

I can still see, hear and smell the fire: Cognitive, emotional and personal consequences of a natural disaster, and the impact of evacuation

Igor Knez^a, Johan Willander^{a,*}, Andrew Butler^b, Åsa Ode Sang^c, Ingrid Sarlöv-Herlin^c, Ann Åkerskog^d

^a Department of Occupational Health Sciences and Psychology University of Gävle, Sweden

^b Department of Urban and Rural Development, Uppsala Swedish University of Agricultural Sciences, Sweden

^c Department of Landscape Architecture, Planning and Management, Alnarp Swedish University of Agricultural Sciences, Sweden

^d Fieldforest Research Institute, Uppsala, Sweden

ARTICLE INFO

Keywords:

Natural disaster
Autobiographical memory
Flashbulb memory
Sensory-perceptual re-experiencing
Emotions
Personal consequentiality
Evacuation

ABSTRACT

We investigated the effects of evacuation experience on autobiographical memory, sensory-perceptual re-experiencing, emotions, and personal consequentiality of a natural disaster one year after. A total of 601 individuals participated, living nearby the area of the largest fire in modern times in Sweden. It was shown that evacuated (first-hand experience) compared to not-evacuated (second-hand experience) participants thought and talked more about the fire. Evacuated residents also mentally traveled back and re-lived the disaster more; as well as saw the fire, heard its sound, smelled it more, and felt more anxious, enraged, and emotionally strong. Moreover, evacuated compared to not-evacuated participants estimated that their life and view of the world had changed due to the natural disaster. All this suggests that the psychology of dramatically charged events, such as natural disasters, differs notably between individuals “being there” and those “hearing the news”, indicating a factual flashbulb memory as a result of the first-hand experience.

1. Introduction

Newsflashes about alarming and consequential public incidents, such as political events and natural disasters, are broadcasted daily, entailing social-psychological negative and/or positive aftermaths (Brown & Kulik, 1977; Knez et al., 2018; Luminet & Curci, 2009a; Schmuck & Vlek, 2003). Negative experiences have been shown to elicit emotions of loss and grief, as well as health and well-being problems (Evans & Kantrowitz, 2002; Martin, 2015; Oliver-Smith, 1996). Positive experiences, on the other hand, relate to the phenomenon of post-traumatic growth, suggesting that individuals may undergo positive changes despite many negative aftereffects (Hefferon et al., 2009; Joseph, 2009; Joseph & Williams, 2005; Tedeschi & Calhoun, 1995).

Catastrophes also affect the cognition of individuals (Helton et al., 2011), and they may remember self-related consequential incidents for a long time (Schuman & Scott, 1989). Particularly affected is autobiographical memory, which serves as a cognitive basis for the self and identity (Brown et al., 2009; Conway, 2005; Knez, 2014). Autobiographical memory is involved in the processes of maintaining personal

and social bonding, sharing, and continuity in the self-system, as well as the processes of directing present and future self-goals and behaviors (Bluck et al., 2005; Conway & Pleydell-Pearce, 2000; Conway & Rubin, 1993; Knez, 2017; Knez et al., 2017; Pillemer, 2003). It enables individuals to remember and re-experience past self-biographical events (Conway & Pleydell-Pearce, 2000), outlined as life chronicles (Brewer, 1999; Fivush, 2011; Habermas & Bluck, 2000; Tulving, 2002).

Autobiographical memory, serving the self (Conway, 2005; Knez, 2014; Neisser, 1988; Pillemer, 2003), organizes self-biographical information from sensory details to life time periods (Conway & Pleydell-Pearce, 2000; Knez, 2006; Williams et al., 2008). In this cognitive vocation, the process of mental time travel enables the self to re-experience autobiographical information at hand, conveying a phenomenological experience of personal ownership (Boyer & Wertsch, 2009; Fivush et al., 2011; Klein, 2014). As a result, and in James' (1890/1950) terms, we could say that the self involves the psychological processes of continuity, coherence, agency, time and self-consciousness (Conway et al., 2004; Klein et al., 2004), suggesting that “The I who knows me is the same I who knows everything else, and the mental

* Corresponding author. Department of Occupational Health Sciences and Psychology University of Gävle, Sweden.

E-mail addresses: igor.knez@hig.se (I. Knez), johan.willander@hig.se (J. Willander), andrew.butler@slu.se (A. Butler), asa.sang@slu.se (Å.O. Sang), ingrid-sarlov.herlin@slu.se (I. Sarlöv-Herlin), ann@fieldforest.se (A. Åkerskog).

<https://doi.org/10.1016/j.jenvp.2021.101554>

Received 18 June 2020; Received in revised form 11 January 2021; Accepted 11 January 2021

Available online 16 February 2021

0272-4944/© 2021 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

representation of this knowledge is no different, except perhaps in intimacy and richness, than the mental representation of anything else I know." (Kihlstrom et al., 2003, p. 69).

Sensory types of information (Barsalou, 1988; Conway, 2009; Knez, 2006; Singer, 1995) involved in the autobiographical memory, as a cognitive and emotional goal-directed system (Conway, 2009; Conway et al., 2004; Conway & Pleydell-Pearce, 2000; Knez, 2014, 2016; Singer 1995, 2005), pertain to several sensory modalities, such as the visual, auditory and olfactory. Sensory information is an integral part of traumatic memories that can be a trigger of memories related to traumatic events. Regarding non-traumatic memories, Karlsson et al. (2013) found that the content of autobiographical memories is related to the modality of the retrieval cue. More specifically, the autobiographical memory content related to visual, auditory and olfactory retrieval-cues differ, whereas the content of multimodally retrieved memories may be described as a combination of the visual, auditory and olfactory retrieved memories. Other studies have also reported phenomenological differences between visually, olfactory and verbally evoked memories. Odors evoke more emotional memories and produce a stronger feeling of being brought back (Chu & Downes, 2002; Herz & Schooler, 2002; Karlsson et al., 2013; Willander & Larsson, 2006, 2007), suggesting an interaction between the physical environment and encoding/retrieval of events.

In sum: (1) Sensory information plays a significant role in autobiographical memory recall associated with different, modality-related, retrieval cues; and (2) Several interrelated but distinct psychological components and processes related to autobiographical memory might account for the self (Conway et al., 2004; Klein et al., 2004; Klein & Gangi, 2010; Knez, 2017; Knez et al., 2017; Knez and Nordhall, 2017; Neisser, 1988; Prebble et al., 2013).

Flashbulb memory has been suggested as a special category of autobiographical memory, which is a type of personal and collective remembering of emotionally-charged and surprising events (Brown et al., 2009; Brown & Kulik, 1977; Luminet et al., 2004; Pezdek, 2003). This type of memory is suggested to be stronger, more enhanced, and vivid than other autobiographical memories containing detailed recollections of the incident at hand, such as the environmental context, people involved, sensory-perceptual aspects and the precise time of hearing the news about the incident (Bohannon, 1988; Conway et al., 1994; Larsen, 1992). The definition per se and the brand name of this type of memory incorporates a photographic metaphor corresponding to the mental snapshots of alarming and consequential events frozen in time (Brown & Kulik, 1977; Lanciano et al., 2010; but see; Cubelli & Della Sala, 2008; Neisser, 2003).

Most of the flashbulb memory findings have been related to the public events broadcasted by the media, such as the assassination, resignation, and death of politicians, pop stars, explosion of the Challenger, and September 9/11 (Brown & Kulik, 1977; Christianson, 1989; Conway et al., 1994; Curci et al., 2001; Curci & Luminet, 2009; Demiray & Freund, 2015; Denver et al., 2010; Finkenauer et al., 1998; Neisser & Harsch, 1992). As a consequence, most of the data obtained have been based on memories of second-hand experiences of "hearing the news", thus, not of first-hand experiences of "being there" (Pillemer, 2009).

Very few studies of flashbulb memories, only two as far as we know, have investigated the first-hand experiences of "being there" compared to second-hand experiences of "hearing the news", namely, Neisser et al. (1996) and Er (2003). They reported that the former vs. the latter type of experience was associated with stronger vivid and consistent memory of the target disaster (earthquake in both studies). Respondents with second-compared to first-hand experiences were not directly affected by the disaster as related to the inconsistencies in memory performance. Additionally, both studies indicated that personal involvement and consequentiality had a direct impact on the formation of flashbulb memory for the disaster event. Based on these findings, and related to the main functions of the autobiographical memory, to maintain personal and social continuity in the self-system and direct present and

future self-goals and behaviors, Pillemer (2009, pp. 137–138) concluded that: "... memories of first-hand experiences are more likely than memories of hearing the news to serve a directive function, because personal circumstances contain useful information related to future well-being. Direct experiences also contribute strongly to a sense of personal identity. As a result, memories of salient and important first-hand experiences may receive more frequent and purposeful rehearsal, which could enhance persistence and consistency."

Despite some criticisms (e.g., that flashbulb memories are not stronger, more enhanced, and vivid than other autobiographical memories) of the status of flashbulb memory as a special category of autobiographical memory (Cubelli & Della Sala, 2008; Neisser, 2003; Weaver, 1993), research propagating this type of "photographic" memory has suggested three prerequisites for the formation of a flashbulb memory to occur: (a) novelty and surprise (comprising emotionality); (b) personal consequentiality (importance of the event for the individual); and (c) rehearsal (in time extended intra- and interpersonal processes of "talking" about the event; that is, personal reflections and social sharing), with personal consequentiality and strong emotions as the most fundamental predictors (Luminet, 2009; Luminet & Curci, 2009b).

1.1. Present study

On the July 31, 2014, a small forest fire was ignited during forestry work in Västmanland County, Sweden (59°54'N, 16°09'E). Due to human factors and weather the fire spread quickly, turning into the largest forest fire in modern times in Sweden. It covered an area of 14 000 ha (equivalent to almost 20 000 football/soccer fields) and affected four municipalities. The fire claimed the life of one forest worker, destroyed more than 20 houses, required the evacuation of almost 1200 people, and forced 4500 to stand-by for urgent evacuation. Twelve days after the initial event, on the 11th of August, the fire was finally considered to be under control. Reports on some of the psychological aftermaths of this disaster have been published, but only related to the phenomena of place-identity and well-being issues (Butler et al., 2019; Knez et al., 2018). Thus, no memory, emotion, and personal consequentiality data have yet been reported.

Following the studies presented above, we ascribed first-hand experiences to the evacuated group and second-hand experiences to the not-evacuated group of respondents, because the former compared to the latter harbored more of the dramatic "being there" involvements (Er, 2003; Neisser et al., 1996; Pillemer, 2009). All forms of autobiographical memories including flashbulb memories were investigated in the study.

1.1.1. Hypotheses

To investigate emotional, cognitive and personal consequences of a natural disaster in relation to evacuation, we formulated the following four hypotheses:

Hypothesis 1. Previous findings have reported emotional reactions to different types of disasters (Conway et al., 2008; Finkenauer et al., 1998; Lanciano et al., 2010; Lerner et al., 2003), suggesting strong emotions to be one of the fundamental predictors of the flashbulb memory phenomenon (Luminet, 2009; Luminet & Curci, 2009b). Assuming that evacuated compared to not-evacuated respondents had more of the first-hand experiences we predicted stronger emotional reactions to the natural disaster in the former than in the latter group.

Hypothesis 2. Given that first-hand experiences are emotionally and cognitively more directive for the self (Pillemer, 2009), for example, enhancing memory performance (Conway, 1995; Conway et al., 2008; Er, 2003; Neisser et al., 1996), we predicted a better autobiographical memory (processes of reflection, sharing, mental travel, and re-living) of the natural disaster in evacuated compared to not-evacuated residents.

Hypothesis 3. In line with the findings reporting that

autobiographical sensory information might aid the self (Conway, 2005; Knez et al., 2017; Neisser, 1988; Pillemer, 2003; Willander & Larsson, 2007; Williams et al., 2008), we predicted that evacuated vs. not evacuated participants would show a higher sensory-perceptual re-experiencing (retrieval of visual, auditory and olfactory information) of the natural disaster.

Hypothesis 4. Given that first-hand experiences serve a personal directive function and that one of the basic predictors for a flashbulb memory is the phenomenon of personal consequentiality (Luminet, 2009; Luminet & Curci, 2009b), we predicted that evacuated compared to not-evacuated residents will estimate that their life and view of the world had changed more due to the natural disaster.

In summary, and in general terms, the four hypotheses predict that evacuated compared to not-evacuated participants will show more of a factual flashbulb memory, or more of an exceptionally effectual encoding, because “efficient encoding of novel information is elementary for the successful adaptation and adjustment to the environment” (Finkenauer et al., 1996, p. 530). In other words, respondents with first-hand experiences will report stronger emotional reactions (Hypothesis 1), better autobiographical performance (Hypothesis 2), more of the sensory re-experiencing (Hypothesis 3) and personal consequentiality (Hypothesis 4) of the natural disaster than respondents with second-hand experiences.

2. Methods

2.1. Sample

A total of 2264 households randomly identified from a population register and living nearby the disaster area were sent a survey, one year after the fire. This was done because psychological impacts of natural disaster on inhabitants living nearby the disaster area have been reported by previous research (Ruiz & Hernandez; 2014; Shavit et al., 2013; Weinstein et al., 2000). Thus, the survey was not sent to a randomly identified sample across the four municipalities involved, but to randomly identified individuals that were first and foremost affected by the fire (see also Knez et al., 2018).

The survey was conducted in accordance with APA’s (American Psychological Association) ethics code. Accordingly, participants were informed about: (a) the objectives of this research; (b) their right to withdraw their participation at any time without any consequences; (c) how long it would take to complete the questionnaire, and information about the types of questions involved; (d) confidentiality; (e) there not being any financial compensation for participation; and (f) whom to contact with any questions related to the research project and survey. Their consent to participate was indicated by the return of the completed survey. The study received ethical approval; decision Nr 2015/7 (ethics application 2015/485), from the Ethics committee of Lund University, Sweden.

A total of 656 (29%) replies were obtained, of which 48.4% were women and 51.6% men, distributed across seven age groups, i.e. 18-25 (3%), 26–35 (5.6%), 36–45 (10.2%), 46–55 (15%), 56–65 (26.4%), 66–75 (28.9%), and 76–85 (10.9%). The power analysis was conducted with SPSS 27. The estimation was based on extracting parameters from previous work, which are reported in this paper (for an overview see e. g., Murphy et al., 2009). The sample size estimation indicated that $n = 321$ participants were needed for a power of .80 and $\alpha = 0.05$. In this article we report data on: (a) Emotional reactions for the first hours of the natural disaster and one year after; (b) Autobiographical memory one year after; (c) Sensory-perceptual re-experiencing one year after; (d) Perceived personal importance/consequentiality of the catastrophe one year after. In total, 601 subjects, who answered the evacuated/not-evacuated question, participated in this study, categorized as evacuated ($N = 182$) or not-evacuated ($N = 419$). The evacuated group comprised individuals that were evacuated and those that were

told to stand-by for urgent evacuation.

2.2. Measures

2.2.1. Emotions

Respondents were asked to estimate how they felt during the first hours of the disaster and one year after. This was done using a 7-point scale, ranging from 1 (completely disagree) to 7 (completely agree), related to thirteen emotional reactions/questions, “How did you feel during the first hours after learning the news about the disaster (respectively “When I think about the disaster today, I feel”): Angry; Sad; Confused; Frightened; Vulnerable; Strong; Indifferent; Desire to fight back; Hatred; Outrage; Helpless; A need to give help; and Distracted” (Conway et al., 2008). Cronbach alpha was .88.

2.2.2. Autobiographical memory

This included four statements measuring four autobiographical memory processes of reflection, sharing, mental travel, and re-living (Klein, 2013; Klein et al., 2004; Knez, 2014, 2017; Suddendorf & Corballis, 2007; Sutin & Robins, 2007), with a Cronbach alpha of .91. Respondents responded to the statement, “When I think about the disaster today I often: reflect on it, talk about it (sharing), can in my thoughts mentally travel back to the disaster, and re-live it”. Responses were made on a 7-point scale, ranging from 1 (completely disagree) to 7 (completely agree).

2.2.3. Sensory-perceptual Re-experiencing

Participants were asked to estimate their sensory-related visual, auditory, and olfactory re-experiencing of the fire (Knez et al., 2017), on a 7-point scale ranging from 1 (completely disagree) to 7 (completely agree). These scales were related to the statements “When I think about the fire I can still: see it, hear it, and smell it”. Cronbach alpha was .86.

2.2.4. Personal consequentiality

This was measured by two questions: “My life has changed because of the fire?” and “My view of the world has changed because of the fire?” (Conway et al., 2008) on a 7-point scale, ranging from 1 (completely disagree) to 7 (completely agree), with a Cronbach alpha of .77.

2.3. Design and analyses

A non-equivalent, comparison-group, quasi-experimental design (McGuigan, 1983) was used with one independent between-subject variable (evacuated vs. not-evacuated). Given that all measures comprised several scales, a MANOVA was used for each one of the dependent variables. An “amplifier” (Field, 2013) role of evacuation experience (moderator) was addressed using the plug-in PROCESS (Hayes, 2013) developed for IBM SPSS Statistics. See Fig. 1 a-d for the tested evacuation moderator effects.

Finally we assumed that data for the first hours of the natural disaster were not subjected to memory errors because self-reported data from a correctly recalled event, including a dated relevant situation, are firm data (Guttek, 1978; Loftus & Marburger, 1983).

3. Results

3.1. Emotions evoked by natural disaster

To determine whether correlations among the emotional responses (Angry; Sad; Confused; Frightened; Vulnerable; Strong; Indifferent; Desire to fight back; Hatred; Outrage; Helpless; A need to give help; and Distracted) were sufficiently strong to justify a factor analysis, Kaiser’s (1974) measure of sampling adequacy (homogeneity level) and Bartlett’s (1954) test of sphericity (that correlations in a correlation matrix are zero; i.e., that all diagonals are one and all off-diagonals are zero) were computed. Homogeneity level statistics showed values of 0.81

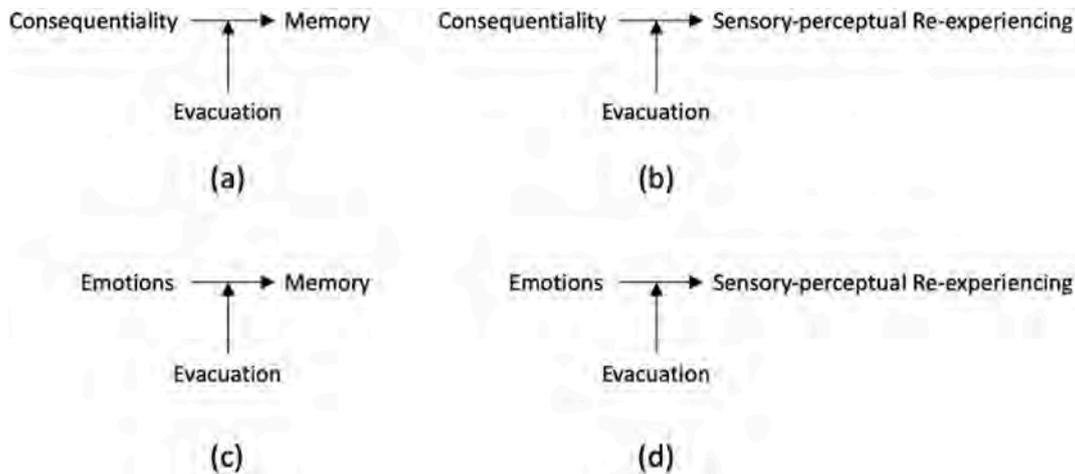


Fig. 1. The tested moderator effects of evacuation (a–d).

(emotional reactions for the first hours of catastrophe) and 0.82 (present, one year after, emotional reactions). They are, therefore, above the value of 0.06 needed for a good factor analysis (Tabachnick & Fidell, 1989). In addition, values of sphericity statistics were large ($p < .001$). All this suggested that we could proceed with the factor analysis.

Exploratory factor analyses, with principal component extraction and varimax rotation for different emotional responses, for the first hours of catastrophe and one year after were computed. As can be seen in Table 1A/B, both analyses suggested a three-factor solution involving emotions of “anxiety”, “rage”, and “emotional strength”; these categorizations were made in line with Conway et al. (2008).

In addition, t-tests showed that the intensity of anxiety and rage decreased significantly between encoding (first hours of catastrophe) and retrieval (one year after), $t(528) = 25.27, p < .001$ (at encoding $M = 4.4, SD = 1.72$ vs. at retrieval $M = 2.81, SD = 1.53$) and $t(500) =$

Table 1

The two factor analyses and their respective three-factor solutions (with factor loadings) for the emotional responses at (A) encoding (first hours of disaster) and (B) at retrieval (one year after the disaster), including mean and standard deviation statistics.

Emotions	M	SD	Anxiety	Rage	Strength
Factor analysis A					
(first hours of disaster)					
Sad	5.23	1.98	.599		
Confused	4.32	2.19	.788		
Frightened	4.52	2.16	.852		
Vulnerable	4.52	2.17	.830		
Helpless	4.53	2.26	.681		
Distracted	3.39	1.99	.562		
Angry	3.93	2.31		.715	
Hatred	2.13	1.74		.888	
Outrage	2.17	1.79		.890	
Strong	3.23	1.79			.653
Desire to fight back	4.19	2.02			.823
A need to give help	4.34	1.87			.815
Factor analysis B					
(one year after the disaster)					
Sad	3.98	2.17	.563		
Confused	2.03	1.56	.752		
Frightened	2.18	1.67	.827		
Vulnerable	3.07	2.04	.773		
Helpless	2.87	2.04	.650		
Distracted	2.01	1.41	.622		
Angry	2.89	2.08		.721	
Hatred	1.69	1.36		.890	
Outrage	1.68	1.44		.878	
Strong	3.91	1.98			.786
Desire to fight back	3.59	1.96			.840
A need to give help	4.05	1.89			.825

11.40, $p < .001$ (at encoding $M = 2.78, SD = 1.81$ vs. at retrieval $M = 2.09, SD = 1.52$); but not for emotional strength ($p = .21$; at encoding $M = 3.92, SD = 1.58$ vs. at retrieval $M = 3.85, SD = 1.69$). Firstly, this indicates that the emotionally charged event of a natural disaster was emotionally more intense at encoding (first hours) than on retrieval one year after; secondly, that all three emotions of anxiety, rage and emotional strength were extracted at both occasions and are thereby part of the autobiographical memory in people living nearby the disaster area. Thirdly, the intensity of emotional strength was shown to be constant between encoding (first hours of catastrophe) and retrieval (one year after).

Furthermore, a MANOVA showed, Wilks’s $\lambda = 0.96 (3, 512) = 7.44, p < .001, \eta^2 = 0.04$, that those evacuated felt more anxious ($p < .001$), enraged ($p < .001$), and emotionally strong ($p < .001$) one year after the disaster than not-evacuated participants (see Fig. 2).

In addition, and as can be seen in Fig. 2, all respondents felt more emotionally strong than anxious and enraged one year after, Greenhouse-Geisser, $F(2,875) = 496.14, p < .001, \eta^2 = 0.33$ (anxiety $M = 2.68, SD = 1.41$; rage $M = 2.07, SD = 1.48$; strength $M = 3.84, SD = 1.69$).

3.2. Memories for natural disaster

A MANOVA showed, Wilks’s $\lambda = 0.94 (4, 514) = 7.65, p < .001, \eta^2 = 0.06$, that one year after the disaster, evacuated compared to not-

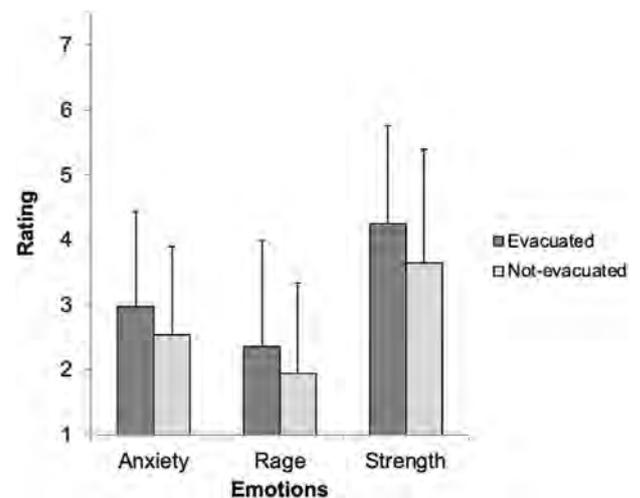


Fig. 2. Emotions (anxiety, rage, and emotional strength) in evacuated vs. not-evacuated one year after the disaster (error bars indicate 1 SD).

evacuated residents thought (reflection, $p < .001$) and talked more (sharing, $p < .001$) about the fire. They also mentally traveled back ($p < .001$) and re-lived ($p < .001$) the disaster more (see Fig. 3).

3.3. Sensory-perceptual re-experiencing of a natural disaster

As shown in Fig. 4, those evacuated saw the fire ($p < .001$), heard its sound ($p < .001$), and smelled ($p < .001$) it more one year after than not-evacuated participants, Wilks's $\lambda = 0.94$ (3, 534) = 10.54, $p < .001$, $\eta^2 = 0.06$.

3.4. Personal consequentiality of a natural disaster

A MANOVA showed, Wilks's $\lambda = 0.94$ (2, 515) = 16.79, $p < .001$, $\eta^2 = 0.06$, that evacuated compared to not-evacuated participants felt more that their life ($p < .001$) and view of the world ($p < .001$) had changed due to the natural disaster (see Fig. 5).

3.5. Evacuation as moderator in consequentiality → memory and consequentiality → sensory-perceptual re-experiencing relationships

Given the results reported above, a moderator analysis [PROCESS, developed by Andrew F. Hayes (2013) for IBM SPSS], was performed to check for the moderator type of influence of evacuation experience on the relationships between Consequentiality → Memory and Consequentiality → Sensory-perceptual Re-experiencing. As can be seen in Table 2/Model 1 (see interaction effect statistics), evacuation was shown to amplify significantly the relationship between personal consequentiality and autobiographical memory. Evacuation did not, however, influence the link between personal consequentiality and sensory-perceptual re-experiencing ($p = .64$). In addition, all regressions were significant: (1) personal consequentiality → autobiographical memory ($p = .00$); (2) personal consequentiality → sensory-perceptual re-experiencing ($p = .00$); (3) evacuation → autobiographical memory ($p = .00$); and (4) evacuation → sensory-perceptual re-experiencing ($p = .01$). The latter (points 3 and 4) confirms the MANOVA results reported above.

3.6. Evacuation as moderator in emotions → memory and emotions → sensory-perceptual re-experiencing relationships

In line with the above, we also tested for the moderator effects of evacuation experience on the relationships between Emotions →

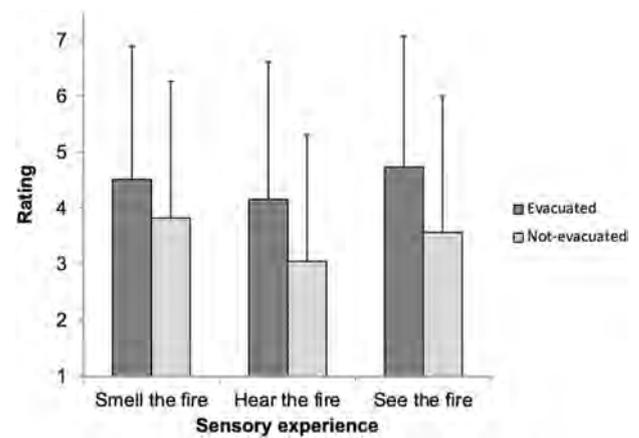


Fig. 4. Sensory-perceptual re-experiencing (retrieval of visual, auditory and olfactory information) in evacuated vs. not-evacuated one year after the disaster (error bars indicate 1 SD).

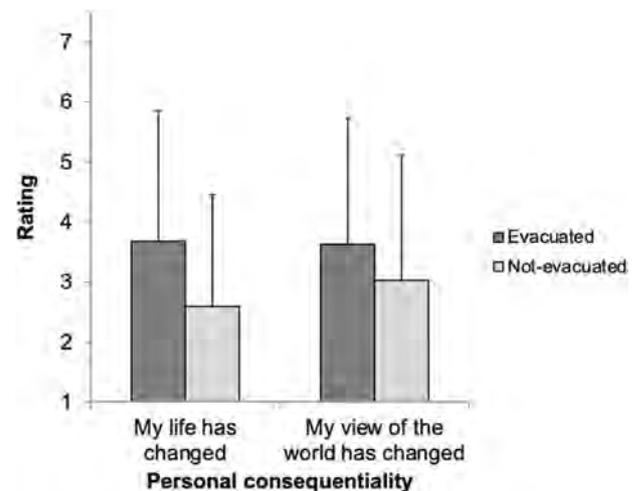


Fig. 5. Personal consequentiality (“My life has changed because of the fire?” and “My view of the world has changed because of the fire?”) in evacuated vs. not-evacuated one year after the disaster (error bars indicate 1 SD).

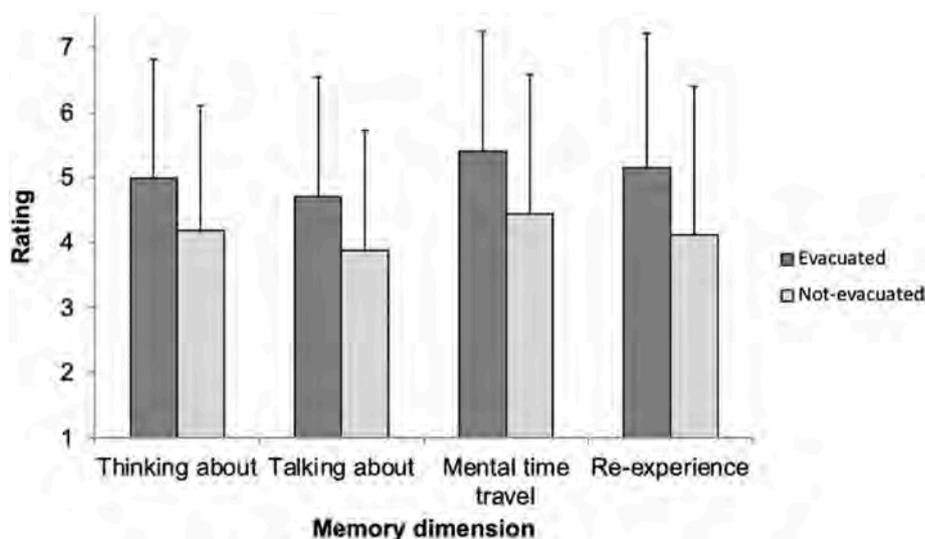


Fig. 3. Autobiographical memory (reflection, sharing, mental travel, and re-living) in evacuated vs. not-evacuated one year after the disaster (error bars indicate 1 SD).

Table 2

Moderator-analysis statistics (including confidence intervals LLCI and ULCI) for two models. Model 1, the relations between consequentiality (CON) and autobiographical memory including evacuation (E) as moderator, and interaction effect (INT) of consequentiality X evacuation as a measure of the moderator impact. Model 2, the relations between anxiety (ANX) and autobiographical memory including evacuation (E) as moderator, and interaction effect (INT) of anxiety X evacuation as a measure of the moderator impact.

Model	b	se	t	p	LLCI	ULCI
Model 1						
CON	.51	.05	10.05	<.001	.41	.61
E	.43	.14	3.00	<.001	.15	.70
INT	.14	.06	2.20	.03	.01	.26
Model 2						
ANX	.48	.06	7.92	<.001	.36	.59
E	.72	.15	4.88	<.001	.43	1.00
INT	.19	.08	2.35	.02	.03	.34

Memory and Emotions → Sensory-perceptual Re-experiencing. As can be seen in Table 2/Model 2 (see interaction effect statistics), evacuation was shown to amplify significantly the relationship between anxiety and autobiographical memory, but not between anxiety and sensory-perceptual re-experiencing ($p = .65$). Relationships between rage and emotional strength respectively, with autobiographical memory and sensory-perceptual re-experiencing respectively, were not significant ($p > .05$). In addition, all regressions between emotions/evacuation and autobiographical memory/sensory-perceptual re-experiencing were significant ($p < = .001$); thus, confirming MANOVA results reported above.

4. Discussion

The general aim was to investigate the role of first- (evacuated) compared to second-hand (not-evacuated) experience of a natural disaster, suggesting that evacuated compared to not-evacuated participants would show more of a factual flashbulb memory, or more of an especially efficient encoding, serving a directive role for the self in an efficacious adaptation and adjustment to a novel environment (Conway, 1995; Finkenauer et al., 1998; Knez, 2014; Knez & Eliasson, 2017; Knez et al., 2018b, 2020; Pillemer, 2009). In line with this reasoning, we hypothesized that respondents with first-compared to second-hand experience would report stronger emotional reactions (Hypothesis 1), better autobiographical performance (Hypothesis 2), and more of the sensory re-experiencing (Hypothesis 3) and personal consequentiality (Hypothesis 4) of the natural disaster.

Hypothesis 1 was supported and it was shown that feelings of, above all, anxiety, rage and emotional strength were present in both the first hours of the catastrophe and one year after, indicating that these, compared to other emotional responses, played more of a directive role for the self, and were thereby merged in the autobiographical memory of people living nearby the natural disaster area. These emotions were also shown to be more intense at the time of the fire (i.e. at encoding) than on retrieval one year after. All this is in line with previous research reporting emotional reactions to different types of catastrophe (Conway et al., 2008; Finkenauer et al., 1998; Lanciano et al., 2010; Lerner et al., 2001), suggesting strong emotions to be one of the central predictors of efficient encoding and flashbulb memory (Conway et al., 1994; Finkenauer et al., 1998; Luminet, 2009; Luminet & Curci, 2009b). Additionally, and in line with Hypothesis 1, evacuated compared to not-evacuated residents were shown to feel more anxious, enraged, and emotionally strong one year after. This is a tentative indication that first-compared to second-hand emotional experience may play a stronger directive role for the self (Pillemer, 2009) in adapting to a dramatically charged event of a natural disaster (Finkenauer et al., 1998).

In line with Hypothesis 2, and corresponding with previous findings

(Conway, 1995; Er, 2003; Neisser et al., 1996; Pillemer, 2009), respondents with first vs. second-hand experience were shown to perform better in autobiographical memory tasks. More precisely, they reflected upon and talked more about the catastrophe one year after than respondents with second-hand experience. They also mentally re-lived and traveled back more to the event. Thus, “memories of salient and important first hand experiences may receive more frequent and purposeful rehearsal, which could enhance persistence and consistency” (Pillemer, 2009, p. 138), leading to an especially effective recall of autobiographical information (Conway, 1995).

Given that autobiographical sensory information might likewise aid the self (Conway, 2005; Knez et al., 2017; Neisser, 1988; Pillemer, 2003; Willander & Larsson, 2007; Williams et al., 2008), we predicted that first compared to second-hand experience would indicate more of a sensory-perceptual re-experiencing (Hypothesis 3). In agreement with this, evacuated respondents saw the fire, heard its sound, and smelled it more one year after than respondents with second-hand experience. Corresponding to previous findings (Chu & Downes, 2000; Koppel & Berntsen, 2015; Willander et al., 2015; Willander & Larsson, 2006, 2007), this displays the importance of sensory information in autobiographical memory recall serving the self (Knez et al., 2017; Williams et al., 2008). It may be suggested that the degree of vividness could drive mental time travel. Thus, it is interesting to note that the evacuated individuals both experienced more sensory details (vividness) and mental time travel compared to the non-evacuated individuals who experienced both lower levels of sensory details and mental time travel. Our results also support the notion that sensory re-experience is an integral part of traumatic memories.

The phenomenon of personal consequentiality (importance of the event for the individual) is one of the fundamental predictors of flashbulb memory (Luminet, 2009; Luminet & Curci, 2009b). Given this, we predicted that respondents with first compared to second-hand experience would estimate that their life and view of the world might have changed more due to the natural disaster (Hypothesis 4). Consistent with this, evacuated compared to respondents with second-hand experience estimated to a higher degree that their life and view of the world had changed due to the catastrophe, suggesting that a dramatically charged event of this kind might be evaluated in terms of personal importance and consequentiality as suggested by flashbulb memory research (Brown & Kulik, 1997; Conway, 1995). In addition, this finding is in line with the phenomenon of posttraumatic growth, that individuals, despite largely negative aftereffects might subsequently undergo positive changes in their lives (Hefferon et al., 2009; Joseph, 2009; Joseph & Williams, 2005; Tedeschi & Calhoun, 1995).

Signifying the importance of first-, “being there”, compared to second-hand, “hearing the news”, experience of a dramatically charged event, we found that the former type of experience also played a moderator role in the relationships between: (a) anxiety and autobiographical memory, and (b) personal consequentiality and autobiographical memory. Accordingly, the first-hand experience was shown to amplify (Field, 2013) the basic psychological conditions (strong emotion and personal importance) needed for a flashbulb memory to develop (Brown & Kulik, 1977; Conway, 1995; Luminet, 2009; Luminet & Curci, 2009b). In view of this and the above discussion, we conclude with a question: Does first-compared to second-hand experience (Er, 2003; Neisser et al., 1996; Pillemer, 2009) of an emotionally charged event bring forth a special category of autobiographical memory (a factual flashbulb memory) or an especially efficient memory, aiding the self in its goal-directed adjustments to a novel situation and a changing environment?

For the time being, our conclusion is: Flash or not (Cubelli & Della Sala, 2008; McCloskey et al., 1988; Muzzulini et al., 2020), the psychology of dramatically charged events such as natural disasters differ notably between individuals “being there” and those “hearing the news”.

4.1. Limitations

The non-equivalent comparison-group quasi-experimental design (McGuigan, 1983) used in this study might be considered to be weaker because it lacks random subject assignment (Liebert & Liebert, 1995). However, our respondents were randomly identified/recruited from a population register, and, according to Campbell and Stanley (1963, p. 34; see also Shadish et al., 2002), there are “many natural social settings in which the researcher can introduce something like experimental design ... even though the researcher lacks full control over the scheduling of experimental stimuli”. Consistent with this, and in line with some previous research (e.g., Gunnarsson et al., 2017; Hedblom et al., 2017; Knez, Ode Sang, et al., 2018; Knez & Thorsson, 2006, 2008; Ode Sang et al., 2016), a quasi-experimental design has been used despite the lack of an unambiguous causal interpretation.

4.2. Practical implications

According to Alexander (2002), disaster management comprises four stages, i.e. mitigation, preparedness, response, and recovery. In line with previous research, we have shown that a natural disaster affects people's cognitive and emotional processes, and their personal consequentiality for a long time (Evans & Kantrowitz, 2002; Helton et al., 2011; Martin, 2015; Oliver-Smith, 1996; Schuman & Scott, 1989). This provides the evacuated individuals especially, with the first-hand experience of the natural disaster (Shavit et al., 2013; Weinstein et al., 2000). In consequence, and as a part of mitigation and preparedness phases, evacuation of persons “being there” must be planned in detail, catering for both their practical and psychological needs (Hong et al., 2019; Silver & Grek-Martin, 2015). Given that the management stages of response and recovery occur after a disaster, our results suggest that disaster management must not only plan for a short-term rescue, e.g. saving human lives, but also for a long-time psychological recovery of the evacuated (first-hand experience) individuals (Shaw, 2006; Vallianou et al., 2020).

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

This study is a part of the research project, “Landscape up in smoke; revealing the changing landscape-related identity among people who previously used the area in their daily lives” sponsored by FORMAS (The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning), grant number 2014-1876.

References

- Alexander, D. (2002). *Principles of emergency planning and management*. Hertfordshire, England: Terra Publishing.
- Barsalou, L. W. (1988). The content and organization of autobiographical memories. In U. Neisser, & E. Winograd (Eds.), *Remembering reconsidered: Ecological and traditional approaches to the study of memory* (pp. 193–243). New York, NY: Cambridge University Press.
- Bartlett, M. S. (1954). A note on the multiplying factors for various chi square approximations. *Journal of the Royal Statistical Society*, 16(Series B), 296–298.
- Bluck, S., Alea, N., Habermas, T., & Rubin, D. C. (2005). A tale of three functions: The self-reported uses of autobiographical memory. *Social Cognition*, 23, 91–117.
- Bohannon, J. N. (1988). Flashbulb memories for the space shuttle disaster: A tale of two theories. *Cognition*, 29, 179–196.
- Boyer, P., & Wertsch, J. (2009). *Memory in mind and culture*. Cambridge: Cambridge University Press.
- Brewer, W. F. (1999). What is recollective memory? In D. C. Rubin (Ed.), *Remembering our past: Studies in autobiographical memory* (pp. 19–66). Cambridge: Cambridge University Press.
- Brown, R., & Kulik, J. (1977). Flashbulb memories. *Cognition*, 5, 73–99.

- Brown, N. R., Lee, P. J., Krslak, M., Conrad, F. G., Hansen, T. G., Havelka, J., & Reddon, J. R. (2009). How war, terrorism, and natural disaster affect the organization of autobiographical memory. *Psychological Science*, 4, 399–405.
- Butler, A., Knez, I., Åkerskog, A., Sarlöv-Herlin, I., Ode Sang, Å., & Ångman, E. (2019). Foraging for identity: The relationships between landscape activities and landscape identity after catastrophic landscape change. *Landscape Research*, 44, 303–319. <https://doi.org/10.1080/01426397.2019.1580352>
- Campbell, D. T., & Stanley, J. C. (1963). *Experimental and quasi-experimental designs for research*. Dallas: Houghton Mifflin Company Boston.
- Christianson, S. A. (1989). Flashbulb memories: Special, but not so special. *Memory & Cognition*, 17, 435–443.
- Chu, S., & Downes, J. J. (2000). Proust knows best: odor are better cues of autobiographical memory. *Memory & Cognition*, 30, 511–538.
- Chu, S., & Downes, J. J. (2002). Proust nose best: Odors are better cues of autobiographical memory. *Memory & Cognition*, 4, 511–518.
- Conway, M. A. (1995). *Flashbulb memories*. Hove, UK: Erlbaum.
- Conway, M. A. (2005). Memory and the self. *Journal of Memory and Language*, 53, 594–628.
- Conway, M. A. (2009). Episodic memories. *Neuropsychologia*, 47, 2305–2313.
- Conway, M. A., Andersson, S. J., Larsen, S. F., Donnelly, C. M., McDaniel, M. A., McClelland, A. G. R., & Rawles, R. E. (1994). The formation of flashbulb memories. *Memory & Cognition*, 22, 326–343.
- Conway, M. A., & Pleydell-Pearce, C. W. (2000). The construction of autobiographical memories in the self-memory system. *Psychological Review*, 2, 261–288.
- Conway, M. A., & Rubin, D. C. (1993). The structure of autobiographical memory. In A. F. Collins, S. E. Gathercole, M. A. Conway, & P. E. Morris (Eds.), *Theories of memory* (pp. 103–137). Hove, UK: Lawrence Erlbaum Associates Ltd.
- Conway, M. A., Singer, J. A., & Tagini, A. (2004). The self and autobiographical memory: Correspondence and coherence. *Social Cognition*, 22, 495–537.
- Conway, A. R. A., Skitka, L. J., Hemmerich, J. A., & Kershaw, T. C. (2008). Flashbulb memory for 11 september 2001. *Applied Cognitive Psychology*, 5, 605–623. <https://doi.org/10.1002/acp.1497>
- Cubelli, R., & Della Sala, S. (2008). Flashbulb memories: Special but not iconic. *Cortex*, 44, 908–909.
- Curci, A., & Luminet, O. (2009). Flashbulb memories for expected events: A test of the emotion integrative model. *Applied Cognitive Psychology*, 23, 98–114.
- Curci, A., Luminet, O., Finkenauer, C., & Gisle, L. (2001). Flashbulb memories in social groups: A comparative test-retest study of the memory of French president Mitterand's death in a French and a Belgian group. *Memory*, 9, 81–101.
- Demiray, B., & Freund, A. M. (2015). Michael Jackson, Bin Laden and I: Functions of positive and negative, public and private flashbulb memories. *Memory*, 23, 487–506.
- Denver, J. Y., Lane, S. M., & Cherry, K. E. (2010). Recent versus remote: Flashbulb memory for 9/11 and self-selected vents from the reminiscence bump. *International Journal of Aging and Human Development*, 70, 315–337.
- Er, N. (2003). A new flashbulb memory model applied to the Marmara earthquake. *Applied Cognitive Psychology*, 17, 503–517.
- Evans, G. W., & Kantrowitz, E. (2002). Socioeconomic status and health: The potential role of environmental risk exposure. *Annual Review of Public Health*, 23, 303–331.
- Field, A. (2013). *Discovering statistics using IBM SPSS statistics* (4th ed.). Los Angeles: Sage.
- Finkenauer, C., Lummet, O., Gisle, L., El-Ahmadi, A., van der Linden, M., & Philippot, P. (1988). Flashbulb memories and the underlying mechanisms of their formation: Toward an emotional-integrative model. *Memory & Cognition*, 26, 516–531.
- Fivush, R. (2011). The development of autobiographical memory. *Annual Review of Psychology*, 62, 559–582.
- Fivush, R., Habermas, T., Waters, T. E. A., & Zaman, W. (2011). The making of autobiographical memory: Intersections of culture, narratives and identity. *International Journal of Psychology*, 46, 321–345.
- Gunnarsson, B., Knez, I., Hedblom, M., & Sang, Å. (2017). Effects of biodiversity and environment-related attitude on perception of urban green space. *Urban Ecosystems*, 20, 37–49. <https://doi.org/10.1007/s11252-016-0581-x>
- Guterk, B. A. (1978). On the accuracy of retrospective attitudinal data. *Public Opinion Quarterly*, 42, 390–401.
- Habermas, T., & Bluck, S. (2000). Getting a life: The emergence of the life story in adolescence. *Psychological Bulletin*, 5, 748–769.
- Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York: The Guilford Press.
- Hedblom, M., Knez, I., Gunnarsson, B., & Ode Sang, Å. (2017). *Evaluations of natural sounds in urban greenery: Potential impact for urban nature preservation*. 4. Royal Society Open Science, Article 170037. <https://doi.org/10.1098/rsos.170037>
- Hefferon, K., Grealy, M., & Mutrie, N. (2009). Post-traumatic growth and life threatening physical illness: A systematic review of the qualitative literature. *British Journal of Health Psychology*, 14, 343–378.
- Helton, W. S., head, J., & Kemp, S. (2011). Natural disaster induced cognitive disruption: Impacts on action slips. *Consciousness and Cognition*, 20, 1723–1737.
- Herz, R. S., & Schooler, J. W. (2002). A naturalistic study of autobiographical memories evoked by olfactory and visual cues: Testing the Proustian hypothesis. *American Journal of Psychology*, 115, 21–32.
- Hong, Y., Jong-Suk, K., & Xiong, L. (2019). Media exposure and individuals' emergency preparedness behavior for coping for natural and human-made disasters. *Journal of Environmental Psychology*, 63, 82–91.
- James, W. (1890/1950). *The principles of psychology*. New York: Dover.
- Joseph, S. (2009). Growth following adversity: Positive psychological perspectives on posttraumatic stress. *Psychological Topics*, 2, 335–344.
- Joseph, S., & Williams, R. (2005). Understanding posttraumatic stress: Theory, reflections, context, and future. *Behavioural and Cognitive Psychotherapy*, 33, 423–441.

- Kaiser, H. (1974). An index of factorial simplicity. *Psychometrica*, 39, 31–36.
- Karlsson, K., Sikström, S., & Willander, J. (2013). The semantic representation of event information depends on the cue modality: An instance of Meaning-based retrieval. *PLoS One*, 8(10), Article e73378.
- Kihlstrom, J. F., Beer, J. S., & Klein, S. B. (2003). Self and identity as memory. In M. R. Leary, & J. P. Tangney (Eds.), *Handbook of self and identity* (pp. 68–90). New York: The Guilford Press.
- Klein, S. B. (2013). Making the case that episodic recollection is attributable to operations occurring at retrieval rather than to content stored in a dedicated subsystem of long-term memory. *Frontiers in Behavioral Neuroscience*. <https://doi.org/10.3389/fnbeh.2013.00003>
- Klein, S. B. (2014). *The two selves: Their metaphysical commitments and functional independence*. New York, NY: Oxford University Press.
- Klein, S. B., & Gangi, C. E. (2010). The multiplicity of self: Neuropsychological evidence and its implications for the self as construct in psychological research. *Annals of the New York Academy of Sciences*, 1, 1–15.
- Klein, S. B., German, T. P., Cosmides, L., & Gabriel, R. (2004). A theory of autobiographical memory: Necessary components and disorders resulting from their loss. *Social Cognition*, 5, 460–490.
- Knez, I. (2006). Autobiographical memories for places. *Memory*, 14(3), 359–377.
- Knez, I. (2014). Place and the self: An autobiographical memory synthesis. *Philosophical Psychology*, 2, 164–192.
- Knez, I. (2016). Towards a model of work-related self: A narrative review. *Frontiers in Psychology*, 7(331). <https://doi.org/10.3389/fpsyg.2016.00331>
- Knez, I. (2017). *Life goals, self-defining life goal memories, and mental time travel among females and males going through emerging vs. entering adulthood: An explorative study*. <https://doi.org/10.1037/cns0000123>. Psychology of Consciousness: Theory, Research, and Practice.
- Knez, I., Butler, A., Ode Sang, Å., Ångman, Sarlöv-Herlin, I., & Åkerskog, A. (2018). Before and after a natural disaster: Disruptions in emotion component of place-identity and wellbeing. *Journal of Environmental Psychology*, 55, 11–17.
- Knez, I., & Eliasson, I. (2017). Relationships between individual and collective place-identity and well-being in mountain communities. *Frontiers in Psychology*. <https://doi.org/10.3389/fpsyg.2017.00079>
- Knez, I., Eliasson, I., & Gustavsson, E. (2020). Relationships between identity, well-being and willingness to sacrifice, in personal and collective favorite places: The mediating role of well-being. *Frontiers in Psychology*, 11, 151. <https://doi.org/10.3389/fpsyg.2020.00151>
- Knez, I., & Nordhall, O. (2017). Guilt as a motivator for moral judgment: An autobiographical memory study. *Frontiers in Psychology*, 7, 850. <https://doi.org/10.3389/fpsyg.2017.00750>
- Knez, I., Ode Sang, Å., Gunnarsson, B., & Hedblom, M. (2018). Wellbeing in urban greenery: The role of naturalness and place identity. *Frontiers in Psychology*, 9, 491. <https://doi.org/10.3389/fpsyg.2018.00491>
- Knez, I., & Thorsson, S. (2006). Influences of culture and environmental attitude on thermal, emotional and perceptual evaluations of a square. *International Journal of Biometeorology*, 50, 258–268.
- Knez, I., & Thorsson, S. (2008). Thermal, emotional and perceptual evaluations of a park: Cross-cultural and environmental attitude comparisons. *Building and Environment*, 43, 1483–1490.
- Knez, I., Ljunglöf, L., Arshamian, A., & Willander, J. (2017). Self-grounding visual, auditory and olfactory autobiographical memories. *Consciousness and Cognition*, 52, 1–8.
- Koppel, J., & Berntsen, D. (2015). The peaks of life: The differential temporal locations of the reminiscence bump across disparate cueing methods. *Journal of Applied Research in Memory and Cognition*, 1, 66–80.
- Lanciano, T., Curci, A., & Semin, G. (2010). The emotional and reconstructive determinants of emotional memories: An experimental approach to flashbulb memory investigation. *Memory*, 18, 473–485.
- Larsen, S. F. (1992). Potential flashbulb: Memories of ordinary news as the baseline. In E. Winograd, & U. Neisser (Eds.), *Affect and accuracy in recall* (pp. 32–64). New York: Cambridge University Press.
- Lerner, J. S., Gonzales, R. M., Small, D. A., & Fischhoff, B. (2003). Effects of fear and anger on perceived risks of terrorism: A national field experiment. *Psychological Science*, 14, 144–150.
- Liebert, R. M., & Liebert, L. L. (1995). *Science and behavior: An introduction to methods of psychological research*. New York: Prentice Hall.
- Loftus, E. F., & Marburger, W. (1983). Since the eruption of Mt. St. Helens, has anyone beaten you up? Improving the accuracy of retrospective reports with landmark events. *Memory & Cognition*, 2, 114–120.
- Luminet, O. (2009). Models for the formation of flashbulb memories. In O. Luminet, & A. Curci (Eds.), *Flashbulb memories: New issues and new perspectives* (pp. 51–76). New York: Psychology Press.
- Luminet, O., & Curci, A. (2009a). *Flashbulb memories: New issues and new perspectives*. New York: Psychology Press.
- Luminet, O., & Curci, A. (2009b). Introduction. In O. Luminet, & A. Curci (Eds.), *Flashbulb memories: New issues and new perspectives* (pp. 1–9). New York: Psychology Press.
- Luminet, O., Curci, A., Marsh, E. J., Wessel, I., Constantin, T., Gencoz, F., & Yogo, M. (2004). The cognitive, emotional, and social impacts of the September 11 attacks: Group differences in memory for the reception context and the determinants of flashbulb memory. *The Journal of General Psychology*, 131, 197–224.
- Martin, U. (2015). Health after disaster: A perspective of psychological/health reactions to disaster. *Cogent Psychology*, 2, Article 1053741.
- McCloskey, M., Wible, C. G., & Cohen, N. J. (1988). Is there a special flashbulb-memory mechanism? *Journal of Experimental Psychology: General*, 2, 171–181.
- McGuigan, F. J. (1983). *Experimental psychology: Methods of research*. New Jersey: Prentice Hall.
- Murphy, K. R., Myers, B., & Wolach, A. (2009). *Statistical power analysis*. New York: Routledge.
- Muzzulini, B., Tinti, C., Conway, M. A., Testa, S., & Schmidt, S. (2020). Flashbulb memory: Referring back to Brown and Kulik's definition. *Memory*, 28, 766–782.
- Neisser, U. (1988). Five kinds of self-knowledge. *Philosophical Psychology*, 1, 35–59.
- Neisser, U. (2003). New directions of flashbulb memories: Comments on the ACP special issue. *Applied Cognitive Psychology*, 17, 1149–1155.
- Neisser, U., & Harsch, N. (1992). Phantom flashbulbs: False recollections of hearing the news about Challenger. In E. Winograd, & U. Neisser (Eds.), *Affect and accuracy in recall* (pp. 9–32). New York: Cambridge University Press.
- Neisser, U., Winograd, E., Bergman, E. T., Schreiber, C. A., Palmer, S. E., & Weldon, M. S. (1996). Remembering the earthquake: Direct experience vs. hearing the news. *Memory*, 4, 337–357.
- Ode Sang, A., Knez, I., Gunnarsson, B., & Hedblom, M. (2016). The effects of naturalness, gender, and age on how urban green space is perceived and used. *Urban Forestry and Urban Greening*. <https://doi.org/10.1016/j.ufug.2016.06.008>
- Oliver-Smith, A. (1996). Anthropological research on hazards and disasters. *Annual Review of Anthropology*, 25, 303–328.
- Pezdek, K. (2003). Event memory and autobiographical memory for the vents of September 11, 2001. *Applied Cognitive Psychology*, 17, 1033–1045.
- Pillemer, D. B. (2003). Directive functions of autobiographical memory: The guiding power of the specific episode. *Memory*, 11, 193–202.
- Pillemer, D. B. (2009). "Hearing the news" versus "being there": Comparing flashbulb memories and recall of first-hand experiences. In O. Luminet, & A. Curci (Eds.), *Flashbulb memories: New issues and new perspectives* (pp. 125–140). New York: Psychology Press.
- Prebble, S. C., Addis, D. R., & Tippett, L. J. (2013). Autobiographical memory and sense of self. *Psychological Bulletin*, 4, 815–840.
- Ruiz, C., & Hernandez, B. (2014). Emotions and coping strategies during an episode of volcanic activity and their relations to place attachment. *Journal of Environmental Psychology*, 38, 279–287.
- Schmuck, P., & Vlek, C. (2003). Psychologists can do much to support sustainable development. *European Psychologist*, 2, 66–76.
- Schuman, H., & Scott, J. (1989). Generations and collective memories. *American Sociological Review*, 54, 359–381.
- Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inferences*. Boston, MA: Houghton Mifflin.
- Shavit, T., Shahabran, S., Benzion, U., & Rosenboim, M. (2013). The effect of a forest fire disaster on emotions and perception of risks: A field study of the Carmel fire. *Journal of Environmental Psychology*, 36, 129–135.
- Shaw, R. (2006). Indian ocean tsunami and aftermath. *Disaster Prevention and Management*, 15, 5–20.
- Silver, A., & Grek-Martin, J. (2015). "Now we understand what community really means": Reconceptualizing the role of sense of place in the disaster recovery process. *Journal of Environmental Psychology*, 42, 32–41.
- Singer, J. A. (1995). Seeing one's self: Locating narrative memory in a framework of personality. *Journal of Personality*, 3, 429–457.
- Singer, J. A. (2005). *Memories that matter: Using self-defining memories to understand and change your life*. Oakland, CA: New Harbinger.
- Suddendorf, T., & Corballis, M. C. (2007). The evolution of foresight: What is mental time travel, and is it unique to humans? *Behavioral and Brain Sciences*, 30, 299–313.
- Sutin, A. R., & Robins, R. W. (2007). Phenomenology of autobiographical memories. *Memory*, 15, 390–411.
- Tabachnick, B. G., & Fidell, L. S. (1989). *Using multivariate statistics*. New York: Harper and Row.
- Tedeschi, R., & Calhoun, L. (1995). *Trauma and transformation: Growing in the aftermath of suffering*. Thousand Oaks, CA: Sage.
- Tulving, E. (2002). Chronesthesia: Awareness of subjective time. In D. T. Stuss, & R. C. Knight (Eds.), *Principles of frontal lobe function* (pp. 311–325). New York: Oxford University Press.
- Vallianou, K., Alexopoulos, V., Plaka, M. K., Seleventi, V., & Skanavis, C. (2020). Building resilient communities: The traumatic effect of wildfire on Mati, Greece. *International Journal of Business, Human, and Social Sciences*, 14, 474–479.
- Weaver, C. A., III (1993). Do you need a "flash" to form a flashbulb memory? *Journal of Experimental Psychology: General*, 122, 39–46.
- Weinstein, N. D., Lyon, J. H., Rothman, A. J., & Cuite, C. L. (2000). Changes in perceived vulnerability following natural disaster. *Journal of Social and Clinical Psychology*, 19, 372–395.
- Willander, J., & Larsson, M. (2006). Smell your way back to childhood: Autobiographical odor memory. *Psychonomic Bulletin & Review*, 2, 240–244.
- Willander, J., & Larsson, M. (2007). Olfaction and emotion: The case of autobiographical memory. *Memory & Cognition*, 35(7), 1659–1663.
- Willander, J., Sikström, S., & Karlsson, K. (2015). Multimodal retrieval of autobiographical memories: Sensory information contributes differently to the recollection of events. *Frontiers in Psychology*, 6, 1681. <https://doi.org/10.3389/fpsyg.2015.01681>
- Williams, H. L., Conway, M. A., & Cohen, G. (2008). Autobiographical memory. In G. Cohen, & M. A. Conway (Eds.), *Memory in the real world* (pp. 21–90). New York: Psychology Press.