobiographical memory in general, but the current instructions focused participants on rating the functional use of the four specific memories generated in the study. TALE items were presented in random order across participants. Cronbach’s alphas were high for all memory types (self-continuity: .91–.95, social bonding: .89–.91, directive function: .88–.94).

To assess the psychological distance of flashbulb memories, participants answered three questions on the subjective impression of the temporal distance between the event and the present (Ross & Wilson, 2002). They rated how long ago the event felt, how far away the event felt and how close they felt today to their “past self” in the event on 11-point scales (1 = *like yesterday/very close*; 11 = *like a very long time ago/very distant*). These three items were added to create a composite psychological distance score (Cronbach’s alpha ranged between .74 and .87 for the four flashbulb memories). Finally, participants were asked to report the month and the year of each event. If they were not certain about the date, they were asked to report their best estimate.

Background measures. In addition to demographic information (age, gender, ethnicity, education, income, employment status), this section of the questionnaire also included single items

assessing subjective overall health and general life satisfaction (rated on a 7-point scale ranging from 1 “very poor” to 7 “very good”).

RESULTS

Preliminary analyses

Preliminary analyses examined potential differences in demographic variables (i.e., ethnicity, sex, education, income, employment status) to identify any necessary control variables. Separate multivariate analyses of variance (MANOVAs) with the major study variables (i.e., three memory functions and psychological distance of memories) entered as dependent variables and demographic variables entered as independent variables were conducted separately for the four memory types. Results showed no education, income or employment status differences in memory functions across the four memory types, F ranged from 0.26 to 1.62, all $p > .05$. There was a small gender-related difference in the psychological distance of flashbulb memories for Osama bin Laden's death: Women felt psychologically more distant from this memory than men, $F(1, 529) = 11.87$, $p = .001$, $\eta_p^2 = .02$. There were significant multivariate ethnicity effects regarding the flashbulb memory functions of Michael Jackson's death, $F(12, 1557) = 2.08$, $p = .02$, $\eta_p^2 = .02$. African Americans reported using their Michael Jackson memories more than Caucasians for self-continuity, $t = 3.13$, $p = .018$ and directive functions, $t = 2.92$, $p = .04$. In terms of psychological distance of memories, African Americans felt psychologically more distant from the flashbulb memory for Osama bin Laden's death compared to Caucasians, $t = 2.92$, $p = .04$. As ethnicity and sex differences were small, they were not included as control variables in major analyses.

The three manipulation check items were unexpectedness (i.e., surprise), emotional positivity and emotional negativity of memories. A repeated-measures analysis of variance showed that all memory types were highly ($M = 5.28$, $SD = 1.85$) and similarly surprising, $F(3, 448) = 1.18$, $p = .31$, in line with the essential aspects of flashbulb memories. In terms of emotional positivity, the positive private flashbulb memory received the highest ratings ($M = 5.51$, $SD = 1.77$), followed by Osama bin Laden's death ($M = 4.74$, $SD = 1.89$), Michael Jackson's death ($M = 1.77$, $SD = 1.31$) and the negative private flashbulb memory ($M = 1.21$, $SD =$

.81). All memories were significantly different from each other, $F(3, 448) = 871.48$, $p < .001$. In terms of emotional negativity, the negative private flashbulb memory was significantly more negative ($M = 6.39$, $SD = 1.16$) than Michael Jackson's death ($M = 3.27$, $SD = 1.96$), which was significantly more negative than both Osama bin Laden's death ($M = 1.97$, $SD = 1.45$) and the positive private flashbulb memory ($M = 2.05$, $SD = 1.71$), $F(3, 448) = 972.69$, $p < .001$. These results confirmed that the two negative flashbulb memories included in this study were more negative than the two positive flashbulb memories, and that the two positive flashbulb memories were more positive than the two negative flashbulb memories.

Participants were free to recall the two private events from any period of their lives. The age of private events was calculated by subtracting the reported date of the private event from the current date of data analyses. The mean age of negative private events ($M = 7.60$, $SD = 8.16$) was significantly smaller than the mean age of positive private events ($M = 9.73$, $SD = 11.09$), $F(1, 503) = 19.43$, $p < .001$. That is, participants recalled and reported significantly older good news than negative news. As expected, there was a positive correlation between age of the participants and age of their private memories, $r = .41$ and $.75$ ($p < .001$) for negative and positive private flashbulb memories, respectively. Comparing the two age groups, middle-aged adults recalled significantly older private flashbulb memories than young adults, $t = 14.03$ and 30.96 ($p < .01$) for negative and positive private flashbulb memories, respectively. The two public events had fixed dates (i.e., Michael Jackson's death on June 25, 2009, and Osama Bin Laden's death on May 2, 2011), but most participants' estimates of these dates deviated from the actual dates. Participants tended to assign Michael Jackson's death a later date ($M = -.48$, $SD = 1.14$, in years), whereas they recalled Osama bin Laden's death as having occurred at an earlier date than its actual date ($M = .14$, $SD = 1.03$). The two age groups did not differ significantly in terms of these public flashbulb memory date estimates, $t = 0.06$ and 0.45 ($p > .05$) for Michael Jackson and Osama bin Laden's death, respectively. In order to control for the differences in date estimates, the age of memories was used as a control variable in all major analyses.

Regarding the memory recall score out of 4, the negative private flashbulb memory received the highest score, followed by the positive private flashbulb memory; t ranges between 2.74 and 7.82, all $p < .05$. The private flashbulb memories received

TABLE 2

Descriptive statistics for memory qualities (including significance) and memory functions separately for the four memory types

Variables	<i>Jackson</i>		<i>Bin Laden</i>		<i>Negative</i>		<i>Positive</i>	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Importance	2.71	1.71	4.40	1.82	6.30	1.17	5.33	1.84
Consequentiality	1.84	1.41	2.74	1.72	5.45	1.66	4.60	2.31
Emot. intensity	3.01	1.79	4.01	1.81	6.06	1.36	5.21	1.77
Vividness	3.70	1.93	3.97	1.93	5.70	1.68	4.69	1.98
Rehearsal	2.40	1.41	2.75	1.46	4.02	1.56	3.41	1.73
Significance	2.73	1.32	3.57	1.34	5.50	1.13	4.65	1.51
Self-continuity	2.21	1.58	2.62	1.59	3.56	1.73	3.33	1.78
Social-bonding	2.40	1.51	2.41	1.49	3.58	1.67	3.51	1.68
Directive	2.15	1.53	2.29	1.50	3.78	1.70	3.29	1.73
Psyc. distance	7.06	2.38	5.85	2.46	6.27	3.07	5.32	2.90

Maximum score for all scales = 7, except for psychological temporal distance (max = 11).

higher scores than both public flashbulb memories, which did not significantly differ from each other, $t = 1.18$, $p = 1.0$. There were no age-related differences in memory recall, $F(1, 2199) = 3.27$, $p > .05$. Focusing on different recall categories, 4% of all the memories received a total score of 0 indicating no flashbulb memory for those specific events. These memories were excluded from analyses, as there was no reliable data on these non-existing flashbulb memories' qualities or functions. Twenty-eight per cent of all memories received recall scores of 1, 2 or 3 and were referred to as "weaker flashbulb memories". Finally, 61% of memories were classified as "strong flashbulb memories" that consisted of all four canonical categories.

In terms of memory significance, the negative private flashbulb memory received the highest score, followed by the positive private flashbulb memory, which was rated higher than Osama bin Laden's death, and Michael Jackson's death received the lowest ratings; t ranges between 9.12 and 32.31, all $p < .05$. Middle-aged adults rated all four flashbulb memories as more significant than young adults, $F(1, 2111) = 74.12$, $p < .001$.

For descriptive purposes, Table 2 presents means and standard deviations for memory qualities (as well as the composite score of memory significance), and memory functions separately for the four memory types. Pearson's correlations were computed for all variables included in the major regression analyses and are reported in Table 3.

Main analyses

Functions of flashbulb memories. The first aim of the study was to compare the functionality of the

four flashbulb memories (i.e., Michael Jackson, Osama bin Laden, positive private memory, negative private memory) in terms of the tripartite model functions (self-continuity, social-bonding, directionality), as well as their psychological distance. This was tested using two sets of hierarchical regression analyses: The first nine regressions were conducted with the three functions as the criterion variables, and the second set of three regressions were conducted with the psychological distance of memories as the criterion variable (resulting in a total of 12 regressions). Dummy variables were used for the four memory types. Age of memory was included in the initial step of each regression as a control variable.⁴ In the second step, age group (i.e., young vs. middle-aged adults), general significance of memory, recall category (i.e., strong flashbulb memories vs. weaker flashbulb memories) and three dummies for memory type were entered (with the fourth memory type as the comparison group). In the third step, two-way interaction terms were entered (i.e., significance $\times$ age group, significance $\times$ recall, recall $\times$ age group).⁵ Variables included in the interaction terms were centred. Results from the first set of nine regressions are presented in Table 4, and results

⁴These regression analyses were replicated with the order of memories added as a second control variable. Adding order as a control variable resulted in the same findings for all memory functions.

⁵These regression analyses were replicated twice: One with the comparison of private versus public memories, and one with the comparison of positive versus negative memories. These regressions revealed no significant interactions between the predictors (i.e., memory significance, recall score, age group) and the four memory types. Therefore, in our final 12 regressions (Tables 4 and 5), interactions with memory types were not included (e.g., bad news $\times$ age group).

TABLE 3
Pearson correlation coefficients for all variables included in the regression analyses

Variables	1	2	3	4	5	6	7
1. Memory significance	–						
2. Self-continuity	.45**	–					
3. Social-bonding	.46**	.71**					
4. Directive	.52**	.82**	–				
5. Psyc. distance	–.24**	–.11**	–.12**	–			
6. Recall category	.30**	.14**	.13**	.17**	–		
7. Age group	.15**	–.01	.01	.03	–.10**	–	
					–.03	.02	–

** $p < .01$. Recall category: 1 = Weak flashbulb memory, 2 = Strong flashbulb memory. Age group: 0 = Young, 1 = Middle-aged.

from the second set of three regressions are presented in Table 5 with only the relevant final step of each regression model for brevity. Table 6 presents a verbal summary of the differences between each flashbulb memory in terms of functions.

Regarding the three memory functions, we expected that private flashbulb memories serve higher self-continuity, social-bonding and directive functions. First, dummy variables for the flashbulb memory types were compared in terms of the self-continuity function (Table 4, Lines 1–6). There was no significant difference between the two private flashbulb memories (Line 1), and only the positive private memory served a higher self-continuity function than the two public flashbulb memories. The positive private memory was associated with higher levels of the self-continuity function than Michael Jackson's (Line 4) and Osama bin Laden's death (Line 6, marginally significant, $p = .06$). Second, recalling a positive private flashbulb memory was associated with higher levels of the social-bonding function compared to recalling a negative private flashbulb memory, Michael Jackson's death and Osama bin Laden's death (Table 4, Lines 1, 4 and 6). Recalling a negative private flashbulb memory and recalling Michael Jackson's death were similar (Line 3) and were associated with higher levels of the social-bonding function than Osama bin Laden's death (Line 5). Third, regarding the directive function, the two private flashbulb memories did not significantly differ from each other (Table 4, Line 1), but were both higher than Osama bin Laden's and Michael Jackson's death (Lines 2 and 3 for the negative private memory, Lines 4 and 6 for the positive private memory). Finally, recalling Michael Jackson's death was associated with a higher directive function than recalling Osama bin Laden's death (Line 5). In sum, expectations regarding the three functions of flashbulb memories were mostly supported: Private flashbulb memories tended to receive higher ratings than public flashbulb memories (see Table 6 for a summary of all findings).

Regarding the psychological distance of flashbulb memories, we had predicted that participants report feeling psychologically closer to their positive than their negative flashbulb memories, independent of the private versus public status of their memories. This expectation was supported. Participants felt psychologically closest to the two positive flashbulb memories, which did not differ (Table 5, Line 6), followed by Michael Jackson's

TABLE 4
Summary of nine hierarchical multiple regressions predicting the memory functions from the tripartite model

Step 3	Self-continuity function				Social-bonding function				Directive function			
	B	SE B	β	t	B	SE B	β	t	B	SE B	β	t
1. Bad news vs. good	0.68	.49	.03	1.37	1.37	.47	.07	2.92*	-0.21	.47	-.01	-0.43
2. Bad news vs. Osama	-0.31	.57	-.02	-0.54	-1.72	.53	-.09	-3.123**	-3.02	.54	-.15	-5.61**
3. Bad news vs. MJ	-0.46	.61	-.02	-0.75	0.13	.58	.01	0.23	-1.64	.58	-.08	-2.81*
4. MJ vs. good news	1.14	.57	.06	1.99*	1.24	.54	.06	2.30*	1.43	.55	.07	2.63*
5. MJ vs. Osama	0.15	.50	.01	0.31	-1.86	.47	-.10	-3.96**	-1.38	.47	-.07	-2.93*
6. Osama vs. good news	0.99	.55	.05	1.80	3.10	.52	.16	5.98**	2.81	.52	.14	5.39**
7. Significance	2.29	.14	.44	16.76**	2.28	.13	.46	17.61**	2.44	.13	.47	18.74**
8. Recall category	-0.02	.41	-.00	-0.06	-0.33	.39	-.02	-0.84	0.24	.39	.01	0.61
9. Age group	-1.48	.41	-.08	-3.64**	-1.13	.38	-.06	-2.93*	-0.48	.39	-.03	-1.24
10. Significance $\times$ age	0.48	.23	.04	2.04*	0.30	.22	.03	1.37	0.34	.22	.03	1.53
11. Significance $\times$ recall	-0.38	.24	-.03	-1.56	-0.57	.23	-.05	-2.46*	-0.09	.23	-.01	-0.38
12. Recall $\times$ age	-0.77	.86	-.02	-0.90	-0.36	.81	-.01	-0.44	-0.91	.82	-.02	-1.11

Good = Good news (i.e., positive private FM), MJ = Michael Jackson's death, Osama = Osama bin Laden's death.

In lines 1–3: Bad news = 0, Good news = 1, Osama = 1, MJ = 1.

In lines 4–5: MJ = 0, Good news = 1, Osama = 1.

In line 6: Osama = 0, Good news = 1.

Recall category: 1 = Weak flashbulb memory, 2 = Strong flashbulb memory.

$R^2 = .02$ for Step 1 ($p < .05$); $\Delta R^2 = .19$ for Step 2 ($p < .05$); $\Delta R^2 = .00$ for Step 3 ($p > .05$) for self-continuity function.

$R^2 = .03$ for Step 1 ($p < .05$); $\Delta R^2 = .20$ for Step 2 ($p < .05$); $\Delta R^2 = .01$ for Step 3 ($p < .05$) for social-bonding function.

$R^2 = .03$ for Step 1 ($p < .05$); $\Delta R^2 = .26$ for Step 2 ($p < .05$); $\Delta R^2 = .00$ for Step 3 ($p > .05$) for directive function.

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

death (Lines 4 and 5), which felt closer than the negative private flashbulb memory (Line 3).

TABLE 5

Summary of three hierarchical multiple regressions predicting the psychological distance of flashbulb memories

Step 3	B	SE B	β	t
1. Bad news vs. good	-3.90	.52	-.20	-7.49**
2. Bad news vs. Osama	-3.90	.59	-.21	-6.65**
3. Bad news vs. MJ	-1.23	.63	-.07	-1.95*
4. MJ vs. good news	-2.67	.59	-.14	-4.53**
5. MJ vs. Osama	-2.67	.50	-.14	-5.29**
6. Osama vs. good news	0.00	.57	.00	.00
7. Significance	-1.22	.14	-.25	-8.70**
8. Recall category	-0.49	.43	-.03	-1.14
9. Age group	0.33	.42	.02	0.78
10. Significance $\times$ age	0.47	.24	.05	1.96**
11. Significance $\times$ recall	0.28	.25	.03	1.10
12. Recall $\times$ age	-0.43	.89	-.01	-0.48

Good = Good news (i.e., positive private FM), MJ = Michael Jackson's death, Osama = Osama bin Laden's death.

In lines 1–3: Bad news = 0, Good news = 1, Osama = 1, MJ = 1.

In lines 4–5: MJ = 0, Good news = 1, Osama = 1.

In line 6: Osama = 0, Good news = 1.

Recall category: 1 = Weak flashbulb memory, 2 = Strong flashbulb memory.

$R^2 = .01$ for Step 1 ($p < .05$); $\Delta R^2 = .09$ for Step 2 ($p < .05$); $\Delta R^2 = .00$ for Step 3 ($p > .05$).

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

Memory qualities. The second study aim was to explore how perceived memory significance and objective recall of the memory were related to the functions of the memory. We had predicted that higher memory significance and better recall of the canonical categories are associated with stronger memory functions. This was tested using the two sets of hierarchical regression analyses reported above.⁶ Confirming our expectation, there was a significant positive relation between memory significance and memory functions (Tables 4 and 5, Line 7). That is, independent of memory type, high levels of memory significance were associated with high levels of self-continuity, social-bonding and directive functions and feeling psychologically closer to the memories. In contrast, recall of the memory was

⁶ We preferred hierarchical regressions in order to test all of our study aims together in one analysis. In fact, these relations could also be tested using SEM, for example, separately for the four memory types. However, this would allow us to examine differences between the four memory types in terms of the *relations* between recall, personal significance and functions of memories (not differences between memory types in terms of *functions* themselves, which is the main study aim). Therefore, we use the current analytical approach, which is more adequate to address the specific aims of this study.

TABLE 6

Summary of differences between the four flashbulb memories
in terms of functions

Self-continuity	Good news > MJ = Osama Good news = bad news Bad news = MJ = Osama
Social-bonding	Good news > bad news = MJ > Osama
Directive	Good news = bad news > MJ > Osama
Psychological distance	Bad news > MJ > good news = Osama

Higher scores in psychological distance indicate feeling more distant from the memory.

not related to any memory functions (Tables 4 and 5, Line 8). That is, strong flashbulb memories (with a recall score of 4 out of 4) were not significantly different from weaker flashbulb memories (with a recall score of 1, 2 or 3) in terms of their self-reported functions. In other words, how many canonical category details one recalled about a flashbulb memory did not predict the functions served by that memory.

The interaction between memory significance and recall category was significant for the social-bonding function (Table 4, Line 11). Follow-up Pearson's correlations between memory significance and the social-bonding function were conducted separately for strong flashbulb memories versus weaker flashbulb memories. For strong flashbulb memories, there was a positive correlation between the significance of memories and their social-bonding function, $r(1524) = .42, p < .001$. This positive correlation was even stronger for weaker flashbulb memories, $r(617) = .53, p < .001$. These two correlations were significantly different from each other, $Z = 2.86, p = .004$.

Age-group differences in flashbulb memory functions. The third study aim was to explore differences between young and middle-aged adults. Age group was a significant predictor of two functions: self-continuity and social bonding (Table 4, Line 9). Being middle-aged was associated with reports of weaker self-continuity and social-bonding functions, but was unrelated to the directive function (Table 5, Line 9, rightmost part), or to the psychological distance of memories (Table 6, Line 9).

The interaction between age group and recall category was non-significant for all functions (Tables 5 and 6, Line 12). The interaction between age group and memory significance was significant for self-continuity and psychological distance

(Tables 5 and 6, Line 10). Follow-up Pearson's correlations showed that there was a positive correlation between the significance of memories and their self-continuity function in young adults, $r(1455) = .44, p < .001$, and that this relation was significantly stronger for the middle-aged adults, $r(664) = .50, p < .001, Z = 1.78, p = .04$. Moreover, there was a marginally stronger negative correlation between the significance of memories and their psychological distance in younger adults, $r(1409) = -.25, p < .001$, than in middle-aged adults, $r(646) = -.19, p < .001, Z = 1.41, p = .08$.

DISCUSSION

Taking a functional approach to the study of flashbulb memories, the current study addressed the question whether the emotional valence and privacy of flashbulb memories affect their functions. Results suggest, first, that private flashbulb memories are generally perceived as more functional than public ones. Moreover, participants felt psychologically closer to positive flashbulb memories than to negative ones. Second, although the recall of canonical categories was unrelated to memory functions (i.e., no functional differences between strong vs. weaker flashbulb memories), higher memory significance was associated with higher functions. Finally, middle-aged adults rated their flashbulb memories as serving lower self-continuity and social-bonding functions than young adults (with no age differences in other functions). We now address each of the functions individually, before turning to the discussion of memory qualities and age-related differences.

Self-continuity function

The current study showed that private flashbulb memories contribute more strongly to self-continuity than public memories. The fact that there was no difference between the two private memories and no difference between the two public memories shows that emotional valence has no effect on the self-continuity function. It is the private versus public status of both positive and negative flashbulb memories that determines their self-continuity function. This finding fits well with the self-memory system model of autobiographical memory (Conway, Singer & Tagini, 2004), postulating that the self-relevance of memories feeds into one's sense of identity (Demiray & Bluck,

2011). Private memories tend to be more central to people's life stories (Rasmussen & Berntsen, 2009), as they are personally more significant. In line with this, participants of the current study rated their memory of the moment they heard about their pregnancy (or their wife's, friend's, relative's pregnancy) as more important, consequential, emotionally intense, vivid and frequently rehearsed than the news of celebrities' or political figures' deaths. They might have incorporated this private news and the details of how they received the news (e.g., where they were, what they were doing) into their life stories (Habermas & Bluck, 2000), which, in turn, might serve an important self-continuity function.

Social-bonding function

Based on previous findings on autobiographical memories in general, functions of recalling and sharing flashbulb memories with others may be to strengthen relationships (e.g., Bazzini, Stack, Martincin, & Davis, 2007), to increase intimacy with each other (e.g., Alea & Bluck, 2007), to provide material for conversation (Pasupathi, Lucas, & Coombs, 2002) and to elicit empathy for each other (Bluck, Baron, Ainsworth, Gesselman, & Gold, 2013). According to the results of the current study, the social-bonding function is highest for the positive private memory and lower for the two negative memories. This is consistent with previous work on autobiographical memory that shows that memories for positive events are more frequently talked about than negative memories (Baker-Ward, et al., 2005; Byrne, Hyman, & Scott, 2001) and that positive memories serve higher social functions than negative memories (Rasmussen & Berntsen, 2009). The finding that the private negative memory and the public negative memory serve similar levels of the social-bonding function indicates that the private versus public nature of the memory is not relevant for this function: People report recalling a loved one's death news (or injury) and Michael Jackson's death news for similar functions, such as to get to know others better, to develop intimacy with others, and to maintain or enhance relationships with others.

Flashbulb memories have been proposed to serve not only as personal recollections, but also as linking us to our society, history and culture (Neisser, 1982). Berntsen (2009) theorises that the formation of public flashbulb memories depends

on the activation of one's *social* identity as belonging to a social group and on the social and cultural relevance of the public event. The public memory of Osama bin Laden's death received the lowest ratings in the social-bonding function, although it is likely to be highly linked to Americans' national and social identities. Participants also reported rehearsing it infrequently, although it was considered a positive event. This might be due to the fact that, although it is framed as good news for American citizens, it is essentially a negative and violent event about the death of a person associated with terrorism. The finding that Michael Jackson's death received higher ratings than the death of bin Laden might be related to the continued exposure to his music with ongoing positive effects in people's lives. Future research should include social identity and attitudes measures (e.g., patriotism scale) in order to tap onto a broader social-bonding function (with one's society) rather than only focusing on the social bonding function of flashbulb memories in the individual level (i.e., TALE measure).

Directive function

The directive function of autobiographical memory involves retrieving past experiences when setting goals, deciding on a plan of action or solving problems to direct one's current and future behaviour (e.g., Baddeley, 1988). Given that events such as the death of a celebrity have little bearing on people's everyday behaviours, it is not surprising that the private memories were rated higher in terms of their directive function. Note that the private memories were similarly high in consequentiality (whereas the public memories were low), which indicates that they might represent "lessons learned" and guide future behaviours (Pillemer, 1984, 2009). Independent of their emotional valence, the two private memories equally served the directive function. This was surprising, as previous work has shown that people's negative personal memories served higher directive functions than their positive memories, and that directive memories were dominated by negative emotion and unpleasant content (Harris, Rasmussen, & Berntsen, 2012; Rasmussen & Berntsen, 2009). These differences between studies might suggest that the directive function of private flashbulb memories is different to that of general autobiographical memories. However, this is currently speculative, as memories other than

flashbulb memories were not included in the current study.

Psychological temporal distance of flashbulb memories

As expected, positive flashbulb memories were rated as psychologically closer than negative ones. This finding is consistent with previous research on autobiographical memories that shows that participants report feeling closer to their positive important autobiographical memories and further away from their negative important autobiographical memories (Demiray & Janssen, 2014; Wilson & Ross, 2001). This is in line with the pleasantness bias in autobiographical memory (Bohn & Berntsen, 2007) and might represent an *emotion regulatory* function of autobiographical memory (Hyman & Faries, 1992; Robinson & Swanson, 1990), including flashbulb memories. People might up-regulate their mood by feeling closer to and reliving highly significant positive events and by distancing themselves from dramatic negative ones (e.g., Peetz & Wilson, 2008). Previous work shows that the recall of positive memories leads to higher positive affect after recall (Alea & Bluck, 2007; Pasupathi & Carstensen, 2003; Sakaki, 2007). Similarly, mood-incongruent memory findings show that with the motivation to reduce or eliminate negative affect, people tend to retrieve positive memories to regulate their mood (Isen, 1985; Josephson, 1996; Rusting & DeHart, 2000). Future studies including assessments of participants' mood are needed to address the effectiveness of flashbulb memories compared to other memories as a means of emotion regulation.

Subjective and objective qualities of flashbulb memories: Relations with functions

A few studies have shown positive relations between autobiographical memory functions and their frequency of rehearsal (Hyman & Faries, 1992), personal importance (Alea & Bluck, 2007), emotional intensity (Kuwabara & Pillemer, 2010) and recollective experience (e.g., sensory details; D'Argembeau & Van der Linden, 2008). The *significance* variable in the current study is a composite construct that includes these memory qualities, and it is also positively associated with all

memory functions. Independent of memory type, flashbulb memories that were more significant tended to serve higher functions, as well as feeling psychologically closer. This suggests that, similar to general autobiographical memories, flashbulb memories' perceived significance enhances their functionality.

Our findings on the objective recall of flashbulb memories showed that recall category was not related to any memory function: There was no significant difference between strong and weaker flashbulb memories in terms of their self-reported functions. That is, how many canonical category details one recalled about a flashbulb memory did not predict the functions served by that memory. This may be due to our recall score that showed low variance and high scores for most of the sample. Future research should use a more fine-grained coding scheme for canonical categories (e.g., coding the specificity of participants' responses) and assess the objective recall of flashbulb memories more thoroughly in order to examine its impact on functions. It is not possible to examine the functions of memories that are not formed in the first place (i.e., with a recall score of 0), but there may be functional differences between flashbulb memories that are recalled with very specific details versus those that include weaker specificity. An alternative interpretation of our finding is that subjective memory qualities might be better predictors of functions than more objective recall qualities because they indicate how personally meaningful a memory is. This fits with previous work showing a significant discrepancy between the meta-cognitive perception of flashbulb memories (e.g., vividness, confidence in the memory) and their objective recall (Talarico & Rubin, 2009).

Age-related differences in flashbulb memory functions

While autobiographical memory may serve some universal functions, various age groups may utilise it differently to face the specific demands and developmental tasks of different life phases (Bluck & Alea, 2008). Young adulthood is a life phase in which forming a clear and coherent sense of self is the primary developmental task (Erikson, 1959). Thus, it is not surprising that younger adults reported a higher self-continuity function of flashbulb memories than middle-aged adults. This is in line with previous work showing that young adults

report recalling their past mostly for identity formation purposes (Niedzwieńska & Swiezy, 2010) and report more often using their autobiographical memories for maintaining self-continuity than middle-aged and older adults (Bluck & Alea, 2008; Harris et al., 2012). Middle-aged adults who tend to have a more consistent and stable sense of self (Rice & Pasupathi, 2010) depend on their flashbulb memories less often in order to achieve self-continuity (e.g., Webster & Gould, 2007).

In line with previous work on the social-bonding function of autobiographical memories (Harris et al., 2012), we found that young adults were more likely to depend on their flashbulb memories for social bonding purposes than middle-aged adults. A major developmental task for young adults is to form intimate and positive relationships with other people (intimacy vs. isolation; Erikson, 1959), whereas middle-aged adults focus on other tasks such as maximising financial and psychological resources, which may decrease the salience of the social-bonding function in midlife. Previous work has shown that the social-bonding function is experienced with equal frequency in young and older adulthood (Alea & Bluck, 2007; Bluck & Alea, 2009), when developmental tasks coincide with intimacy goals (Neugarten, 1979). Taking the results of the current and previous studies together suggests a non-linear relationship, with flashbulb memories and general autobiographical memories being important for self-continuity in young and older adulthood, but less so in midlife. This emphasises the importance of including midlife samples in studies of adult development (Staudinger & Bluck, 2001).

Previous work has shown that young adults report more often using their memories for directing their future behaviour and gaining life experience than older adults (Bluck & Alea, 2009). We had expected a similar reduction in the directive function of flashbulb memories in midlife, but found that young and middle-aged adults rated the directive function similarly high. This indicates that middle-aged adults continue to use their memories for shaping their behaviours and predicting their future, which may be due to their similar levels of personal growth and purpose in life as young adults (Ryff & Keyes, 1995).

Finally, we found that young and middle-aged adults felt similarly close to their flashbulb memories. To our knowledge, this is the first study that examined age-related effects in the psychological distance of memories. Given the potential emotion-regulatory function (Mather & Carstensen,

2005) of psychologically placing negative memories further in distance and positive memories closer to the present, future studies should include measures of affect in order to investigate possible age-related differences in affective consequences of the psychological distance of flashbulb memories.

Limitations and future directions

The current study had several limitations. First, recruiting individuals in mid-life to participate in research is notoriously difficult (Nosek, Banaji, & Greenwald, 2002). We do not know if the obtained sample, although relatively large, is different from those who were invited but did not participate, or how representative they are of the middle-aged population. For example, MTurk workers are highly familiar with computers and the internet, which might have increased their rehearsal of public news through the usage of social media. However, it is unlikely that a large percentage of middle-aged individuals are computer illiterate given current rates of computer ownership and literacy (e.g., the Pew Internet and American Life Project, 2013, shows that 83% of adults between 50 and 64 years actively use the internet; "Who's Online", 2012). Finally, the current sample does not include older adults, as there are not many older MTurk workers. Future research should recruit samples spanning the ages between adolescence and old age to contribute to the limited literature on the effects of adult development and ageing on flashbulb memories and their functions.

One major challenge in the current research was selecting which four flashbulb memories to examine, especially the positive memories that should carry qualities of flashbulb memories and match the negative memories on all dimensions except valence. Although we conducted pilot studies to identify the most appropriate memories, the actual study revealed some differences between positive and negative memories (e.g., in emotional intensity, recall score). This was also the case when comparing private and public memories. For example, the private negative memory and the public negative memory were not equal in terms of negativity, positivity and emotional intensity. One way of achieving a perfect match between the different types of memories could be to have participants generate individual flashbulb memories that fulfil these criteria. However, this procedure would sacrifice comparability on other

dimensions such as their content and the timing of the events. One of the strengths of the current study is that the four events were the same for all participants. However, it is uncertain whether our finding that private memories tend to be more functional than public memories is specific to these four events or whether it would generalise to other event combinations. For example, selecting a more serious and impactful negative public event such as 9/11 (rather than Michael Jackson's death) might have led to different results. Such significant public memories associated with both personal safety and social identity might serve higher functions than private flashbulb memories that are perceived as less significant. Thus, future research should replicate this work with a different selection of public versus private events.

In addition, we tried to select flashbulb memories similarly meaningful for young and middle-aged adults. Our pilot samples had age ranges (19–69 years) similar to the age range in the current study. Therefore, we believe that the events we selected based on the pilot studies are similarly relevant in young and middle-aged adults' lives. For example, for the private flashbulb memories, similar percentages of young and middle-aged participants reported not having experienced any pregnancy or death news. One difference between the age groups was that middle-aged adults rated all memories as more significant than young adults. However, there were no major interactions with age group in the main regression analyses. Therefore, we did not elaborate on age group differences.

Another limitation is that our self-report measure for the three functions may not assess actual functions, but people's *beliefs* about the functions their memories might serve. People are usually not aware that their autobiographical memory is an adaptive system that serves functions (Kulkofsky, Wang, & Hou, 2010), and memories may influence feelings, thoughts and behaviours implicitly, without conscious awareness of the connection between the recall of a memory and its subsequent consequences (Kulkofsky, Wang & Koh, 2009). Thus, in order to directly tap onto flashbulb memory functions, future research should use experimental designs (Bluck, et al., 2013) such as assessing the immediate effects of recalling certain flashbulb memories on, for example, feelings of intimacy towards one's partner or donation behaviours (directive function, Kuwabara & Pillemer, 2010).

CONCLUSIONS

Flashbulb memories are commonly experienced by almost everybody. As of yet, the function of recalling details about the reception of unexpected and emotionally intensive news is unclear. Understanding people's beliefs about the functions of their flashbulb memories may help researchers to figure out why people recall trivial details about the circumstances of receiving important news. It may contribute to understanding the conditions and mechanisms that lead to the formation of flashbulb memories and whether flashbulb memories are a distinct type of autobiographical memory. It seems that the functions of flashbulb memories depend on whether the flashbulb memory concerns private or public events. Private flashbulb memories tend to serve higher self-continuity, social-bonding and directive functions than public ones. This suggests that the functions of flashbulb memories are less about the shared societal reality and more about highly individual events shaping one's private life. This interpretation is supported by the fact that subjective rather than objective qualities of the memories are related to their functions. Thus, although public events lend themselves nicely to the study of flashbulb memories (as they are shared by all participants due to their public nature), future research on the functions of flashbulb memories needs to focus more on individual, private memories. Moreover, the current study suggests that flashbulb memory functions vary according to where the rememberer is in the lifespan, underscoring the importance of a lifespan developmental approach to the study of autobiographical memories.

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