Remembering terrorist attacks: Evolution over time

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Abstract
The present study aims to analyse the effect of the passage of time on the phenomenological characteristics of the memory of a traumatic event of social relevance. The terrorist attack that took place in Barcelona (Spain) in August 2017 was taken as the traumatic event. A priori, this event meets the criteria to produce a flashbulb memory (level of surprise, consequentiality and emotional activation). A total of 364 memories from different individuals (78% women and a mean age of 20 years) were studied at five different time points, between September 2017 and December 2018, using the CCFRA/PQAM questionnaire. The results show that the memories only comply with the characteristics usually associated with flashbulb memories in the medium term (about 7 months after the immediately and are lost just over a year after the event. Therefore, the passage of time seems to have a great influence on the characteristics of memories of violent events, such as terrorist attacks. However, this influence may depend more on the relevance given to the event than on the elapsed time, as it is the relevance that determines the number of subsequent recalls, influencing the maintenance of the memory.

Keywords
autobiographical memory, emotional memory, event memory, flashbulb memory, terrorism

Introduction

In recent years, a wave of terrorist attacks has affected different countries throughout the world. Some of the recent attacks have marked a milestone in the individual and collective memory of the people who live in the places where they have occurred and in their history. Many of these events have had significance throughout the world, like for example the attacks during 1972 Summer Olympics in Munich, or the attacks against the World Trade Center on September 11th 2001. It seems difficult to forget the attacks in New York, Casablanca, Bogotá, Bali, Jakarta, Baghdad, Istanbul, Mumbai, London, Paris or Madrid. Generations of Europeans will probably never forget the attacks in the London underground, the London Bridge, Westminster and the Manchester Arena in Great Britain; in France, those of the Sala Bataclán, at the editorial of the magazine Charlie Hebdo, at the Christmas market in Strasbourg, and those of Nice; the attacks at Brussels airport in Belgium; the mass shooting in Munich and the attacks of the Christmas market in Berlin in Germany; and in Spain those of the trains in Madrid, and the attacks at Las Ramblas in Barcelona. Many people died in these attacks and many others were injured. All of us remember the television images of the dead and wounded, the destruction, the ambulances, the police and military armed, the panic. . .and many of the things that occurred after (police checks, deserted streets, tributes to the victims, etc.). In these cases, mass media gave rise to a mediatised memory (O'Connor, 2019). The autobiographical memories of these events will be vivid and accessible. In the collective memory, these events will be unforgettable for several generations even when decades have passed since they occurred. Both individual and collective memories of these events will be reinforced by their historical significance and by mass and social media. So, it can be distinguished between two types of historical memories: autobiographical memories about lived historical events, and collective memories about those same events. There are many parallels between collective memory and individual (autobiographical) memory, the

latter being the bricks with which the former is built. Collective memory is constructed from different types of sources, among which the testimonies of people who have experienced historical events in the first or third person play a preferential role. So, collective memories arise from more than the sum of individual memories, in a kind of synergy involving a large number of factors. Much of what a society (person) is, it is determined by its history. The mechanisms to create and maintain the memories about these types of events may be of interest for psychotherapists, sociologists and historians. As time passes, autobiographical memories will be recoded and reprocessed as a result of multiple, voluntary or involuntary, recalls and subsequent information that affects the quality and characteristics of the memory of the event (Curci and Luminet, 2006, 2009; Finkenauer et al., 1998). In this way, two different types of information have been of interest, the memory of the witnessed events and the memory of the contextual circumstances surrounding those events (Curci and Luminet, 2006; Manzanero et al., 2015).

Event Memories (EM) are mental representations of scenes remembered as unique occurrences (Rubin and Umanath, 2015), which can have special characteristics when they represent individually or socially relevant emotional events (Pezdek, 2003). When the event has a negative valence and affects a collective (such as in the case of natural disasters, terrorist attacks, etc.), the memories generated are characterized by being durable and accessible over time (Conway et al., 1994), remaining in the collective memory of the society where they occur.

Flashbulb Memories (FBM) are a type of autobiographical memory about the personal context in which an event was witnessed from which important consequences are derived and which has great emotional impact. Its main characteristic is that the moment and the circumstances surrounding this event are remembered in a particularly clear, vivid, and detailed way and are accompanied by the feeling of being stable and accurate over time (Hirst and Phelps, 2016; Talarico and Rubin, 2003).

Brown and Kulik (1977) proposed the existence of a special mechanism responsible for FBM. Numerous studies have shown the relationship between the frequency with which information has been recovered and the generation of this type of memories (Bohn and Berntsen, 2007; Conway et al., 1994; Curci and Luminet, 2006, 2009; Finkenauer et al., 1998; Talarico and Rubin, 2003, 2007; Tinti et al., 2014). In general, EM and FBM are reinforced by information from exposure to the media (Curci and Luminet, 2006; Pillemer, 2003) and conversations held in our environment (Roehm, 2016; Tinti et al., 2014). Smith et al. (2003), taking the 11S attacks as a reference, performed a study that showed that the EM was not immune to subsequent reconstructions and only 65% of the personal information provided at 6 months coincided with the information recalled 1 week after the event. Autobiographical details increased dramatically, suggesting the influence of reconstructive processes over that time.

FBM formation

Several theoretical proposals have tried to explain FBMs. According to the *emotional-integrative model* (Finkenauer et al., 1998), the formation and maintenance of this type of memory is influenced by the level of emotion associated with the event and by the frequency of information recall. The assessment of the event is directly mediated by the effect generated by the surprise factor and by the emotional state it provokes. The memory, in addition, is influenced by mental rumination, the tendency to share the memory socially and the monitoring of the information provided by mass media. Finkenauer et al. (1998) postulated that the greater the emotional impact of the event, the greater the number of recalls we will make (mental rumination, talking about the event,

following the media . . .). In this way, multiple recovery could produce an effect of hypermnesia (Payne, 1987). Although, it might seem that high emotional involvement could be related to amnesia (or repressed memories), what are known about memory indicates that this is not the case (Manzanero and Palomo, 2020; Patihis et al., 2018).

Different studies have supported the hypothesis about emotional-integrative model. Curci and Luminet (2009), taking as reference the death of President Mitterrand (France), conducted a study that confirmed the existence of two ways to develop a vivid memory: one is related to the effect of emotion (emotional state) and the other is related to the influence of subsequent recalls (reconstructive processes). Therefore, the emotion associated with the event and the number of times the information is recalled influence the strength and duration of the FBM. Along this line, Tinti et al. (2014) found that the number of times we talk about an event is a necessary factor for the maintenance of a vivid memory and that FBMs could only be maintained after thinking and discussing with others about the event experienced. In addition, Roehm (2016), after carrying out a study with the purpose of evaluating the maintenance of the vividness of a memory, found that the greater vividness of a memory over time correlated with the number of times that such memory had been spoken about. Manzanero et al. (2020) analysed the characteristics of the memories of the bombings of the summer of 2014 in the Gaza Strip by comparing them with those of memories of positive events, and found that the memories of the traumatic events were more sensory, vivid, detailed and emotionally more intense than those of positive events. They were also associated with more recurring thoughts, although with less flashbacks, they were talked about more and more subsequent events related to the traumatic event were remembered.

In sum, according to this emotional-integrative model, the novelty of the event causes a surprise reaction that affects the formation of a vivid memory. The level of surprise, together with the relevance of the event for the person and the attitude adopted determine the emotional intensity experienced. However, it has not always been possible to show the relationship between surprise and the generation of FBM (Coluccia et al., 2010; Kraha et al., 2014).

Subsequently, Er (2003) proposed a second theory through the *importance-driven emotional reactions* model, according to which the relevance of the event (the personal or social consequences it may have for the person involved) determines the intensity of the emotional reaction, which is a fundamental factor in the formation and maintenance of a vivid memory. The more relevant an event is and the greater the emotional reaction it causes, the more accurate and detailed its memory is. The emotional activation is different depending on the consequences that we think the event may have. The relevance granted causes intense emotional reactions that, when shared with others, reinforce the memory trace and cause the formation of FBM. Curci et al. (2015) conducted a study on FBM, taking as reference the resignation of Pope Benedict XVI (Italy). The results showed that when a person considers that a public event has great personal consequences or consequences to his/her environment, the person tends to maintain a vivid and consistent memory of the event. Similarly, recent research shows that the events that contribute to the configuration of social identity tend, more likely, to generate FBM (Luminet and Curci, 2009; Talarico et al., 2019). In this direction, several studies have also shown how the age of the participants affects the generation of FBM, as younger people have less ability to assess the consequences or relevance of the events (Denver et al., 2010; Vallet et al., 2017).

The passage of time

One way to study the evolution of the memory over time is by using the test-retest technique, which allows assessing the consistency between two descriptions, one given immediately after the event takes place and the other after a certain interval of time has elapsed. Most studies use a time interval of 1 year (Conway et al., 1994; Curci et al., 2001; Smith et al., 2003; Talarico and Rubin, 2003; Tekcan et al., 2003) and 3 years (Hornstein et al., 2003; Neisser and Harsch, 1992; Tekcan et al., 2003). The data show that EM is not resistant to distortion or inconsistency as time passes (Curci et al., 2001), although confidence of the memory remains high (Neisser and Harsch, 1992; Talarico and Rubin, 2003). A recent study by Krackow et al. (2019), with shorter time intervals, found that EMs decline after a period of between 3 and 5 months.

Shapiro (2006) carried out a study on the memory of the 11S attacks in New York with the objective of analysing the effects of the retention interval and the successive recalls on memory, after 2 years had lapsed. The memory was evaluated after 11 weeks, after 1 year and after 2 years had lapsed. The results showed a turning point 1 year after the event occurred: retention improved at 11 weeks and 2 years, but at 1 year it worsened. According to these authors, the memories of this event were affected differently by the recalls and the retention interval.

The present research aims to analyse the effect of the passage of time on the memory of a traumatic event of social relevance and study its possible influence on the phenomenological characteristics of that memory. It is expected that the retention interval will affect the maintenance of this memory and the genesis of a FBM (accessible, vivid, emotional and high confidence) as a result of the multiple recalls and recoding.

Method

Participants

The participants were 364 university students, 284 women (78%), with a mean age of 20.71 years (SD = 4.75) and 80 men (22%), with a mean age of 20.59 years (SD = 2.11). No statistically significant gender differences were observed across the age variable, $t(362) = 0.225$; $p = .822$. The criteria to participate in the study stated that participants had to be in Spain during August 2017 and had to have knowledge of the event.

Instruments

The *Phenomenological Questionnaire on Autobiographical Memory* (CCFRA/PQAM-31) was used to evaluate the participants' memories (see Appendix). This questionnaire allows to explore the phenomenological characteristics of memory on a Likert-type scale ranging between 1 and 7. At one extreme there is a category, for example 'My feelings were very negative '(1), at the other extreme is 'My feelings were very positive' (7). In all the dimensions evaluated, we would find a central point (the cutoff point of this Likert-type scale is 4), which can be considered neutral between the two poles that gather the extreme categories of each item. In other words, four would indicate that it is not very negative and not very positive. Therefore, the central tendency of the scores would indicate that the subject would not have a disposition to orient himself towards either of the two extreme aspects in relation to that particular characteristic. The further the answer moves away from the central tendency, the more it positions itself towards one of the two categories proposed for that item. Note that each item measure different aspects and, therefore, the labels corresponding to these extreme values are also different.

The dimensions evaluated were: *Quality of the memory* (degree of detail, vividness, fragmentation, comprehension, definition, complexity, recovery perspective, doubts,

visual information, colour, sound, smell, touch, taste,); *Associated emotions* (implications, intensity of feelings, valence, relevance, feelings during the event and now, thoughts during the event); and *Accessibility* (recall effort, forgetting details, reviviscence, remembering previous and subsequent events, thinking and talking about the event). Items 8 and 29, about where and when the event occurred, have not been accounted for, because these specific data were provided in the instructions as an indication of recovery (Barcelona attacks of August 2017). Item 28 was not considered in these analyses because, in this group of participants, their index of discrimination was very poor (.015).

The reliability coefficients, using Cronbach's alpha, were .88 for the 28 items evaluated in this study, and .84, .81 and .74 for each of the dimensions of memory quality, associated emotions and accessibility, measured with 14, 7 and 7 items, respectively. Therefore, according to George and Mallery's (2003) classification, the internal consistency indexes of the questionnaire were good.

Procedure

The terrorist attack that took place in Barcelona (Spain) on August 17, 2017 has been used as a reference. In this event, there was a vehicle-ramming attack. The vehicle travelled 530m, causing the death of 16 people and wounding 130. The event caused great impact on the Spanish population, acquiring international relevance and had important consequences, which, a priori, meet the requirements that usually give rise to a FBM.

To evaluate the phenomenological characteristics of the memory of these events, all participants were asked to remember it and then perform the CCFRA/PQAM questionnaire anonymously, asking them to only state their age and sex. Participants were given the following instructions when asked to answer the questionnaire: Do you remember the Barcelona attacks a few months ago? Could you answer a questionnaire about the characteristics of that memory? Then, participants were given the questionnaire that included an informed consent. All participants collaborated with the research voluntarily and without any type of benefit.

The questionnaires were collected at five different time points:

- September 2017: 93 participants
- January 2018: 62 participants
- March 2018: 36 participants
- September 2018: 101 participants
- December 2018: 72 participants

A between-subject design was used to avoid the effect of learning and multiple recall. If the same subjects had been asked to provide the data at five different time points, such as in a longitudinal study, we would not know if the effect found could be due to the passage of time or to the second or subsequent time they perform the questionnaire. One of the effects that this design tried to avoid is the hypermnesia produced by the induced multiple retrieval, and the subsequent effects that this could cause. For this reason, different groups of participants were used for each evaluation.

Analyses

To test the hypothesis, ANOVA analyses were used, with the evaluation moment as an independent variable (time interval spanning from the attacks in Barcelona in August 2017 until the evaluation was carried out), and as dependent variables (a) the items of the CCFRA/PQAM Questionnaire, and (b) the scores of the three dimensions that cover:

memory quality, associated emotions and accessibility. For those cases in which statistically significant effects of the IV were found, the corresponding multiple comparisons were carried out using the Bonferroni procedure. In all cases, the corresponding effect sizes (η^2) are provided.

Additionally, an analysis was performed for each time period by means of Pearson's correlation to assess the association between the three components of the instrument (memory quality, associated emotions and accessibility).

Results

The results obtained for each variable according to the retention interval are shown in Tables 1 and 2. As multiple comparisons were performed, the level of significance was adjusted to $p<.002$ (Bonferroni).

If we consider that the central point (4) indicates an intermediate position between the two categories that define the extremes in a characteristic measured with items, the analysis on this central point is particularly relevant. Statistically significant lower values indicate that the memory is characterized in the direction of the category at the lower end and statistically significant higher values indicate that the memory is characterized in the direction of the category at the upper end (Table 1)

Quality

In general, results show that the memories of the attacks are visual and colourful but lack other sensory modalities, characteristics that are maintained throughout the whole time without statistically significant differences.

With respect to the other quality dimensions, no significant differences were found with the neutral point, except for the degree of detail and fragmentation that are significantly lower for all the moments evaluated except March 2018. Definition and vividness were significantly lower only in December. 2018, with no differences in the rest of the moments evaluated.

Emotions

Results confirm that the memories of the attacks are emotionally significant throughout the entire time, as participants perceived the events as negative, emotionally intense (except in December 2018) and with serious implications. The relevance attributed to the event, the memory of the feelings associated with the attack and what they thought then were only significant in March 2018.

Table 1. Statistical significance test (*T* and *p* statistic) in relation to the theoretical midpoint of each element based on the time of evaluation and for the overall sample.

	Sept. 17 (*N*=93)		Jan. 18 (*N*=62)		Mar. 18 (*N*=36)		Sept. 18 (*N*=101)		Dec. 18 (*N*=72)		Global (*N*=364)	
	T	*p*	*T*	*p*	*T*	*p*	*T*	*P*	*T*	*p*	*T*	*p*
12. Definition	−1.31	.195	−0.34	.738	1.62	.114	−0.43	.672	−4.59	<.001*	−2.50	.013
19. Vividness	−1.81	.074	−3.02	.004	1.51	.141	−0.23	.822	−3.97	<.001*	−3.50	.001*
24. Detail	−4.19	<.001*	−3.53	.001*	0.12	.907	−4.79	<.001*	−6.53	<.001*	−8.79	<.001*
11. Fragmentation	−4.14	<.001*	−6.21	<.001*	−2.22	.033	−6.28	<.001*	−6.72	<.001*	−11.41	<.001*
30. Comprehension	−0.13	.897	−0.60	.551	1.17	.249	−2.93	.004	−2.63	.010	−2.58	.010
4. Complexity	−2.99	.004	−4.19	<.001*	0.21	.835	−0.83	.411	−2.03	.046	−4.54	<.001*
27. Doubts	1.48	.143	−0.49	.628	−1.36	.181	−2.20	.030	−3.08	.003	−2.38	.018
20. Perspective	−2.69	.009	−1.21	.230	−1.39	.173	−2.90	.005	−1.63	.108	−4.55	<.001*
7. Colour	10.12	<.001*	8.86	<.001*	7.93	<.001*	9.63	<.001*	7.12	<.001*	19.33	<.001*
16. Visual	2.61	.011	1.98	.052	4.97	<.001*	3.33	.001*	1.73	.088	6.14	<.001*
6. Sound	−4.57	<.001*	−7.94	<.001*	−.37	.716	−6.81	<.001*	−4.95	<.001*	−10.86	<.001*
2. Smell	−26.65	<.001*	−22.10	<.001*	−13.20	<.001*	−46.19	<.001*	−20.46	<.001*	−55.29	<.001*
23. Touch	−20.21	<.001*	−20.46	<.001*	−14.15	<.001*	−28.16	<.001*	−20.21	<.001*	−46.45	<.001*
15. Taste	−32.01	<.001*	−58.96	<.001*	−34.39	<.001*	−53.43	<.001*	−21.43	<.001*	−73.40	<.001*
Quality	−7.61	<.001*	−7.93	<.001*	−2.50	.017	−9.95	<.001*	−8.39	<.001*	−16.59	<.001*
13. Implications	5.01	<.001*	9.65	<.001*	18.83	<.001*	12.62	<.001*	16.96	<.001*	21.06	<.001*
1. Valence	21.30	<.001*	20.44	<.001*	34.39	<.001*	33.21	<.001*	18.74	<.001*	50.42	<.001*
10. Intensity	3.90	<.001*	3.60	.001*	8.20	<.001*	5.15	<.001*	3.01	.004	9.67	<.001*
5. Relevance	0.984	.325	−0.10	.922	5.01	<.001*	0.89	.376	−0.17	.865	2.27	.024
3. Feelings event	2.24	.028	2.18	.033	4.16	<.001*	1.87	.065	−0.79	.432	3.56	<.001*
25. Feelings now	−2.19	.031	−3.65	.001*	1.60	.119	−2.70	.008	−4.84	<.001*	−5.53	<.001*
31. Thoughts event	1.90	.060	−1.54	.128	5.79	<.001*	2.19	.031	−0.32	.747	2.69	.007
Emotions	5.56	<.001*	5.01	<.001*	11.89	<.001*	7.68	<.001*	4.05	<.001*	13.32	<.001*
17. Recall effort	2.59	.011	1.15	.253	1.87	.069	0.00	.999	−1.95	.055	1.50	.135
9. Previous events	−4.52	<.001*	−6.54	<.001*	−4.90	<.001*	−8.18	<.001*	−7.47	<.001*	−13.89	<.001*
26. Subsequent events	1.14	.256	−2.05	.045	2.16	.038	0.88	.382	−2.81	.006	0.44	.658
14. Thinking event	−1.84	.069	−6.83	<.001*	0.14	.886	−6.42	<.001*	−8.24	<.001*	−10.30	<.001*
18. Talking event	5.43	<.001*	−1.14	.257	5.48	<.001*	0.62	.538	−1.70	.093	2.71	.007
21. Forgetfulness event	0.302	.763	−3.26	.002*	−0.28	.782	−2.78	.006	−6.04	<.001*	−5.19	<.001*
22. Reliving the event	0.302	.763	−29.32	<.001*	8.37	<.001*	−28.12	<.001*	−6.59	<.001*	−18.76	<.001*
Accesibility	0.55	.580	−8.00	<.001*	−1.47	.150	−4.85	<.001*	−5.79	<.001*	−7.95	<.001*

*Significative $p<.002$ (Bonferroni adjustment for multiple comparisons).

Table 2. Means, standard deviations, significance test (*F* and *p* statistic) and effect size (η^2) and group comparison.

	Sept. 17 (a) (*N*=93)		Jan. 18 (b) (*N*=62)		Mar. 18 (c) (*N*=36)		Sept. 18 (d) (*N*=101)		Dec. 18 (e) (*N*=72)		*F*	*p*	η^2	Group comparison
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*				
12. Definition*	3.75	1.83	3.94	1.51	4.39	1.44	3.93	1.64	3.18	1.51	4.75	.001	.043	c–e/d–e
19. Vividness*	3.69	1.66	3.50	1.30	4.36	1.44	3.97	1.32	3.33	1.42	4.19	.002	.045	c–b/c–e/d–e
24. Detail	3.35	1.49	3.37	1.41	4.03	1.42	3.32	1.44	2.94	1.37	3.47	.008	.037	c–e
11. Fragmentation	3.30	1.63	3.00	1.27	3.44	1.50	3.01	1.58	2.83	1.47	1.58	.178	.017	–
30. Comprehension	3.98	1.60	3.89	1.48	4.33	1.71	3.57	1.46	3.47	1.70	2.67	.032	.029	c–e
4. Complexity	3.48	1.68	3.21	1.48	4.06	1.59	3.89	1.33	3.67	1.39	2.99	.019	.032	c–b
27. Doubts	4.23	1.48	3.90	1.57	3.64	1.59	3.67	1.49	3.47	1.45	3.07	.016	.033	a–e
20. Perspective	3.48	1.85	3.68	2.09	3.47	2.27	3.36	2.23	3.60	2.10	0.27	.896	.003	–
7. Colour	5.50	1.43	5.60	1.42	5.50	1.13	5.42	1.48	5.28	1.52	0.48	.754	.005	–
16. Visual	4.45	1.67	4.40	1.60	5.28	1.54	4.50	1.49	4.31	1.50	2.58	.037	.028	c–e
6. Sound	3.13	1.84	2.65	1.34	3.89	1.82	2.91	1.61	3.07	1.60	3.50	.008	.038	c–b/c–d
2. Smell	1.34	0.96	1.35	0.94	1.64	1.07	1.19	0.61	1.42	1.07	1.80	.129	.020	–
23. Touch	1.52	1.19	1.40	1.00	1.58	1.03	1.38	0.94	1.44	1.07	0.39	.814	.004	–
15. Taste	1.23	0.84	1.13	0.38	1.22	0.49	1.15	0.54	1.35	1.05	1.03	.390	.011	–
Quality	46.43	12.12	45.02	10.91	50.83	12.39	45.26	10.85	43.36	12.79	2.61	.035	.028	c–e
13. Implications*	5.01	1.95	5.71	1.40	6.42	0.77	5.75	1.40	5.90	0.95	7.81	.000	.080	b–a/c–a/d–a/e–a
1. Valence*	1.82	0.99	1.77	0.86	1.22	0.49	1.62	0.72	1.86	0.97	4.22	.002	.045	c–a/c–b/c–e
10. Intensity*	4.55	1.36	4.56	1.24	5.64	1.20	4.65	1.28	4.47	1.33	5.78	<.001	.060	c–a/c–b/c–d/c–e
5. Relevance*	4.15	1.42	3.98	1.30	5.03	1.23	4.11	1.23	3.97	1.38	4.55	.001	.048	c–a/c–b/c–d/c–e
3. Feelings event	4.40	1.71	4.50	1.81	5.03	1.48	4.31	1.65	3.81	2.09	3.15	.015	.034	c–e
25. Feelings now*	3.67	1.47	3.35	1.39	4.39	1.46	3.63	1.36	3.18	1.44	4.86	.001	.051	c–b/c–e
31. Thoughts event*	4.39	1.96	3.66	1.73	5.22	1.27	4.41	1.87	3.93	1.82	5.12	.001	.054	c–b/c–e
Emotions*	32.34	7.52	32.00	6.27	38.50	5.30	33.24	6.85	31.40	7.13	7.33	<.001	.076	c–a/c–b/c–d/c–e
17. Recall effort	4.48	1.80	4.23	1.54	4.44	1.42	4.00	1.69	3.63	1.63	3.26	.012	.035	a–e
9. Previous events	3.09	1.94	2.63	1.65	2.69	1.60	2.60	1.72	2.50	1.70	1.48	.207	.016	–
26. Subsequent events	4.23	1.91	3.53	1.80	4.64	1.78	4.65	1.49	3.38	1.89	1.39	.237	.015	–
14. Thinking event*	3.74	1.35	2.81	1.38	4.03	1.16	3.04	1.50	2.79	1.24	10.23	<.001	.102	a–b/a–d/a–e/c–b/c–d/c–e
18. Talking event*	4.83	1.47	3.76	1.67	5.00	1.10	4.10	1.61	3.67	1.66	9.64	<.001	.097	a–b/a–d/a–e/c–b/c–d/c–e
21. Forgetfulness event*	4.04	1.16	3.31	1.68	3.92	1.80	3.48	1.90	3.15	1.19	4.38	.002	.047	a–b/a–e
22. Reliving the event*	4.04	1.16	1.50	.67	2.36	1.18	1.72	.81	3.07	1.20	88.55	<.001	.497	a–b/a–c/a–d/a–e/c–b/c–d/e–b/e–c/ e–d
Accesibility*	28.44	7.71	21.76	6.15	27.08	3.74	23.59	9.12	22.18	8.52	10.82	<.001	.108	a–b/a–d/a–e/c–b/c–e

*Significative $p<.002$ (Bonferroni adjustment for multiple comparisons).

Accessibility

Regarding the accessibility of the memories of the attack, results show that participants have talked about the event in the short term, in September 2017 and March 2018. The participants do not tend to relive the event, with the exception of March 2018. The general tendency is that the participants do not remember the previous events, have not thought about it, do not have the feeling that they have forgotten details, nor do they tend to relive the event. Global accessibility is low with the exception of September 2017 and March 2018, when mean scores were found.

The results obtained show statistically significant differences (Table 2) in the characteristics of the memory of the attacks in Barcelona in August 2017, based on the retention interval in two items of the memory quality dimension (Figure 1), in six items of the dimension of associated emotions (Figure 2) and in four accessibility items of that memory (Figure 3).

As can be seen in Figure 1, in March 2018, the results obtained in the elements of the *quality of memory* of vividness and definition reach a significantly higher score than that reported in those items by the participants in December 2018 (p=.005 and p=.002 respectively). The rest of the comparisons were not statistically significant.

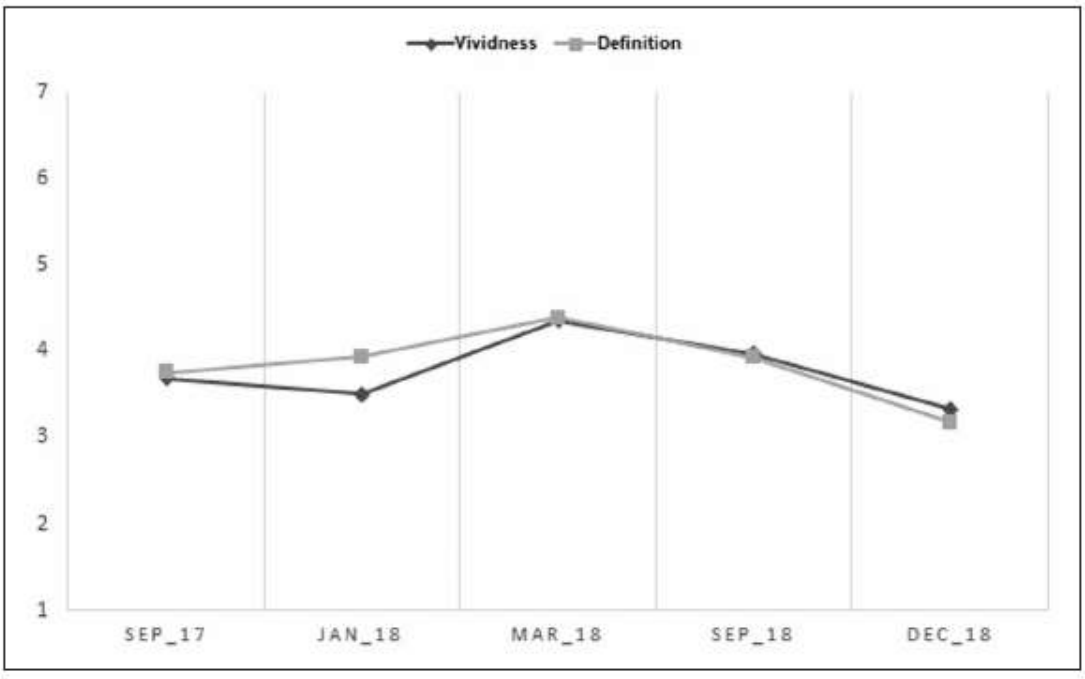

Figure 1. Graphical representation of the mean scores in the memory quality variables with statistically significant effects.

Regarding the *associated emotions* (see Figure 2), the results show that (a) regarding the implications, the scores obtained in September 2017 are significantly lower than those obtained in March, September and December 2018 (p<.001, p=.004 and p=.001, respectively); (b) for valence, the evaluation carried out in March 2018 showed a more negative memory than those carried out in September 2018 (p=.003) and in December 2018 (p=.002); (c) in terms of intensity, the evaluation of this memory carried out in March 2018 was significantly higher than that carried out in the other four time periods (p<.001 in all cases); (d) in terms of relevance, again, the score obtained in March 2018

was statistically higher than those obtained in January 2018 (p=.002), in September 2018 (p=.003) and in December 2018 (p=.001); (e) in the emotions now, the only difference that was found was between March 2018 and December 2018 (p<.001), with the last participants scoring lower in this item; and (f) in thought, again the participants evaluated in March 2018 obtained higher scores than those of January 2018 (p<.001) and December 2018 (p=.003). In general, it is observed that, as time passes, the feelings associated with the event intensify, being also remembered more negatively and with greater implications. In March 2018, the highest scores were obtained in these previously commented aspects. However, the scores tend to decrease in subsequent time periods (in September and December 2018).

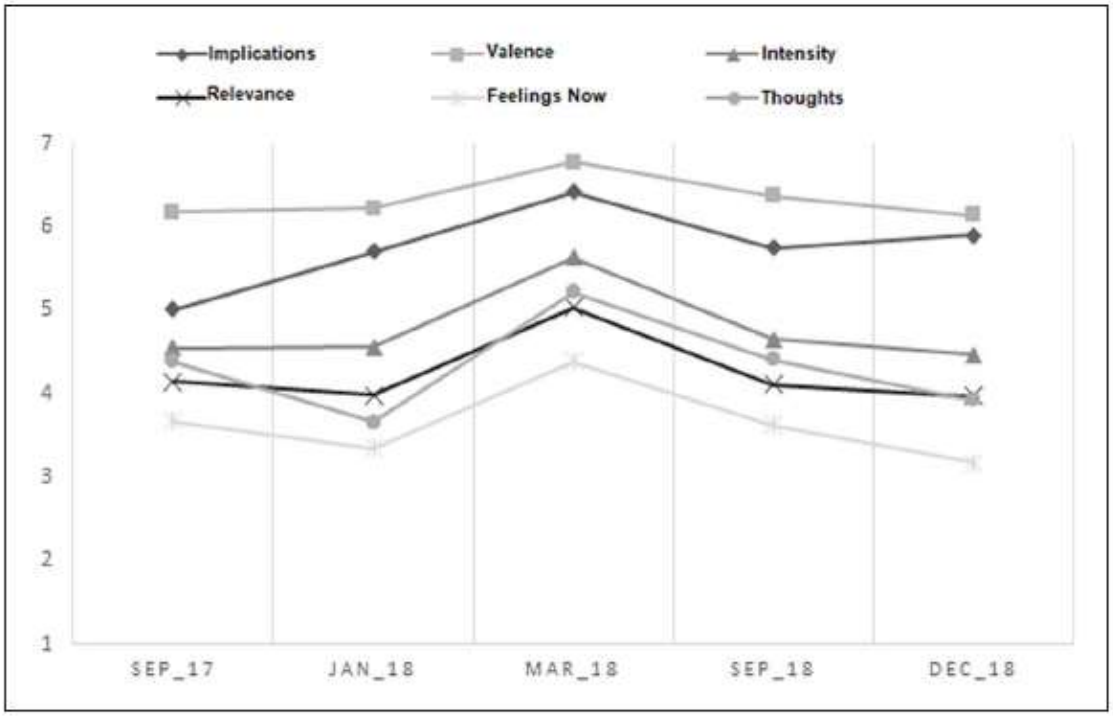

Figure 2. Graphical representation of the mean scores in the emotion variables associated with memory with statistically significant effects.

Regarding its *accessibility* (see Figure 3), results show that (a) for the item of thinking about the event there were no statistically significant differences between the evaluation carried out in September 2017 and that of March 2018, however the scores obtained in these two time periods were significantly higher than the other periods: January, September and December 2018 (p<.001 in all cases); (b) in speaking of the event, exactly the same pattern as the one described above was repeated, again p<.001 for all these comparisons; (c) In forgetfulness, the highest score was obtained in September 2017 and the lowest in December 2018 (p=.003). The rest of the comparisons were not statistically significant; (d) finally, in reliving the event, the score achieved by the participants in September 2017 was significantly higher than the other four time points (p<.001) and the evaluation carried out in December 2018 obtained significantly higher scores than those carried out in January 2018 (p<.001) and in September 2018 (p<.001).

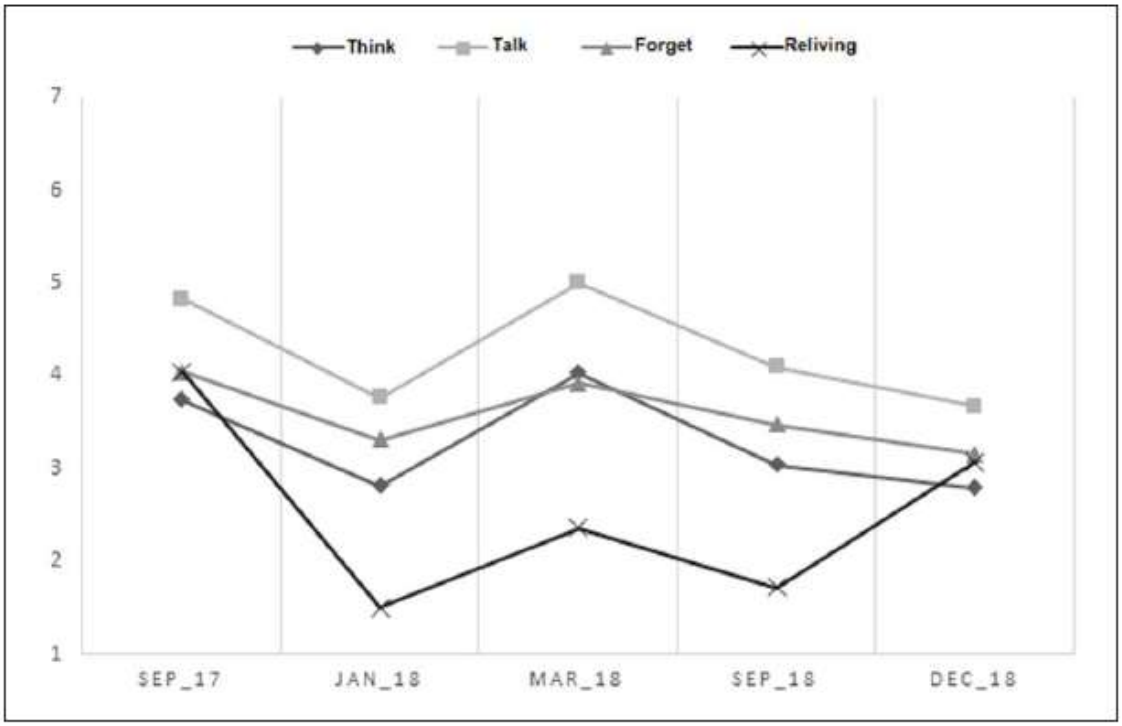

Figure 3. Graphical representation of the mean scores in the variables of accessibility to the memory with statistically significant effects.

Figure 4 shows the effects for the three dimensions of memory characteristics evaluated according to time (on the left side), and on the overall score of the questionnaire (on the right side). Since each dimension is composed of a number of different items, it makes no sense to compare between them. The results indicate that in the quality of the memory, although there seems to be a certain trend, it does not reach the threshold of statistical significance. In the dimension of emotions associated with memory, the score reached in March 2018 was significantly higher than that of the other four time points (p<.001 for all comparisons). In the accessibility dimension, the first evaluation of the memory carried out only 1 month after the attacks in Barcelona was the one that reached the highest score in relation to those carried out in January, September and December 2018 (p<.001 for three comparisons). There were no statistically significant differences in accessibility between the evaluations of September 2017 and March 2018. Finally, in the overall score of the instrument, there were statistically significant differences between the evaluations of March 2018 and those made in January 2018 (p=.002) and December 2018 (p<.001).

Finally, Figure 5 shows the mean scores of the dimensions of quality of memory, associated emotions and accessibility for each of the time periods in which the evaluation of the memory was carried out.

As can be seen in Figure 5, there was -across the five moments evaluated- an intense map of positive and statistically significant correlations (p<.001). This suggests that the three dimensions considered, associated with the characteristics of the memory, share variance between them.

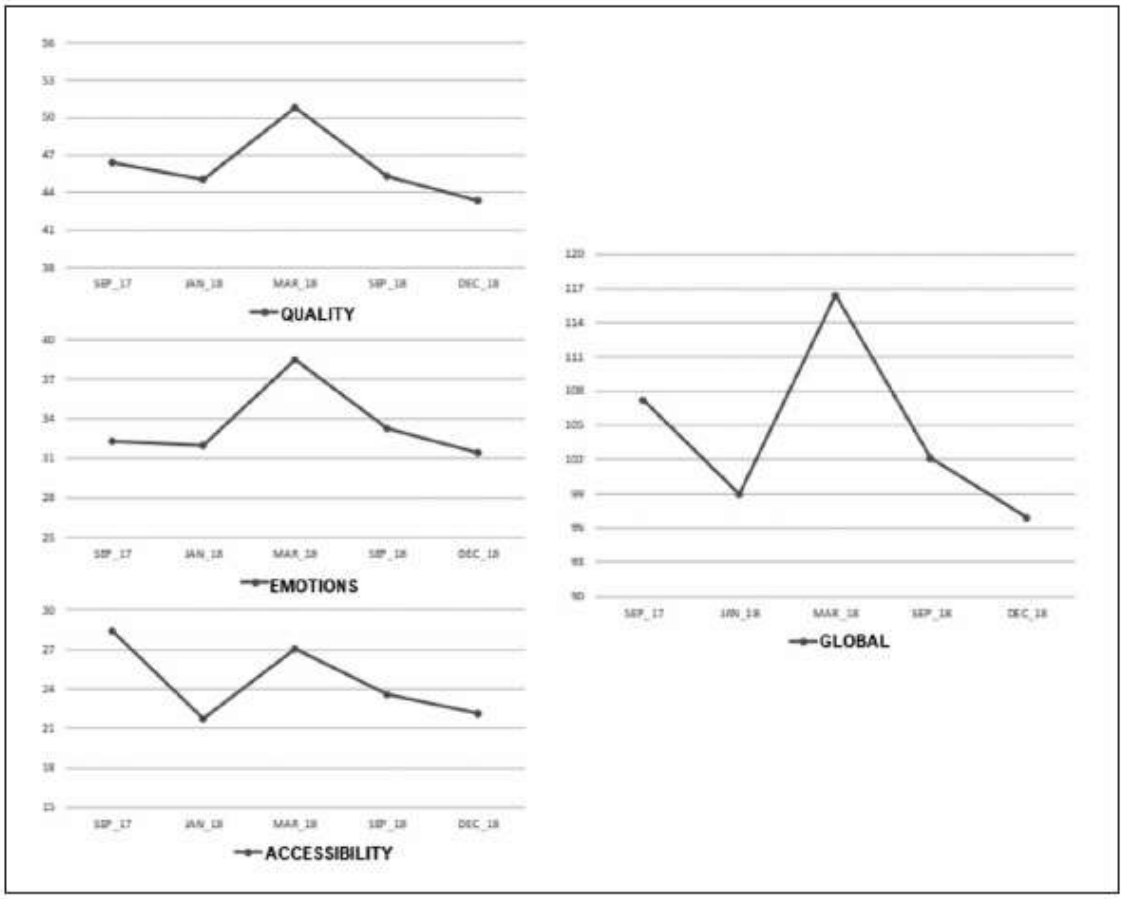

Figure 4. Graphical representation of the mean scores in the three dimensions of the characteristics associated with the memory and the overall score.

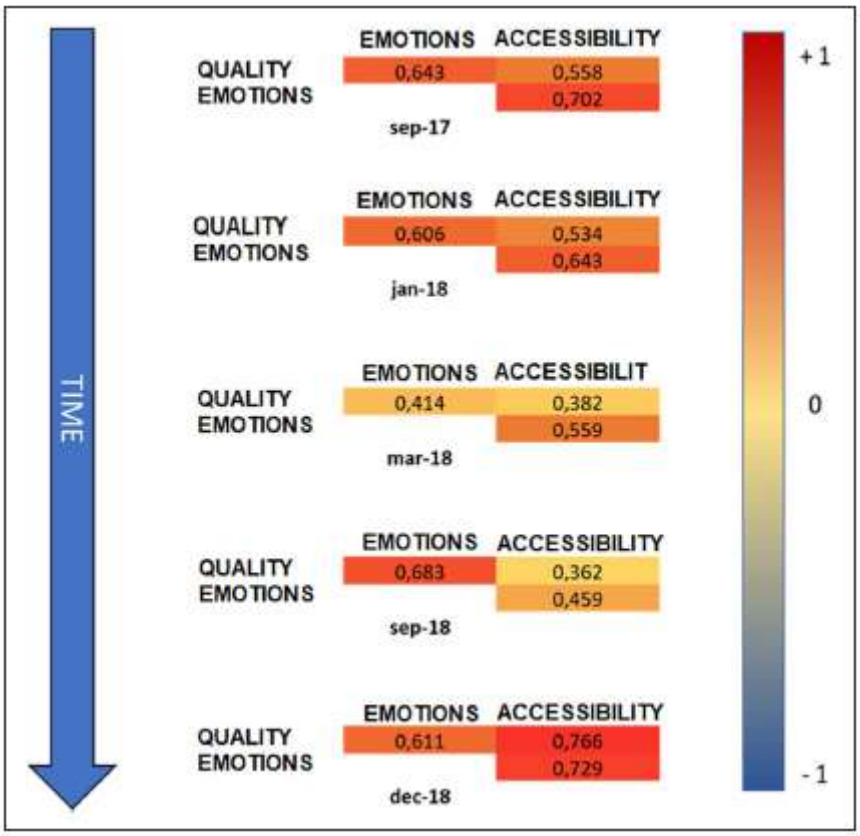

Figure 5. Heat maps of the Pearson's correlations found among the three dimensions evaluated by the CCFRA/PQAM Questionnaire at the five time points. All correlations were statistically significant (p<.001).

Discussion

The results obtained show significant differences in the characteristics of the memory of the attacks in Barcelona in August 2017, depending on the retention interval with respect to the quality of the memory, the associated emotions and its accessibility. This memory is characterized by being very visual, emotional and with low accessibility. However, it would only comply with the characteristics usually associated with FBM in the medium term (about 7 months after the events). That is, these characteristics do not appear in a clear way immediately and are lost just over a year after the event.

The results obtained in *memory quality*, *emotions* and *accessibility* reached their highest score in March 2018. A possible explanation could be that some related event may have affected the results. For this reason, terrorist attacks that may have coincided in dates close to the data collection were investigated. On March 11th, the anniversary of the Madrid attacks of 2004 is celebrated, which previous studies (Vallet et al., 2017) have shown that they remain relevant and memorable, as every year, the media broadcast special news reports about them. In addition, it was noted that on February 14th, a few weeks before the March assessment that took place between days 5 and 16, there was a shooting at Parkland High School (Florida, USA) with 17 dead and 14 injured. On March 23rd, there was an attack in Trèbes (France), where four people died and 16 were injured, although due to the fact that the evaluation in the present study was carried out before, it could not have affected the result. Regarding the evaluation carried out between the 17th and the 21st of December, an attack occurred in a Christmas market in Strasbourg

(France) on December 11th, 2018, with five dead. No other attacks were found that coincided with the evaluation periods.
The differences between the memories of March and December, when previously there were other attacks, lead us to think that the March scores are not due to the occurrence of other related events, as Conway et al. (2009) showed in a study where the presence of the incident in the media, due to the anniversary of the attack, had no apparent effect. In any case, its effect would seem to occur in the very short term. More research would be necessary to assess this effect.

In this way, the consumption of social media, or broadcast media, in younger cohorts could influence relevance and vividness of memory. So future studies should address the role of social networks in the formation and maintenance of the FBM. As stated, some previous studies have already reported that social media would play an important role in collective and autobiographical memory (Hoskins, 2009; O'Connor, 2019), and could facilitate the accessibility of memories (Wang et al., 2017). For this reason, one of the limitations of the present study is that due to the age of the participants, this factor should be controlled or at least evaluated, in the same way as the possible effect of mass media.

In general, it is observed that the associated emotions increase with the passage of time, perceiving the facts more negatively, with greater relevance and with more intense emotions. The increase in perceived relevance or transcendence could explain, at least in part, the effect on other variables in the medium term. Thinking and talking about the event could also explain the effect on the rest of the variables, in the medium term, decreasing in the longer term.

In the direction of the proposals of Er (2003), the results achieved in the present study would indicate that the relevance attributed to the events is one of the important factors, probably more than others, because it has the capacity to influence the rest of the factors. These data are consistent with the tests that show that we only tend to remember the significant (relevant) autobiographical events, while the neutral ones are lost. It could be considered that the passage of time and postevent information regarding other similar events have led to greater knowledge of the consequences of the event, which could motivate the greater emotional intensity found after a time interval of 7 months, being remembered in a more negative way and with greater implications, characteristics that disappear in the long term, in line with previous studies (Shapiro, 2006) where the memories of the event were affected differently by the recalls and the retention interval. Thus, a possible explanation for the decline in scores from March 2018 onwards could be that, as time goes by, we stop thinking and talking about the event, remembering it with less intensity and with less relevance. The memory, therefore, loses the typical characteristics of a FBM. Although the results go in the direction of previous studies, the different size of the groups could be affecting the result, so future studies should try to replicate the effect found.

In short, it can be considered that the lesser relevance with which the long-term event is remembered, and its lower accessibility could be the reason why we make a lower number of recalls and our memory loses characteristics associated with FBMs. In other words, the formation of a vivid memory seems to depend more on the relevance given to the event than on the retention interval, as that relevance will determine the number of subsequent recalls.

The results obtained are consistent with previous research (Rasmussen and Berntsen, 2009; Talarico et al., 2019) that support Er's (2003) hypothesis, according to which, the relevance given to an event by a certain social group is directly related to maintaining a vivid memory. These results provide a better understanding of how individual memories can contribute to the maintenance and accessibility of historical memories of events with

collective and emotionally relevant transcendence. They also give a clue as to how some social factors (significance, consequentiality and the role of the media) might influence recall of historical events over time, and how new related events may affect them retrospectively. More research is needed about this. As stated in the beginning, collective memories are built with the bricks of autobiographical memories. The autobiographical memories, in turn, are influenced by the collective memories that they generated in quality, accessibility and emotional relevance. In this way, an 'objective' event memory can give rise to a 'subjective and emotional' flashbulb memory.

Conflict of interest
No potential conflict of interest was reported by the authors.

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References

Bohn A and Berntsen D (2007) Pleasantness bias in flashbulb memories: Positive and negative flashbulb memories of the fall of the Berlin Wall among East and West Germans. *Memory & Cognition* 35: 565–577.

Brown R and Kulik J (1977) Flashbulb memories. *Cognition* 5: 73–99.

Coluccia E, Bianco C and Brandimonte MA (2010) Autobiographical and event memories for surprising and unsurprising events. *Applied Cognitive Psychology* 24(2): 177–199.

Conway MA, Anderson SJ, Larsen SF, et al. (1994) The formation of flashbulb memories. *Memory & Cognition* 22(3): 326–343.

Conway AR, Skitka LJ, Hemmerich JA, et al. (2009) Flashbulb memory for 11 September 2001. *Applied Cognitive Psychology* 23(5): 605–623.

Curci A, Lanciano T, Maddalena C, et al. (2015) Flashbulb memories of the Pope's resignation: Explicit and implicit measures across differing religious groups. *Memory* 23(4): 529–544.

Curci A and Luminet O (2006) Follow-up of a cross-national comparison on flashbulb and event memory for the September 11th attacks. *Memory* 14(3): 329–344.

Curci A and Luminet O (2009). Flashbulb memories for expected events: A test of the emotional-integrative model. *Applied Cognitive Psychology* 23: 98–114.

Denver JY, Lane SM and Cherry KE (2010) Recent versus remote: Flashbulb memory for 9/11 and self-selected events from the reminiscence bump. *The International Journal of Aging and Human Development* 70(4): 275–297.

Er N (2003) A new flashbulb memory model applied to the Marmara earthquake. *Applied Cognitive Psychology* 17(5): 503–517.

Finkenauer C, Luminet O, Gisle L, et al. (1998) Flashbulb memories and the underlying mechanisms of their formation: Toward an emotional-integrative model. *Memory & Cognition* 26(3): 516–531.

George D and Mallery M (2003) *Using SPSS for Windows Step by Step: A Simple Guide and Reference*. Boston, MA: Allyn & Bacon.

Hirst W and Phelps EA (2016) Flashbulb memories. *Current Directions in Psychological Science* 25(1): 36–41.

Hornstein SL, Brown AS and Mulligan NW (2003) Long-term flashbulb memory for learning of Princess Diana's death. Memory 11: 293–306.

Hoskins A (2009) The mediatisation of memory. In: Garde-Hansen J, Hoskins A and Reading A (eds.) *Save as . . . Digital Memories*. London: Macmillan, pp.27–43.

Krackow E, Deming E, Longo A, et al. (2019) Memories of learning the news of the 2016 U.S. presidential election results. *Psychology of Consciousness: Theory, Research, and Practice* 6(4): 404–416.

Kraha A, Talarico JM and Boals A (2014) Unexpected positive events do not result in flashbulb memories. *Applied Cognitive Psychology* 28(4): 579–589.

Luminet O and Curci A (2009) The 9/11 attacks inside and outside the US: Testing four models of flashbulb memory formation across groups and the specific effects of social identity. *Memory* 17(7): 742–759.

Manzanero AL, Fernández J, Gómez-Gutiérrez MM, et al. (2020) Between happiness and sorrow: Phenomenal characteristics of autobiographical memories concerning war episodes and positive events in the Gaza Strip. Memory Studies 13(6): 917-931.

Manzanero AL and Palomo R (2020) Dissociative amnesia: beyond the evidence about the functioning of memory. *Anuario de Psicología Jurídica* 30: 43–46.

Neisser U and Harsch N (1992) Phantom flashbulbs: False recollections of hearing the news about Challenger. In: Winograd E and Neisser U (eds.) *Affect and Accuracy in Recall: Studies of "Flashbulb Memories"*. Cambridge: Cambridge University Press, pp.9–31.

O'Connor P (2019) The unanchored past: Three modes of collective memory. *Memory Studies*. Epub ahead of print 17 December 2019. DOI: 10.1177/1750698019894694.

Patihis L, Ho LY, Loftus EF, et al. (2018). Memory experts' beliefs about repressed memory. *Memory*. Epub ahead of print 7 October 2018. DOI: 10.1080/09658211.2018.1532521.

Payne DG (1987) Hypermnesia and reminiscence in recall: A historical and empirical review. *Psychological Bulletin* 101(1): 5–27. DOI: 10.1037/0033-2909.101.1.5.

Pezdek K (2003) Event memory and autobiographical memory for the events of September 11, 2001. *Applied Cognitive Psychology* 17(9): 1033–1045.

Pillemer DB (2003) Directive functions of autobiographical memory: The guiding power of the specific episode. *Memory* 11: 193–202.

Rasmussen AS and Berntsen D (2009) Emotional valence and the functions of autobiographical memories:
Positive and negative memories serve different functions. *Memory & Cognition* 37(4): 477–492.

Roehm ML (2016) An exploration of flashbulb memory. *Journal of Consumer Psychology* 26(1): 1–16.

Rubin DC and Umanath S (2015). Event memory: A theory of memory for laboratory, autobiographical, and fictional events. *Psychological Review* 122(1): 1–23.

Schmidt SR (2004) Autobiographical memories for the September 11th attacks: Reconstructive errors and emotional impairment of memory. *Memory & Cognition* 32(3): 443–454.

Shapiro LR (2006) Remembering September 11th: The role of retention interval and rehearsal on flashbulb and event memory. *Memory* 14, 129–147.
Smith MC, Bibi U and Sheard DE (2003) Evidence for the differential impact of time and emotion on personal and event memories for September 11, 2001. *Applied Cognitive Psychology* 17: 1047–1055.
Talarico JM, Bohn A and Wessel I (2019) The role of event relevance and congruence to social groups in flashbulb memory formation. *Memory* 27(7): 985–997.
Talarico JM and Rubin DC (2003) Confidence, not consistency, characterizes flashbulb memories. *Psychological Science* 14(5): 455–461.
Talarico JM and Rubin DC (2007) Flashbulb memories are special after all; in phenomenology, not accuracy. *Applied Cognitive Psychology* 21: 557–578.
Tekcan AI, Ece B, Gülgöz S, et al. (2003) Autobiographical and event memory for 9/11: Changes across one year. *Applied Cognitive Psychology* 17: 1057–1066.
Tinti C, Schmidt S, Testa S, et al. (2014) Distinct processes shape flashbulb and event memories. *Memory and Cognition* 42(4): 539–551.
Vallet R, Manzanero AL, Aróztegui J, et al. (2017) Age-related differences in phenomenal characteristics of long-term memories for the attack of March 11, 2004. *Anuario de Psicología Jurídica* 27: 85–93.
Wang Q, Lee D and Hou Y (2017) Externalising the autobiographical self: Sharing personal memories online facilitated memory retention. *Memory* 25(6): 772–776.

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Appendix

CCFRA/PQAM-31 – Phenomenological questionnaire on autobiographical memory

Please choose the degree to which the characteristics manifested in the scale items are present in your memory about the event retrieved by circling the corresponding number. Number 1 always means the lowest degree of agreement with whatever each item states, whereas 7 indicates the highest degree of agreement, with the rest of the numbers reflecting intermediate degrees between the two extremes. If you have any doubts, ask for help from the person who is administering the scale. Thank you.

Type of event

a. The Event was about:_____
b. Event Date: _____
c. In this event I was
    a. Witness
    b. Participant
    c. Victim
d. The duration of the event was

    1 2 3 4 5 6 7
    Very short very long
e. The place where the event took place was

    1 2 3 4 5 6 7
    unknown familiar

Memory characteristics

1. My feelings were

    1 2 3 4 5 6 7
    very negative very positive
2. My memory of this event involves smell

    1 2 3 4 5 6 7
    not at all definitely
3. I remember how I felt at the time the event took place

    1 2 3 4 5 6 7
    not at all definitely
4. The storyline is

    1 2 3 4 5 6 7
    very simple very complex
5. For me, this event means

    1 2 3 4 5 6 7
    nothing at all a lot
6. My memory of this event involves sound

    1 2 3 4 5 6 7
    not at all definitely

7. My memory of this event is

   1 2 3 4 5 6 7

   in black and white in color

8. My memory about where the event took place is

   1 2 3 4 5 6 7

   very vague very clear/distinct

9. I remember other events that preceded and were related to this event

   1 2 3 4 5 6 7

   not at all very clearly

10. My feelings were

    1 2 3 4 5 6 7

    not at all intense very intense

11. My memory of this event is

    1 2 3 4 5 6 7

    very fragmented complete

12. My memory of this event is

    1 2 3 4 5 6 7

    very vague very sharp/clear

13. This event had serious consequences

    1 2 3 4 5 6 7

    not at all definitely

14. Since it happened, I have thought about this event

    1 2 3 4 5 6 7

    not at all very often

15. My memory of this event involves taste

    1 2 3 4 5 6 7

    not at all definitely

16. My memory of this event involves visual detail

    1 2 3 4 5 6 7

    not at all definitely

17. In general, I remember this event

    1 2 3 4 5 6 7

    with a lot of difficulty very easily

18. I have talked about this event

    1 2 3 4 5 6 7

    not at all very often

19. Overall vividness is

    1 2 3 4 5 6 7

    very vague very vivid

20. When I remember this event I see myself from outside, as if I'm watching a movie

    1 2 3 4 5 6 7

    not at all definitely

21. I feel that I cannot remember some important element of the event

    1 2 3 4 5 6 7

    not at all very clearly

22. I usually relive the event

    1 2 3 4 5 6 7

    not at all very often

23. My memory of this event involves touch [or tactile] sensations

    1 2 3 4 5 6 7

    not at all definitely

24. My memory of this event is

    1 2 3 4 5 6 7

    very sketchy very detailed

25. As I remember it now, my feelings were

    1 2 3 4 5 6 7

    not at all intense very intense

26. I remember other events that followed and were related to this event

    1 2 3 4 5 6 7

    not at all very clearly

27. I am sure about the accuracy of my memory of the event

    1 2 3 4 5 6 7

    not at all totally sure

28. It is difficult for me to put into words what happened

    1 2 3 4 5 6 7

    not at all definitely

29. My memory about when the event happened is

    1 2 3 4 5 6 7

    very vague very clear/distinct

30. The storyline of the event is

    1 2 3 4 5 6 7

    very confusing very clear

31. I remember what I thought when it was happening

    1 2 3 4 5 6 7

    not at all very clearly

Instructions to correct the test

Items of memory quality: 2, 4, 6, 7, 8, 11, 12, 15, 16, 19, 20, 23, 24, 27, 29, 30.
Emotional characteristics: 1, 3, 5, 10, 13, 25, 31.
Accessibility of the memory: 9, 14, 17, 18, 21, 22, 26, 28.
* Note that compared with previous versions of the questionnaire punctuation in item number 27 is in the reverse format.