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The face of memory: experiential avoidance and facial expressions during the retrieval of autobiographical memories

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Abstract

Experiential avoidance refers to attempts to control or suppress unwanted thoughts, feelings and emotions. We investigated whether experiential avoidance is associated with fewer facial expressions during autobiographical retrieval (i.e., retrieval of memory for personal information). We invited participants to retrieve autobiographical memories, and recall was analyzed by a facial analysis software that detects and classifies emotional expressions. Participants were divided into high vs. low experiential avoidance. Analysis showed fewer emotional facial expressions in participants with high experiential avoidance than in those with low experiential avoidance during autobiographical retrieval. This low emotional expression can be regarded as an attempt by individuals with high experiential avoidance to avoid communicating the emotional load to others. This low emotional expression can be also regarded as an attempt by individuals with high experiential avoidance to control or suppress the internal events that contribute to the appearance or persistence of unwanted emotional states during retrieval.

Keywords: autobiographical memory; emotion; experiential avoidance; facial expressions; software for facial analysis

Autobiographical memory, or memory for personal experiences (Conway, 2005; Rubin, 2005), is intimately associated with emotional and affective processing (Schulkind & Woldorf, 2005). A wealth of empirical research has revealed the involvement of emotional processing in autobiographical memory. Studies analyzing autobiographical memories, as recorded in participants' diaries, have revealed that emotional events are typically easier to retrieve than neutral events (Wagenaar, 1986). The emotional involvement in autobiographical memory has been also highlighted by studies on flashbulb memories, which are salient memories for important public events (Brown & Kulik, 1977); for example, studies have demonstrated that an intense emotional state is typically associated with these autobiographical memories (Bohn & Berntsen, 2007; Conway et al., 1994; Conway, Skitka, Hemmerich, & Kershaw, 2009; Curci & Lanciano, 2009; Davidson, Cook, & Glisky, 2006; El Haj & Gandolphe, 2017; El Haj, Gandolphe, Wawrziczny, & Antoine, 2016; Finkenauer et al., 1998; Gandolphe & El Haj, 2016, 2017; Greenberg, 2004; Hirst et al., 2009; Pezdek, 2003; Talarico, Berntsen, & Rubin, 2003; Tinti, Schmidt, Sotgiu, Testa, & Curci, 2009). The relationship between autobiographical memory and emotion can also be illustrated with studies demonstrating high sensorial and contextual recall, as well as high vividness, during emotional autobiographical retrieval (Comblain, D'Argembeau, & Van der Linden, 2005; Schaefer & Philippot, 2005; St Jacques & Levine, 2007). In a similar vein, emotional autobiographical memories have been found to be characterized by a high subjective experience, sense of reliving, and rehearsal (Demiray & Janssen, 2015; Maki, Janssen, Uemiya, & Naka, 2013; Talarico, LaBar, & Rubin, 2004). Taken together, there is a wealth of empirical evidence to suggest that emotional processing is one of the core components of autobiographical memory.

In the above-mentioned literature, the emotional characteristics of autobiographical memory were typically evaluated by analyzing the emotional content of memories or by asking participants to rate this content on subjective scales. In addition to this subjective assessment, emotional involvement in autobiographical memory can also be assessed using cardiovascular and electrophysiological activity (Schaefer & Philippot, 2005), as well as neural activity (Holland & Kensinger, 2010). Another physiological assessment of emotional characteristics of the subjective experience of autobiographical memory is the analysis of facial expressions during retrieval. Unlike neuroimaging or cardiovascular/electrophysiological evaluations, facial expressions analysis is a cheap and non-invasive assessment that allows for the evaluation of physiological characteristics of autobiographical memory during everyday life interactions.

Facial expressions during autobiographical retrieval were investigated by a study in which participants were asked to retrieve three autobiographical memories, each of which was triggered by one of the following cue words: “happy”, “sad”, and “city” (El Haj, Antoine, & Nandrino, 2016). Facial expressions during retrieval were analyzed with a facial analysis software, and analysis showed that emotional cues triggered the corresponding basic facial expressions (i.e., a sad facial expression for memories cued by “sad”). In the latter study, facial analyses were conducted by a software that analyzes 500 key points in the face through three consecutive steps (Bishop, 2010; Den Uyl & Van Kuilenburg, 2005; Noldus, 2008). This software uses an algorithm to locate the face in images and video, then it synthesizes the face by describing the location of 500 key points and the facial texture of the area delineated by these points, and finally, it classifies facial expressions with an artificial neural network. This network is programmed to classify the basic emotions described by Ekman (Ekman, 1992, 1993): happy, sad, angry, surprised, scared, disgusted and neutral. These emotional categories are characterized

by facial action units, each of which represents a distinct movement of the face that can occur in isolation from other parts of the face (Ekman & Friesen, 1978; Ekman, Rosenburg, & Hager, 1998).

Facial expressions during autobiographical retrieval was also evaluated by a study evaluating facial expressions during retrieval of past vs future autobiographical scenarios (El Haj, Antoine, & Nandrino, 2017). Participants were invited to remember events in their lives and imagine future events that might reasonably happen in the future. For all past and future events, participants were invited to rate the emotional valence of the events. Analysis demonstrated that participants rated future events as more positive than past ones. Critically, analysis demonstrated more positive facial expressions for future thinking relative to past thinking. These findings provides behavioral evidence for research demonstrating a positive bias for imagining the future (Berntsen & Bohn, 2010; Berntsen & Jacobsen, 2008; D'Argembeau & Van der Linden, 2004; Finnbogadóttir & Berntsen, 2013; Newby-Clark & Ross, 2003; Ross & Newby-Clark, 1998). Therefore, the study of El Haj et al. (2017) provided a physiological evidence to the psychological theories about the idyllic vision of the future. In the same vein, Gandolphe et al. (2018) evaluated facial expressions during the retrieval of self-defining memories which are memories intimately associated with the self, identity, and emotion (Singer, Blagov, Berry, & Oost, 2013). Results demonstrated more positive than negative facial expressions during retrieval of self-defining memories. According to Gandolphe et al. (2018), these findings reflect meaning making of self-defining memories, namely, how these memories serve to reflect on the positive outcomes of a negative event.

Because autobiographical memories have been found to trigger emotional facial expressions (El Haj et al., 2017; El Haj, Daoudi, Gallouj, Moustafa, & Nandrino, 2018;

Gandolphe et al., 2018), it would be of interest to assess whether experiential avoidance may trigger little emotional facial expressions during autobiographical retrieval. Experiential avoidance refers to attempts to control or suppress unwanted internal events such as thoughts, feelings and, and more specifically, emotions (Hayes, Wilson, Gifford, Follette, & Strosahl, 1996). Experiential avoidance can be expressed in terms of restriction in proactive behaviors as individuals become mainly focused on avoiding events and situations rather than pursuing activities that may contribute to their social development. According to several studies, there is an overlap between experiential avoidance and suppression of internal events that contribute to the appearance or persistence of unwanted emotional states (Hayes et al., 1996; Purdon, 1999). Persistent experiential avoidance has been implicated in many clinical disorders (Blackledge & Hayes, 2001), including fear and anxiety (Feldner, Zvolensky, Eifert, & Spira, 2003; Forsyth, Parker, & Finlay, 2003; Sloan, 2004), substance use (Bordieri, Tull, McDermott, & Gratz, 2014; Buckner, Zvolensky, Farris, & Hogan, 2014; Stewart, Zvolensky, & Eifert, 2002), and eating disorders (Schmidt & Treasure, 2006; Wildes, Ringham, & Marcus, 2010). Experiential avoidance may also lead to social withdrawal (Hayes & Gifford, 1997). Considering its psychological and behavioral consequences, it would be of interest to assess whether experiential avoidance would also be accompanied by few facial expressions during autobiographical retrieval.

Thanks to facial analysis software, previous research has revealed emotional facial expressions during autobiographical retrieval. In this study, we extend prior investigations by assessing whether experiential avoidance would be characterized by few emotional facial expressions during autobiographical retrieval. By doing this, we would like to investigate whether autobiographical retrieval in individuals with high experiential avoidance would be

accompanied by few facial activations. We also evaluated correlations between facial expressions and subjective evaluation of memory, this to evaluate whether facial expressions in individuals with high avoidance can be related with their attempt to control the subjective experience of the recall.

Method

Participants

Thirty-seven subjects (20 women and 17 men; M age = 23.92 years, SD = 5.94; M education = 13.97 years, SD = 4.53) participated to the study. The participants were native French speakers, and exclusion criteria were a history of psychiatric, neurological, or learning disorders. All participants were recruited on a voluntary basis and informed consent was obtained in accordance with the principles laid down by the Helsinki Declaration.

Procedures

Experiential avoidance.

Experiential avoidance was assessed with the Acceptance and Action Questionnaire (AAQ), a 10-item questionnaire with adequate internal consistency and good convergent and discriminant validity (Hayes et al., 2004). The items (e.g., “it is OK if I remember something unpleasant”, “my painful memories prevent me from having a fulfilling life”, “emotions cause problems in my life”...) are rated on a seven-point Likert scale (one = never true, four = sometimes true, seven = always true). A low score on the AAQ indicates action and acceptance, whereas a high score indicates immobility and a high level of experiential avoidance. In our study, we used a French translation of the 10 items, which has been validated in a group of 210 normal subjects and 118 patients with anxiety disorders or depression (Monestès, Villatte,

Mouras, Loas, & Bond, 2009). The French version has been found to present good internal consistency, as well as good concurrent and construct validity (Monestès et al., 2009).

2.2.2. Autobiographical retrieval.

Participants were asked to recount one event in their lives, regardless of when the event occurred. Instructions were provided verbally and participants were asked to be precise and specific, that is, events had to have lasted no more than a day and details had to be provided (e.g., where and when the event occurred, what they were doing during this event, who was present, etc.). Participants were also instructed that they had to describe their feelings during these events (for a similar instructions, see, (Maki et al., 2013; Piolino et al., 2003). Participants were allocated two minutes to describe the memory, and the duration was made clear so that participants could structure their memories accordingly ((for studies adopting the same two-minute duration, see (El Haj et al., 2014; El Haj, Kapogiannis, & Antoine, 2016). Following retrieval, participants were asked to rate the emotional valence of their memories on a five-point scale (-2 = very negative, -1 = negative, 0 = neutral, +1 = positive, +2 = very positive).

2.2.3. Facial expression analysis.

Autobiographical retrieval was recorded with an HD camera. The camera was placed in front of the participant and the recording was later analyzed by the FaceReader™ software. For each recording, the software analyzed the video feed to synthesize the face by describing facial expression information (i.e., lips, cheek muscles, eyebrow muscles). Once the analyses were conducted, the software provided a pie chart representation of the percentage of neutral expressions and mean emotional expressions (i.e., mean of happy, sad, angry, surprised, scared, and disgusted emotions). The pie chart also provided percentages of unknown states, referring to

situations where the face could not be modeled (e.g., when the participant looked away from the camera). An example of the pie chart and the FaceReader™ main output is provided in Figure 1.

[INSERT FIGURE 1 APPROXIMATELY HERE]

2.3. Results

We established a median split on scores obtained on the AAQ scale, which allowed us to divide participants into two groups (those with low vs. those with high experiential avoidance). We then compared the two groups on 1) subjective evaluation of emotion after autobiographical retrieval, and 2) emotional and neutral facial expressions during autobiographical retrieval. Non-parametric tests were conducted because the subjective evaluation of emotion was ordinal, and also because of the distribution of percentage of facial expressions was not normally distributed. For convenience, we calculated Spearman correlations between facial expressions and subjective evaluation of emotion. For all tests, the level of significance was set at $p \leq .05$ and p values between .051 and .10 were considered trends. Effect sizes are reported; $d = .2$ can be considered a small effect size, $d = .5$ represents a medium effect size and $d = .8$ refers to a large effect size (Cohen, 1988). Effect size was calculated for non-parametric tests according to the recommendations of Rosenthal and DiMatteo (2001) and Ellis (2010).

Median split.

We carried out a median split on scores on the AAQ scale, dividing participants into participants with high experiential avoidance (score > 31.00 , $M = 48.61$, $SD = 5.38$, range = 37-57, $n = 18$, 10 women and 8 men) and low experiential avoidance (score < 31.00 , $M = 17.61$, $SD = 5.17$, range = 11-30, $n = 18$, 9 women and 9 men). It is important to note that 1) one participant

obtained a score equal to the median so was thus excluded, and 2) for all participants, mean score on the AAQ scale was 33.05 ($SD = 16.42$).

Low subjective emotional valence rating in participants with high experiential avoidance.

Subjective emotional valence rating following autobiographical retrieval is depicted in Figure 2. Mann–Whitney U-test showed lower rating in participants with high experiential avoidance ($M = 1.12$, $SD = 1.14$) than in those with low ($M = .06$, $SD = .87$) experiential avoidance ($Z = -3.02$, $p < .01$, Cohen’s $d = .89$).

[INSERT FIGURE 2 APPROXIMATELY HERE]

Few emotional facial expressions in participants with high experiential avoidance.

The percentages of emotional and neutral expressions are depicted in Figure 3. Mann–Whitney U-test showed fewer emotional facial expressions in participants with high experiential avoidance ($M = 29.56$, $SD = 8.93$) than in those with low ($M = 49.94$, $SD = 16.88$) experiential avoidance ($Z = -3.99$, $p < .001$, Cohen’s $d = 1.51$). Analyses also showed more neutral facial expressions in participants with high experiential avoidance ($M = 55.50$, $SD = 12.82$) than in those with low ($M = 34.61$, $SD = 10.56$) experiential avoidance ($Z = -3.58$, $p < .001$, Cohen’s $d = 1.62$). Wilcoxon tests showed fewer emotional than neutral facial expressions in participants with high experiential avoidance ($Z = -3.46$, $p < .001$, Cohen’s $d = 2.34$), and more emotional than neutral facial expressions in participants with low experiential avoidance ($Z = -2.24$, $p < .05$, Cohen’s $d = .92$).

[INSERT FIGURE 3 APPROXIMATELY HERE]

Correlations between subjective emotional valence rating and facial expressions.

Analysis demonstrated significant correlations between subjective emotional valence rating and neutral ($r = .52, p < .01, CI [.22, .75]$) and emotional ($r = .48, p < .05, CI [.18, .69]$) facial expressions in participants with high experiential avoidance. Analysis also demonstrated significant correlations between subjective emotional valence rating and neutral ($r = .47, p < .05, CI [.17, .69]$) and emotional ($r = .54, p < .01, CI [.26, .73]$) facial expressions in participants with low experiential avoidance.

Complementary analysis.

For convenience, we evaluated potential effect of sex using ANCOVA with sex as a covariate. Analysis demonstrated significant differences on emotional valence rating between participants with high experiential avoidance and those with low experiential avoidance, $F(1, 35) = 3.91, p < .05$. Analysis also demonstrated significant differences on emotional, $F(1, 35) = 9.95, p < .001$, and neutral, $F(1, 35) = 8.69, p < .001$, facial expressions between participants with high experiential avoidance and those with low experiential avoidance. Thus, the original results hold when controlling for sex effect.

Discussion

The current study assessed facial expressions during autobiographical retrieval with regard to experiential avoidance. Our analysis showed fewer emotional facial expressions in participants with high experiential avoidance than in those with low experiential avoidance during autobiographical retrieval.

Emotional intensity has been found to predict autobiographical experience (Talarico et al., 2004) and emotional valence contributes to the organization of events across the lifespan

(Berntsen & Rubin, 2002; Schulkind & Woldorf, 2005). Emotional valence and intensity of stimuli have been also found to improve the quality of autobiographical experience (Comblain et al., 2005; Schaefer & Philippot, 2005; St Jacques & Levine, 2007). This effect can be attributed to the modulation of encoding and consolidation in the hippocampus, coupled with an input from the amygdala (LaBar & Cabeza, 2006). The emotional load of autobiographical memory has been widely assessed by analyzing emotional content of memories or by asking participants to rate this content on Likert scales. Besides this assessment, emotional involvement in autobiographical memory can be assessed through cardiovascular and electrophysiological activity (Schaefer & Philippot, 2005), as well as through neural activity (for a review, see (Holland & Kensinger, 2010)). The present work extends and complements the literature by assessing emotional facial expressions during autobiographical retrieval.

Our findings revealed fewer emotional facial expressions in participants with high experiential avoidance than in those with low experiential avoidance during autobiographical retrieval. Experiential avoidance, or attempts to control or suppress unwanted feelings and emotions (Hayes et al., 1996; Purdon, 1999), has found to be related with social withdrawal and depression (Buckner et al., 2014; Kashdan, Breen, Afram, & Terhar, 2010; Mahaffey, Wheaton, Fabricant, Berman, & Abramowitz, 2013; Panayiotou, Karekla, & Panayiotou, 2014). More specifically, experiential avoidance acts as a barrier to pursuing and enjoying meaningful social interactions (Kashdan et al., 2010). Some researchers have shown that experiential avoidance is associated with few approach-oriented behaviors, such as inability to introduce oneself to others (Chawla & Ostafin, 2007; Hayes, Luoma, Bond, Masuda, & Lillis, 2006). Our findings contribute to these findings by demonstrating few emotional facial expressions during autobiographical retrieval in individuals with high experiential avoidance. This low emotional

expression can be regarded as an attempt by individuals who use experiential avoidance strategies to avoid communicating the emotional load to other. This low emotional expression can be also regarded as an attempt by individuals with high experiential avoidance to control or suppress the internal events that contribute to the appearance or persistence of unwanted emotional states during retrieval. While this assumption may be plausible, it should be empirically tested in future research.

Our participants with high experiential avoidance did not only demonstrate low facial emotional expressions during retrieval but also low subjective rating of the emotional content of their memories. Thus, facial expressions in these individuals seem to be related with their attempt to control the subjective experience of the recall. This assumption can be supported by the significant correlations between facial expressions and the subjective experience of the recall in these participants. This assumption can also be supported research on the effects of expressive suppression (i.e., the attempt to inhibit outward signs of emotion) on memory (Richards & Gross, 2000, 2006). For instance, Richards and Gross (2006) instructed participants to rate expressive suppression by rating items such as “to what extent did you try to keep your facial muscles from moving? To what extent did you try to keep yourself from showing outward signs of emotion?”. The authors also exposed participants to a movie that depicted a surgical procedure, and then assessed memory for the movie. Results demonstrated that a high use of expressive suppression predicted worse memory. Richards and Gross (2006) suggested that one important contributor to differences on memory may be how people regulate their emotions. Taken together, emotional regulation may not influence facial expressions, as observed by our study, but also the content of memories, as reported by Richards and Gross (2000, 2006).

One shortcoming of our study may be that we assessed only one autobiographical event. It would be of interest to ask participants with high experiential avoidance to retrieve several memories, especially emotional ones, and to analyze their facial expressions accordingly. Another shortcoming may be the lack of assessment of participants' mood or memory characteristics such as age of memory and vividness.

Regardless of its potential limitations, the present paper has the merit to provide empirical description of facial expressions that are triggered by autobiographical recall in individuals with high experiential avoidance. These findings are worth replication in psychiatric and neurological populations who tend to express few facial expressions. For instance, one cognitive characteristic of depression is experiential avoidance (Cernvall et al., 2016). This avoidance leads to the expectation of little emotional facial expressions during autobiographical retrieval. The same thing can be said for post-traumatic stress disorder as this disorder is characterized by high levels of experiential avoidance (Tull, Gratz, Salters, & Roemer, 2004). Interestingly, both depression and post-traumatic stress are characterized by overgenerality of autobiographical memory, i.e., the tendency of patients to retrieve general rather than specific memories, a tendency that has been attributed to the attempt of patients to avoid the emotional charge that is associated with some autobiographical memories (Williams, 2006). Therefore, one may expect for little emotional facial expressions during autobiographical retrieval in depression or post-traumatic stress. Together, measuring facial expressions in psychiatric and neurological populations may provide reliable insight into difficulties in emotion regulation in these populations. Till now, these difficulties have been mainly evaluated with subjective measures (e.g., clinical observation, scales...).

To summarize, experiential avoidance has been widely considered as an attempt to suppress or control internal events that contribute to the appearance or persistence of unwanted emotional states. As suggested by our findings, experiential does not only imply the control of internal emotional states but also the control of external emotional expressions. By evaluating relationship between experiential avoidance and facial expressions, our study provides new behavioral evaluation of the subjective emotional experience associated with memory retrieval in general. In prior studies, physiological activities during autobiographical retrieval have been typically evaluated with neuroimaging. Unlike neuroimaging, facial expressions analysis is a cheap and non-invasive physiological assessment of autobiographical memory. This non-invasive characteristic makes facial expressions analysis an ideal behavioral tool to evaluate the subjective experience of autobiographical memory, and ideally, emotional regulation in patients with affective disorders.

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Declaration of interest statement

The authors declare no conflict of interest

References

- Berntsen, D., & Bohn, A. (2010). Remembering and forecasting: The relation between autobiographical memory and episodic future thinking. *Memory and Cognition*, *38*(3), 265-278. doi: 10.3758/MC.38.3.265
- Berntsen, D., & Jacobsen, A. S. (2008). Involuntary (spontaneous) mental time travel into the past and future. *Consciousness and Cognition*, *17*(4), 1093-1104. doi: <http://dx.doi.org/10.1016/j.concog.2008.03.001>
- Berntsen, D., & Rubin, D. C. (2002). Emotionally charged autobiographical memories across the life span: the recall of happy, sad, traumatic, and involuntary memories. *Psychology and Aging*, *17*(4), 636-652.
- Bishop, C. M. (2010). *Neural networks for pattern recognition* (2nd ed.). Oxford, UK: Oxford university press.
- Blackledge, J. T., & Hayes, S. C. (2001). Emotion regulation in acceptance and commitment therapy. *Journal of Clinical Psychology*, *57*(2), 243-255.
- Bohn, A., & 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 and Cognition*, *35*(3), 565-577.
- Bordieri, M. J., Tull, M. T., McDermott, M. J., & Gratz, K. L. (2014). The Moderating Role of Experiential Avoidance in the Relationship between Posttraumatic Stress Disorder Symptom Severity and Cannabis Dependence. *J Contextual Behav Sci*, *3*(4), 273-278. doi: 10.1016/j.jcbs.2014.08.005
- Brown, R., & Kulik, J. (1977). Flashbulb memories. *Cognition*, *5*(1), 73-99.

- Buckner, J. D., Zvolensky, M. J., Farris, S. G., & Hogan, J. (2014). Social anxiety and coping motives for cannabis use: The impact of experiential avoidance. *Psychology of Addictive Behaviors, 28*(2), 568-574. doi: 10.1037/a0034545
- Cernvall, M., Skogseid, E., Carlbring, P., Ljungman, L., Ljungman, G., & von Essen, L. (2016). Experiential Avoidance and Rumination in Parents of Children on Cancer Treatment: Relationships with Posttraumatic Stress Symptoms and Symptoms of Depression. *Journal of Clinical Psychology in Medical Settings, 23*(1), 67-76. doi: 10.1007/s10880-015-9437-4
- Chawla, N., & Ostafin, B. (2007). Experiential avoidance as a functional dimensional approach to psychopathology: An empirical review. *Journal of Clinical Psychology, 63*(9), 871-890. doi: 10.1002/jclp.20400
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: Erlbaum Associates.
- Comblain, C., D'Argembeau, A., & Van der Linden, M. (2005). Phenomenal characteristics of autobiographical memories for emotional and neutral events in older and younger adults. *Experimental Aging Research, 31*(2), 173-189. doi: 10.1080/03610730590915010
- Conway, M. A. (2005). Memory and the self. *Journal of memory and language, 53*(4), 594-628.
- Conway, M. A., Anderson, S. J., Larsen, S. F., Donnelly, C. M., McDaniel, M. A., McClelland, A. G., . . . Logie, R. H. (1994). The formation of flashbulb memories. *Memory and Cognition, 22*(3), 326-343.
- Conway, M. A., Skitka, L. J., Hemmerich, J. A., & Kershaw, T. C. (2009). Flashbulb memory for 11 September 2001. *Applied Cognitive Psychology, 23*(5), 605-623. doi: 10.1002/acp.1497

- Curci, A., & Lanciano, T. (2009). Features of autobiographical memory: theoretical and empirical issues in the measurement of flashbulb memory. *Journal of General Psychology, 136*(2), 129-150. doi: 10.3200/GENP.136.2.129-152
- D'Argembeau, A., & Van der Linden, M. (2004). Phenomenal characteristics associated with projecting oneself back into the past and forward into the future: influence of valence and temporal distance. *Consciousness and Cognition, 13*(4), 844-858. doi: 10.1016/j.concog.2004.07.007
- Davidson, P. S., Cook, S. P., & Glisky, E. L. (2006). Flashbulb memories for September 11th can be preserved in older adults. *Aging Neuropsychology and Cognition, 13*(2), 196-206. doi: Doi 10.1080/13825580490904192
- Demiray, B., & Janssen, S. M. (2015). The self-enhancement function of autobiographical memory. *Applied Cognitive Psychology, 29*(1), 49-60.
- Den Uyl, M., & Van Kuilenburg, H. (2005). The FaceReader: Online facial expression recognition. *Proceedings of Measuring Behavior, 30*, 589-590.
- Ekman, P. (1992). An argument for basic emotions. *Cognition and Emotion, 6*(3-4), 169-200. doi: 10.1080/02699939208411068
- Ekman, P. (1993). Facial expression and emotion. *American Psychologist, 48*(4), 384-392.
- Ekman, P., & Friesen, W. (1978). *Facial Action Coding System: A technique for the measurement of facial movements*. Palo Alto, CA: Consulting Psychologists Press.
- Ekman, P., Rosenberg, E., & Hager, J. (1998). Facial action coding system affect interpretation database (FACSAID) (Publication no. <http://face-and-emotion.com/dataface/facsaid/description.jsp>).

- El Haj, M., Antoine, P., & Nandrino, J. L. (2016). More emotional facial expressions during episodic than during semantic autobiographical retrieval. *Cognitive, Affective & Behavioral Neuroscience, 16*(2), 374-381. doi: 10.3758/s13415-015-0397-9
- El Haj, M., Antoine, P., & Nandrino, J. L. (2017). Facial expressions triggered by imagining the future. *Journal of Integrative Neuroscience, 16*(4), 483-492. doi: 10.3233/JIN-170030
- El Haj, M., Daoudi, M., Gallouj, K., Moustafa, A. A., & Nandrino, J.-L. (2018). When your face describes your memories: facial expressions during retrieval of autobiographical memories *Reviews in the Neurosciences* (Vol. 29, pp. 861-872).
- El Haj, M., Delerue, C., Omigie, D., Antoine, P., Nandrino, J. L., & Boucart, M. (2014). Autobiographical recall triggers visual exploration. *Journal of Eye Movement Research, 7*(5), 1-7.
- El Haj, M., & Gandolphe, M. C. (2017). Flashbulb memories for Paris attacks in an alcohol-abstinent patient. *Journal of Systems and Integrative Neuroscience, 3*(2), 1-5. doi: 10.15761/jsin.1000152
- El Haj, M., Gandolphe, M. C., Wawrziczny, E., & Antoine, P. (2016). Flashbulb memories of Paris attacks: Recall of these events and subjective reliving of these memories in a case with Alzheimer disease. *Medicine, 95*(46), e5448. doi: 10.1097/md.0000000000005448
- El Haj, M., Kapogiannis, D., & Antoine, P. (2016). Phenomenological Reliving and Visual Imagery During Autobiographical Recall in Alzheimer's Disease. *Journal of Alzheimer's Disease, 52*(2), 421-431. doi: 10.3233/JAD-151122
- Ellis, P. D. (2010). *The Essential Guide to Effect Sizes: Statistical Power, Meta-Analysis, and the Interpretation of Research Results*. New York, NY: Cambridge University Press.

- Feldner, M. T., Zvolensky, M. J., Eifert, G. H., & Spira, A. P. (2003). Emotional avoidance: an experimental test of individual differences and response suppression using biological challenge. *Behaviour Research and Therapy*, *41*(4), 403-411. doi: [http://dx.doi.org/10.1016/S0005-7967\(02\)00020-7](http://dx.doi.org/10.1016/S0005-7967(02)00020-7)
- Finkenauer, C., Luminet, O., Gisle, L., El-Ahmadi, A., Van Der Linden, M., & Philippot, P. (1998). Flashbulb memories and the underlying mechanisms of their formation: Toward an emotional-integrative model. *Memory and Cognition*, *26*(3), 516-531.
- Finnbogadóttir, H., & Berntsen, D. (2013). Involuntary future projections are as frequent as involuntary memories, but more positive. *Consciousness and Cognition*, *22*(1), 272-280. doi: <http://dx.doi.org/10.1016/j.concog.2012.06.014>
- Forsyth, J. P., Parker, J. D., & Finlay, C. G. (2003). Anxiety sensitivity, controllability, and experiential avoidance and their relation to drug of choice and addiction severity in a residential sample of substance-abusing veterans. *Addictive Behaviors*, *28*(5), 851-870. doi: [http://dx.doi.org/10.1016/S0306-4603\(02\)00216-2](http://dx.doi.org/10.1016/S0306-4603(02)00216-2)
- Gandolphe, M. C., & El Haj, M. (2016). Flashbulb memories of the Charlie Hebdo attack. *Journal of Psychology and Cognition*, *1*(1), 20-28.
- Gandolphe, M. C., & El Haj, M. (2017). Flashbulb memories of the Paris attacks. *Scandinavian Journal of Psychology*, *58*(3), 199-204. doi: 10.1111/sjop.12364
- Gandolphe, M. C., Nandrino, J. L., Delelis, G., Ducro, C., Lavallee, A., Saloppe, X., . . . El Haj, M. (2018). Positive facial expressions during retrieval of self-defining memories. *Journal of Integrative Neuroscience*, *17*(3-4), 367-376. doi: 10.3233/jin-170073
- Greenberg, D. L. (2004). President Bush's false [flashbulb] memory of 9/11/01. *Applied Cognitive Psychology*, *18*(3), 363-370. doi: 10.1002/acp.1016

- Hayes, S. C., & Gifford, E. V. (1997). The Trouble with Language: Experiential Avoidance, Rules, and the Nature of Verbal Events. *Psychological Science*, 8(3), 170-173. doi: 10.1111/j.1467-9280.1997.tb00405.x
- Hayes, S. C., Luoma, J. B., Bond, F. W., Masuda, A., & Lillis, J. (2006). Acceptance and commitment therapy: model, processes and outcomes. *Behaviour Research and Therapy*, 44(1), 1-25. doi: 10.1016/j.brat.2005.06.006
- Hayes, S. C., Strosahl, K., Wilson, K. G., Bissett, R. T., Pistorello, J., Toarmino, D., . . . McCurry, S. M. (2004). Measuring experiential avoidance: A preliminary test of a working model. *Psychological Record*, 54(4), 553-578.
- Hayes, S. C., Wilson, K. G., Gifford, E. V., Follette, V. M., & Strosahl, K. (1996). Experiential avoidance and behavioral disorders: A functional dimensional approach to diagnosis and treatment. *Journal of Consulting and Clinical Psychology*, 64(6), 1152-1168. doi: <http://dx.doi.org/10.1037/0022-006X.64.6.1152>
- Hirst, W., Phelps, E. A., Buckner, R. L., Budson, A. E., Cuc, A., Gabrieli, J. D., . . . Vaidya, C. J. (2009). Long-term memory for the terrorist attack of September 11: flashbulb memories, event memories, and the factors that influence their retention. *Journal of Experimental Psychology: General*, 138(2), 161-176. doi: 10.1037/a0015527
- Holland, A. C., & Kensinger, E. A. (2010). Emotion and autobiographical memory. *Phys Life Rev*, 7(1), 88-131. doi: 10.1016/j.pprev.2010.01.006
- Kashdan, T. B., Breen, W. E., Afram, A., & Terhar, D. (2010). Experiential avoidance in idiographic, autobiographical memories: construct validity and links to social anxiety, depressive, and anger symptoms. *Journal of Anxiety Disorders*, 24(5), 528-534. doi: 10.1016/j.janxdis.2010.03.010

- LaBar, K. S., & Cabeza, R. (2006). Cognitive neuroscience of emotional memory. *Nature Reviews: Neuroscience*, 7(1), 54-64. doi: 10.1038/nrn1825
- Mahaffey, B. L., Wheaton, M. G., Fabricant, L. E., Berman, N. C., & Abramowitz, J. S. (2013). The contribution of experiential avoidance and social cognitions in the prediction of social anxiety. *Behavioural and Cognitive Psychotherapy*, 41(1), 52-65. doi: 10.1017/S1352465812000367
- Maki, Y., Janssen, S. M., Uemiya, A., & Naka, M. (2013). The phenomenology and temporal distributions of autobiographical memories elicited with emotional and neutral cue words. *Memory*, 21(3), 286-300. doi: 10.1080/09658211.2012.725739
- Monestès, J. L., Villatte, M., Mouras, H., Loas, G., & Bond, F. W. (2009). Traduction et validation française du questionnaire d'acceptation et d'action (AAQ-II). French translation and validation of the acceptance & action questionnaire (AAQ-II). *Revue Européenne de Psychologie Appliquée/European Review of Applied Psychology*, 59(4), 301-308. doi: <http://dx.doi.org/10.1016/j.erap.2009.09.001>
- Newby-Clark, I. R., & Ross, M. (2003). Conceiving the past and future. *Personality & Social Psychology Bulletin*, 29(7), 807-818. doi: 10.1177/0146167203029007001
- Noldus, I. T. (2008). *FaceReader 2.0: Technical specifications*. Leesburg, VA.
- Panayiotou, G., Karekla, M., & Panayiotou, M. (2014). Direct and indirect predictors of social anxiety: The role of anxiety sensitivity, behavioral inhibition, experiential avoidance and self-consciousness. *Comprehensive Psychiatry*, 55(8), 1875-1882. doi: 10.1016/j.comppsy.2014.08.045
- Pezdek, K. (2003). Event memory and autobiographical memory for the events of September 11, 2001. *Applied Cognitive Psychology*, 17(9), 1033-1045. doi: 10.1002/acp.984

- Piolino, P., Desgranges, B., Belliard, S., Matuszewski, V., Lalevee, C., De la Sayette, V., & Eustache, F. (2003). Autobiographical memory and auto-noetic consciousness: triple dissociation in neurodegenerative diseases. *Brain*, *126*(Pt 10), 2203-2219. doi: 10.1093/brain/awg222
- Purdon, C. (1999). Thought suppression and psychopathology. *Behaviour Research and Therapy*, *37*(11), 1029-1054.
- Richards, J. M., & Gross, J. J. (2000). Emotion regulation and memory: the cognitive costs of keeping one's cool. *Journal of Personality and Social Psychology*, *79*(3), 410-424.
- Richards, J. M., & Gross, J. J. (2006). Personality and emotional memory: How regulating emotion impairs memory for emotional events. *Journal of Research in Personality*, *40*(5), 631-651. doi: <https://doi.org/10.1016/j.jrp.2005.07.002>
- Rosenthal, R., & DiMatteo, M. R. (2001). Meta-analysis: recent developments in quantitative methods for literature reviews. *Annual Review of Psychology*, *52*, 59-82. doi: 10.1146/annurev.psych.52.1.59
- Ross, M., & Newby-Clark, I. R. (1998). Construing the Past and Future. *Social Cognition*, *16*(1), 133-150. doi: 10.1521/soco.1998.16.1.133
- Rubin, D. C. (2005). A basic-systems approach to autobiographical memory. *Current Directions in Psychological Science*, *14*(2), 79-83.
- Schaefer, A., & Philippot, P. (2005). Selective effects of emotion on the phenomenal characteristics of autobiographical memories. *Memory*, *13*(2), 148-160. doi: 10.1080/09658210344000648

- Schmidt, U., & Treasure, J. (2006). Anorexia nervosa: valued and visible. A cognitive-interpersonal maintenance model and its implications for research and practice. *British Journal of Clinical Psychology, 45*(Pt 3), 343-366.
- Schulkind, M. D., & Woldorf, G. M. (2005). Emotional organization of autobiographical memory. *Memory and Cognition, 33*(6), 1025-1035.
- Singer, J. A., Blagov, P., Berry, M., & Oost, K. M. (2013). Self-defining memories, scripts, and the life story: narrative identity in personality and psychotherapy. *Journal of Personality, 81*(6), 569-582. doi: 10.1111/jopy.12005
- Sloan, D. M. (2004). Emotion regulation in action: emotional reactivity in experiential avoidance. *Behaviour Research and Therapy, 42*(11), 1257-1270. doi: 10.1016/j.brat.2003.08.006
- St Jacques, P. L., & Levine, B. (2007). Ageing and autobiographical memory for emotional and neutral events. *Memory, 15*(2), 129-144. doi: 10.1080/09658210601119762
- Stewart, S. H., Zvolensky, M. J., & Eifert, G. H. (2002). The relations of anxiety sensitivity, experiential avoidance, and alexithymic coping to young adults' motivations for drinking. *Behavior Modification, 26*(2), 274-296.
- Talarico, J. M., Berntsen, D., & Rubin, D. C. (2003). Confidence, Not Consistency, Characterizes Flashbulb Memories. *Psychological Science, 14*(5), 455-461. doi: 10.1111/1467-9280.02453
- Talarico, J. M., LaBar, K. S., & Rubin, D. C. (2004). Emotional intensity predicts autobiographical memory experience. *Memory and Cognition, 32*(7), 1118-1132.
- Tinti, C., Schmidt, S., Sotgiu, I., Testa, S., & Curci, A. (2009). The role of importance/consequentiality appraisal in flashbulb memory formation: the case of the

- death of Pope John Paul II. *Applied Cognitive Psychology*, 23(2), 236-253. doi: 10.1002/acp.1452
- Tull, M. T., Gratz, K. L., Salters, K., & Roemer, L. (2004). The role of experiential avoidance in posttraumatic stress symptoms and symptoms of depression, anxiety, and somatization. *Journal of Nervous and Mental Disease*, 192(11), 754-761.
- Wagenaar, W. A. (1986). My memory: A study of autobiographical memory over six years. *Cognitive Psychology*, 18(2), 225-252.
- Wildes, J. E., Ringham, R. M., & Marcus, M. D. (2010). Emotion avoidance in patients with anorexia nervosa: initial test of a functional model. *International Journal of Eating Disorders*, 43(5), 398-404. doi: 10.1002/eat.20730
- Williams, J. M. (2006). Capture and rumination, functional avoidance, and executive control (CaRFAX): Three processes that underlie overgeneral memory. *Cogn Emot*, 20(3-4), 548-568. doi: 10.1080/02699930500450465

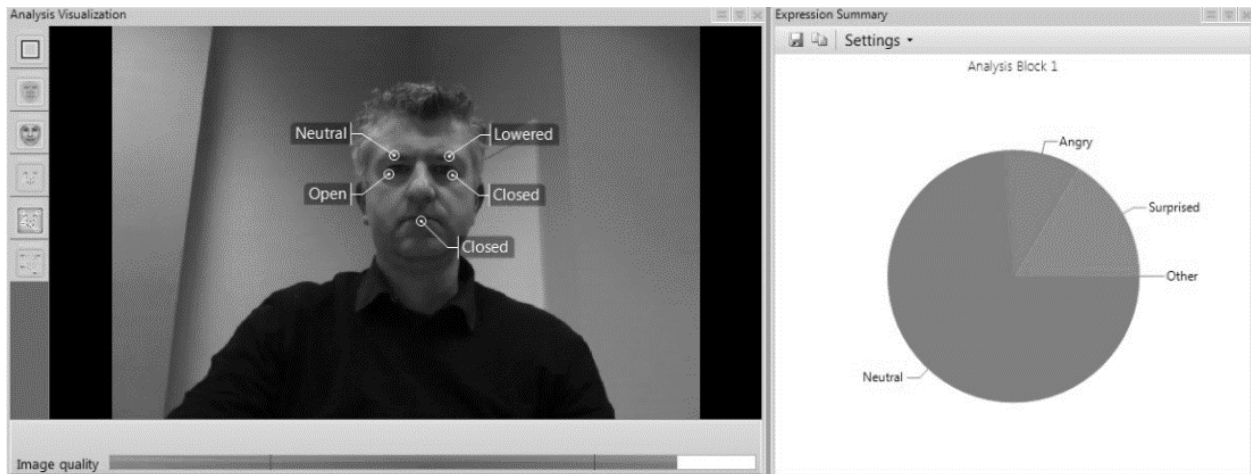


Figure 1. An example of facial expressions analysis of FaceReader™

Note. The figure depicts the face of the third author.

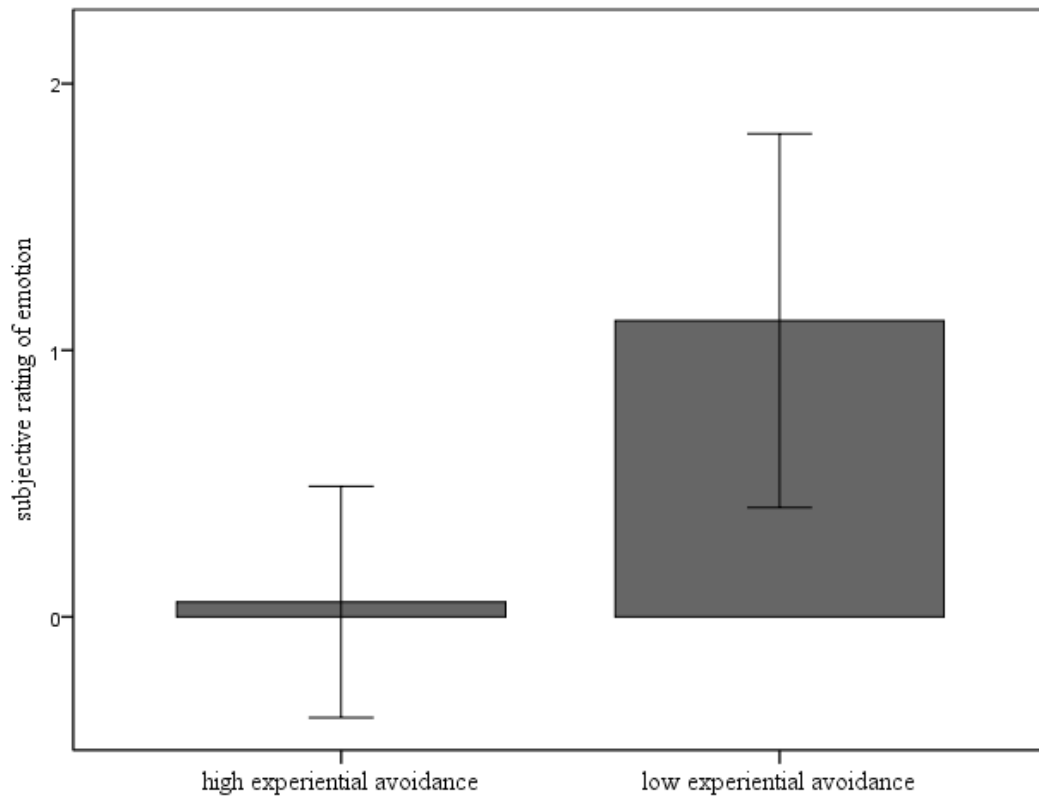


Figure 2. Subjective emotional valence rating in participants with high experiential avoidance and in those with low experiential avoidance. Error bars are 95% within-subjects confidence intervals.

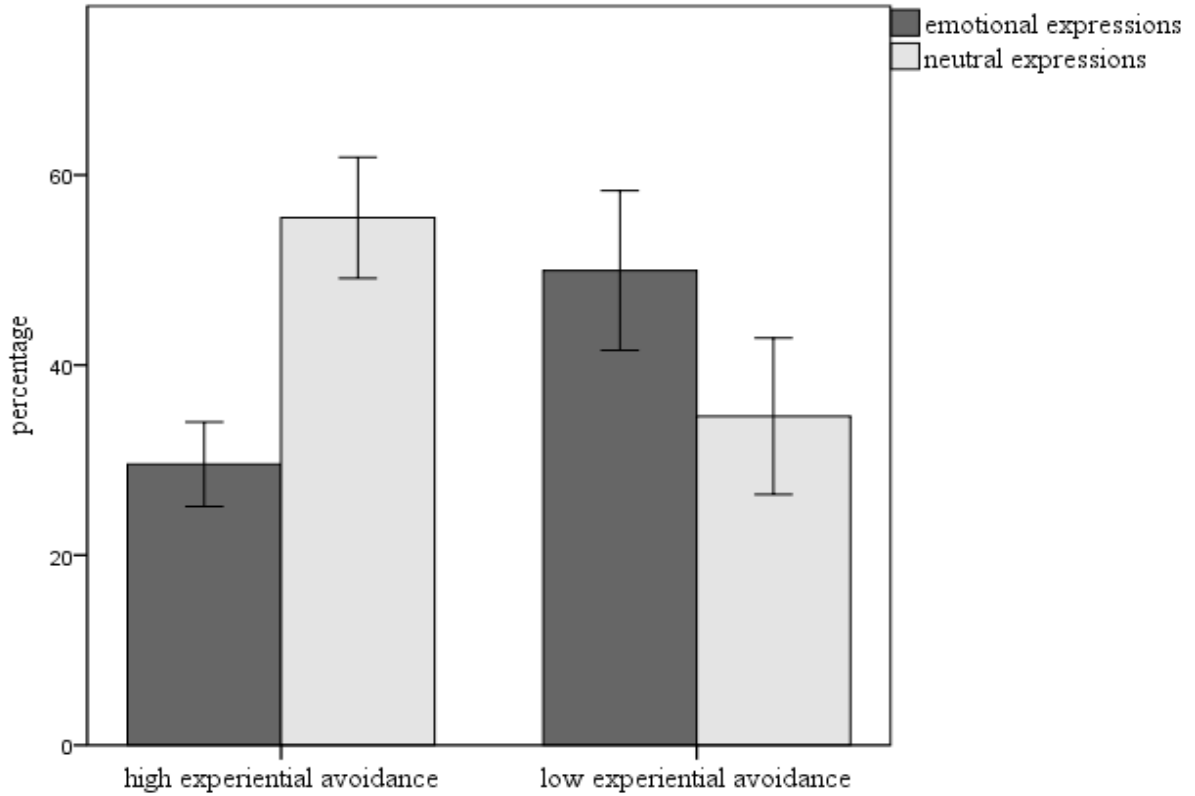


Figure 3. Percentages of emotional and neutral expressions in participants with high experiential avoidance and in those with low experiential avoidance. Error bars are 95% within-subjects confidence intervals.