

The Role of Autobiographical Memory Networks in the Experience of Negative Emotions: How Our Remembered Past Elicits Our Current Feelings

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The present research examined the role of autobiographical memory networks on negative emotional experiences. Results from 2 studies found support for an active but also discriminant role of autobiographical memories and their related networked memories on negative emotions. In addition, in line with self-determination theory, thwarting of the psychological needs for competence, autonomy, and relatedness was found to be the critical component of autobiographical memory affecting negative emotional experiences. Study 1 revealed that need thwarting in a specific autobiographical memory network related to the theme of loss was positively associated with depressive negative emotions, but not with other negative emotions. Study 2 showed within a prospective design a differential predictive validity between 2 autobiographical memory networks (an anger-related vs. a guilt-related memory) on situational anger reactivity with respect to unfair treatment. All of these results held after controlling for neuroticism (Studies 1 and 2), self-control (Study 2), and for the valence (Study 1) and emotions (Study 2) found in the measured autobiographical memory network. These findings highlight the ongoing emotional significance of representations of need thwarting in autobiographical memory networks.

Keywords: autobiographical memory, negative emotions, need thwarting, networked memories, self-determination theory

Although the relation between memory and emotion has long been of interest to researchers in psychology, the vast majority of this research has focused on one possible direction for this relationship—how emotions can affect memories. For example, research during the 1980s and 1990s examined how one's current mood affects the recall of mood-congruent memories (e.g., Bower & Cohen, 1982; Clore & Parrott, 1991) or how emotional memories are better remembered than neutral ones (Heuer & Reisberg, 1990). It is interesting that the reverse relationship—how memory influences emotion—has received much less attention. The purpose of the present research was to investigate this particular direction of the relationship, that is, the directive function of autobiographical memories with respect to emotional experience.

The *directive function* of autobiographical memory refers to the use of past experiences to guide current and future thoughts, emotions, and behaviors (Bluck, Alea, Habermas, & Rubin, 2005). Only recently have researchers begun to examine how memory for everyday life events can have a directive function for diverse adaptive outcomes, including emotional experience (Pillemer,

2003). A process through which memory can influence emotional experience is through people's deliberate use of their autobiographical memory via reminiscence. Research has shown that the recall of autobiographical memories can influence one's current emotional experience (e.g., LeDoux, 1992; Schwartz, Weinberger, & Singer, 1981), and that the specificity of this recall also affects the intensity of this emotional experience (e.g., Philippot, Schaefer, & Herbette, 2003). Research also has shown that autobiographical reminiscence can buffer emotional experiences. Josephson, Singer, and Salovey (1996) presented empirical evidence suggesting that people often deliberately recall positive memories to repair a negative mood. It also has been shown that autobiographical reminiscences can serve a lesson-learning function (Wong & Watt, 1991) or a social sharing function (Alea & Bluck, 2003) that can facilitate emotional appraisal and self-regulation (Pasupathi, 2003) when similar situations are later encountered.

An alternative perspective for examining the use of autobiographical memory on emotional experience is to consider the direct or automatic effect of autobiographical memory. Pillemer (1998, 2001, 2003) suggests that while the directive function of autobiographical memory can be based on reminiscence, it is also likely to occur automatically, based on associative processing of shared similarities between environmental cues and autobiographical memory knowledge. Indeed, it is very unlikely that people purposefully search their autobiographical memory for directive guidance when needed (Pillemer, 2003). Such a directive function is much more likely to occur automatically and mostly out of awareness. In such a way, autobiographical memories would play an active role in emotional experience as their content would automatically be used to inform people on how to appraise situations (Robinson, 1986; Scherer, 2005; Smith & Kirby, 2000). We

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based our research on this conceptualization of an automatic directive function of autobiographical memories directly used by appraisal processes.

Automatic Directive Function of Autobiographical Memory

Our basic premise was that autobiographical memories are an important source of information for the self to adaptively guide responses to life situations (Pillemer, 2003; Robinson, 1992). Autobiographical memories can play such a central role in moment-to-moment appraisal because of their minute sensitivity to cues (Conway & Pleydell-Pearce, 2000). Both external and internal cues—specific situations, people, and contexts encountered in everyday life—trigger specific autobiographical memories that are encoded with features related to these situations, people, or contexts (e.g., a same location, a physical resemblance to a significant other, an evaluative context; e.g., Andersen & Baum, 1994; Mace, 2005; Pillemer, 2003). This triggering mechanism is a continual process of which people are typically unaware (Conway & Pleydell-Pearce, 2000; Roediger, 1990). The autobiographical memories activated by the cue are then processed by higher order cognitive structures, and the information they contain is used to appraise the situation characterized by the cue (Smith & Kirby, 2000). Andersen and Baum (1994) illustrated this process in a study showing that people experienced negative emotions when they were about to meet a stranger who looked slightly similar to a past significant other with whom they had had negative experiences. The encoded experiences related to a past significant other appeared to influence people's current appraisal and emotional experience because the new and the old person shared some similar characteristics. This process is akin to what has been termed *associative processing* in social cognition to account for how implicit attitudes are formed (Gawronski & Bodenhausen, 2006).

A direct consequence of this cuing/triggering process is that it should be mostly context-dependent to facilitate a quick and adapted response—that is, specific themes or contexts trigger specific sets of memories, but not theme-unrelated or context-unrelated sets of memories (Conway & Pleydell-Pearce, 2000; Philippe, Lecours, & Beaulieu-Pelletier, 2009). Consequently, memories activated by a specific theme (e.g., loss) or situation (e.g., unfair treatment) should trigger theme-related memories only, which should in turn predict theme-related or situation-specific outcomes (e.g., people's situational emotional experience or behavior). Thus, memories should be highly context-dependent. Furthermore, autobiographical memories that are related to frequently encountered themes in people's lives should then be frequently activated and should have, over time, an enduring influence on theme-related outcomes.

Another important characteristic of this system is that when a memory is activated, other memories that are linked to it also get activated because activation spreads across the links (Anderson, 1984; Bower, 1981; Christianson & Engelberg, 1999). Such a network of memories is often formed on the basis of the contiguity of memory elements, such as similar events and themes (Brown & Schopflocher, 1998; Burt, Kemp, & Conway, 2003; Kemp, Burt, & Malinen, 2009; Robinson, 1992), but also more specifically between situations or events sharing a common feature, such as a

same place, person (Andersen & Baum, 1994), object, motive (Woike, 2008), or emotion (Bower, 1981; Conway, 2003). Because of their associations with the main memory, networked memories should get activated at the same moment as the main memory is triggered and should equally serve the appraisal processes.

Toward a Self-Determination Perspective of Appraisal

Autobiographical memories remain attached to representations of how the initial event has been experienced, primarily determined by the person's goals at the encoding (Conway, 2008; Conway & Pleydell-Pearce, 2000). For example, in a sports competition, if a person's primary goal is to beat the other team, this person may feel deeply frustrated by a loss and encode this episodic event as a highly negative one. Conversely, another person taking part in the same competition may be motivated to have fun while playing. This goal could be achieved despite the loss, with the competition event encoded as a positive experience. Thus, people's working goals at encoding heavily determine the type of experiential representations that will remain attached to the autobiographical memory (Conway & Pleydell-Pearce, 2000).

Although people's goals may vary across situations, self-determination theory (Deci & Ryan, 2000) proposes that humans have an overarching goal of growth, which is expressed through the daily pursuit of fulfillment of three psychological needs: autonomy, competence, and relatedness. *Autonomy* refers to the need to feel volitional and authentic in one's actions. *Competence* is defined as the need to feel effective and efficacious. *Relatedness* refers to the need to feel connected and to care for others and be cared for by others in turn. Researchers have highlighted the fundamental nature and importance of these three needs in specific events and across diverse domains and cultures (e.g., Deci et al., 2001; Sheldon, Elliot, Kim, & Kasser, 2001) and have shown that their satisfaction in everyday life is positively associated with self-regulatory capacities (Grolnick, McMenemy, & Kurowski, 2006; Ryan, 1995) and measures of well-being such as psychological growth, purposes and meaning in life, and general life satisfaction (e.g., Meyer, Enstrom, Harstveit, Bowles, & Beevers, 2007; Reis, Sheldon, Gable, Roscoe, & Ryan, 2000; Sheldon, Ryan, & Reis, 1996).

Because of the fundamental nature and prominence of these needs across situations, their need satisfaction representations should remain attached to a majority of significant autobiographical memories. Indeed, recent research (Philippe, Koestner, Beaulieu-Pelletier, & Lecours, in press) has shown that need satisfaction in autobiographical memories is a basic component of such memories and a distinct one from several other memory components examined in past memory research. An important point is that, according to self-determination theory, it is not so much the objective situation that is either need satisfying or need thwarting, but whether the situation is perceived as such by the person (Deci & Ryan, 2000). It is thus expected that people are capable of a reflective process as to whether their needs were satisfied or thwarted during a past event when recalling this memory (Philippe et al., in press).

We propose that perceptions of a situation being either need satisfying or need thwarting are determined, at least partly, by the autobiographical memory network triggered by the situation (see

Deci & Ryan, 2000, for a similar view). Therefore, if the overall network of memories activated by a situation contains need-satisfying representations, the appraisal of the situation will be inferred as satisfying the psychological needs, thus signaling possibilities for psychological growth and the opportunity to build the self. The appraisal processes thus will stimulate emotional processes facilitating openness to the environment, such as experiences of positive emotions (Fredrickson, 2001), a lower level of negative emotional reactivity, and emotional self-regulation (Hodgins & Knee, 2002). Conversely, if the overall network of memories contains need-thwarting representations, the appraisal of the situation will be inferred as need thwarting, thus signaling a potential threat to the self and to the innate psychological growth goal and should lead to specific negative emotional experiences related to the ongoing situation that seek to protect the self from the need-thwarting situation (Hodgins & Knee, 2002).

Empirical Evidence

Recent research has empirically supported such an integrated model. First, an autobiographical memory assessment procedure was developed to collect descriptions of a main memory related to a cue (e.g., a film clip) or a given theme (e.g., romantic relationship). In addition, this assessment collects networked memories as participants are asked to freely associate and describe other autobiographical memories that they find related in any way to their main memory, thus allowing for the measurement of an autobiographical memory *network*. Various memory components (e.g., valence, need satisfaction, vividness) also can be measured for each reported memory, including the main and the networked memories (Philippe et al., 2009). Other research previously has shown that need-satisfaction components in autobiographical memory networks are different from other memory components that have been investigated in past research, such as vividness, significance, rehearsal, sharing with others, and power, intimacy, and achievement motives (Philippe et al., in press, Studies 1 and 2). In addition, need satisfaction in autobiographical memory networks was found to be the best predictor of well-being ratings, including informants' ratings of well-being, among the above described memory components (Philippe et al., in press; Philippe, Koestner, Beaulieu-Pelletier, Lecours, & Lekes, 2010, Study 2). Furthermore, need satisfaction in both the main memory and the networked memories was found to contribute independently to the prediction of well-being. This latter finding stresses that the organization of autobiographical memories into networks is a significant component of a memory system. Using a controlled experimental design, another study showed that implicit priming of idiosyncratic (personalized) keywords related to the participants' autobiographical memory network led to higher or lower subsequent well-being ratings, depending on whether the primed memory network was either need satisfying or need thwarting (Philippe et al., 2010, Study 3). This latter study supports the thesis that when one's autobiographical memory network is activated by external cues, one's appraisal processes are automatically influenced as a function of the need-satisfying or need-thwarting information contained in the triggered autobiographical memory network.

The Present Research

The empirical evidence presented above supports the theory that specific organizations of autobiographical memories into networks may have important consequences on people's emotional experiences. However, the above research looked only at general types of autobiographical memory (i.e., self-defining memories; see Singer & Salovey, 1993) and at a very general outcome (well-being). In addition, the context-dependent role of autobiographical memory has not been investigated. In the present research, we sought to show that need thwarting in theme-specific autobiographical memory networks is associated with specific and theme-related negative emotional experiences. That is, autobiographical memory networks related to a specific theme that are replete with representations of incompetence, rejection, or constrained autonomy should be associated with negative emotional experiences theoretically related to such a theme. Moreover, in line with past research (Philippe et al., in press), we expected that the association of need thwarting in memory networks with negative emotions would be independent of the particular valence of the memory network. Study 1 investigated the specificity of autobiographical memory networks by examining whether need thwarting in an autobiographical memory network related to the theme of loss would be specifically associated with depressive negative emotions, but not with nondepressive negative emotions. Study 2 prospectively examined the differential predictive value of two autobiographical memory networks, one theme-related and the other theme-unrelated, on situational anger reactivity.

Study 1

People frequently encounter cues associated with loss during their life—the loss of a significant other, the loss of an important object, interpersonal rejection, and losses related to one's health or role behavior. Experiencing a situation of loss or encountering loss-related cues should trigger specific autobiographical memories that are characterized by loss-related features along with their associated networked memories. Loss has been both theoretically and empirically related to the experience of depressive emotions (e.g., Monroe, Rohde, Seeley, & Lewinsohn, 1999). The *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text revision) reports that depressive states are accompanied by a complex but specific emotional experience characterized by feelings of sadness, guilt, self-devaluation, and lower levels of interest and pleasure (i.e., reduced joy). Therefore, if a loss-related situation is appraised as need thwarting based on the information contained in the activated memory network, depressive emotions should be experienced. Over time, people with need-thwarting loss-related memory networks should come to experience a high frequency of depressive emotions in their life, which should be shown in the report of general depressive emotional experiences, but not in the report of other types of negative emotions theoretically unrelated to loss. Therefore, we hypothesized that need thwarting in loss-related autobiographical memory networks would be significantly associated with depressive emotions, but it would be unrelated to nondepressive negative emotions.

We also sought to underscore that autobiographical memories are not equivalent to a direct measure of life events. In other words, people who experienced a high number of actual loss

events in their life should not necessarily report higher levels of need thwarting in loss-related memories. In line with self-determination theory and the emotional memory network theory, it is how these life events are experienced, encoded, and organized into networks that should determine their related emotional outcomes, not just the number and severity of actual loss events. That is to say, we expected that two people with the same number and severity of actual loss events may represent these losses in their memory networks in very different ways, especially as regards to need thwarting. These differences in memory networks should be associated with distinct and different experiences of depressive emotions. Therefore, we expected that need thwarting in loss-related memories would be associated with greater depressive emotions, even after controlling for the number of life loss events and the impact these events had in people's lives. In addition, this relationship should hold after controlling for neuroticism, which has been shown to play a major role in people's negative emotional experience (e.g., Allik & Realo, 1997; Costa & McCrae, 1995). Finally, in line with past research (Philippe et al., in press), we expected that need thwarting in a loss-related autobiographical memory network would be associated with depressive emotions, even after controlling for the valence of the autobiographical memory network.

Method

Participants. Participants were 215 undergraduate students (188 women, 27 men) from a Canadian university. Mean age was 22.72 years ($SD = 4.88$).

Measures.

Neuroticism. The Ten-Item Personality Inventory (Gosling, Rentfrow, & Swann, 2003) was used to assess neuroticism. This brief scale uses two pairs of adjectives to assess each of the five personality factors. This scale has yielded correlations between .65 and .87 with the complete Big-Five Inventory (John & Srivastava, 1999). In this study, the two pairs of adjectives measuring neuroticism were used. Participants were asked to rate on a 7-point Likert scale (1 = *disagree strongly*, 7 = *agree strongly*) their degree of agreement with each pair of adjectives (e.g., "I see myself as . . . anxious, easily upset"). Adequate evidence of validity and reliability has been found for this scale (Ehrhart et al., 2009; Gosling et al., 2003). In this study, the correlation between the two pairs of adjectives was .47.

Depressive and nondepressive emotions. The Differential Emotions Scale-IV (Izard, Libero, Putnam, & Haynes, 1993) assesses the frequency of experience of 12 different discrete emotions with 36 items. Three items assess each emotion, and each item is rated on a 5-point Likert scale ranging from 1 (*rarely or never*) to 5 (*very often*). Positive emotions include enjoyment and interest, and the negative emotions measured are anger, sadness, disgust, contempt, fear, guilt, shame, shyness, and hostility toward the self. The emotion of surprise constitutes the 12th emotion and can be considered both positive and negative (Izard et al., 1993; Machleit & Eroglu, 2000). The prompt reads, "In your daily life, how often do you . . .?" and sample items include "Feel glad about something" (enjoyment), "Feel discouraged, like you can't make it, nothing is going right" (sadness), "Feel like you did something wrong" (guilt). In the present study, depression-related emotions were combined into an index labeled *depressive emotions*, that is,

guilt, sadness, hostility inward (i.e., self-devaluation), lack of interest (interest reversed), and reduced pleasure (enjoyment reversed). These emotions have shown strong implications in loss-related situations (Blumberg & Izard, 1985, 1986; Izard, 1972). Cronbach's alpha coefficient was .85 for this index. All remaining emotions were combined into an index labeled *nondepressive negative emotions*, that is, anger, contempt, disgust, fear, shame, and shyness. Cronbach's alpha coefficient for this index was .83. Surprise was excluded because it is neither positive nor negative (Izard et al., 1993; Machleit & Eroglu, 2000).

Life loss events scale. A slightly modified version of the Life Events Questionnaires (Sarason, Johnson, & Siegel, 1978) was used in this study. Two researchers examined the 82 items of this inventory and kept only the items highly related to a loss experience (e.g., death of family member or close friend, breaking up with a girlfriend or boyfriend or breaking an engagement, being fired or laid off from work, etc.). Overall, 18 items were retained. For each item, participants rated whether they ever experienced this type of event and, if so, indicated the effect of this event on their life on a scale from 1 (*no effect*) to 7 (*very strong effect*). The sum of the number of yes-rated events and the average of the impact ratings were both standardized and averaged in an index labeled *life loss events*.

Emotional Memory Network Assessment (EMNA).

Loss memory description. The EMNA (Philippe et al., 2009) is a questionnaire used to collect networks of autobiographical emotional memories. In this study, instructions were adapted and participants were asked to describe a main personal memory related to an important loss. The questionnaire first asked the participants to describe "a personal memory of an event in which you experienced an important loss (ex., departure, decease, rejection, the loss of something important, separation, etc.)." Participants also were asked to provide sufficient details in the description of their memory so that another person could understand it.

Loss memory need thwarting. Participants also were asked to rate the level of psychological need satisfaction they experienced when this event occurred on a 7-point Likert scale ranging from -3 (*strongly disagree*) to +3 (*strongly agree*), with 0 representing *do not agree nor disagree or not applicable*, this latter option indicating that there was an equal level of both need satisfaction and need thwarting in the event or that neither need thwarting nor need satisfaction was present in the event. Participants were thus provided with two items assessing each of the three psychological needs postulated by self-determination theory (i.e., autonomy, competence, and relatedness). A sample item for autonomy is "I felt free to do things and to think how I wanted"; for competence, "I felt that my reaction was adequate"; and for relatedness, "I felt connected to one or more people." These items were derived from past research (e.g., Reis et al., 2000; Ryan, Rigby, & Przybylski, 2006; Sheldon et al., 2001) and adapted to assess experience during past events. Confirmatory factor analyses (Philippe et al., in press) showed that these items adequately discriminated the three needs among each other, and a second-order factor also emerged, indicating the possibility of combining all three needs together, as is commonly done by self-determination theory researchers (e.g., Deci et al., 2001; Gagneacute, 2003; Hagger, Chatzisarantis, & Harris, 2006; La Guardia, Ryan, Couchman, & Deci, 2000). In addition, Philippe et al. (in press, Study 1) showed that there existed a very large correlation ($r = .70$) between need satisfaction

in memory descriptions as rated by the participants themselves and as coded by independent blind judges. Therefore, participants' ratings of need satisfaction in memories for past events can be considered as reliable and valid. All items were reverse-coded to refer to need thwarting and averaged in an index that is referred to as *loss memory need thwarting*. Cronbach's alpha for this index was .73 in this study.

Loss memory valence. Participants were asked to rate the emotional valence of their reported main memory when it occurred on a 7-point Likert scale, ranging from -3 (*very negative*) to $+3$ (*very positive*). This assessment provides an overall measure of the approach versus avoidance value of the loss memory.

Networked memories. To assess the networked memories of the reported main memory, the EMNA further asked participants to recall and list other personal memories that they might find to be directly or indirectly related to the main memory they had just described and to write down a description for each. A maximum of seven spaces was provided to the participants to describe seven networked memories. However, they were informed that they did not have to report as many memories. They could write down only those memories that came spontaneously to mind. Thus, participants were free to recall any number of networked memories between one and seven. However, only the first three memories were analyzed.¹ After describing all of their networked memories, participants were asked to rate their degree of need satisfaction for each networked memory using the same items and scale presented above. In line with the scoring algorithm presented in Philippe and colleagues (2009), the need satisfaction score of each network memory was averaged, thus taking into account the number of networked memories reported in the score. This score was reverse-coded to assess need thwarting and was labeled *networked memories need thwarting*. Participants were also asked to indicate whether each of their reported networked memories was either a positive or negative experience and to rate its intensity on the same valence scale presented above. These ratings were also averaged in an index labeled *networked memories valence*.

Overall memory network (OMN) need thwarting and valence. In line with the emotional memory network theory (Philippe et al., 2009), which specifies that it is the whole network composed of a main memory and its related networked memory that is important—and not each of its constituents taken separately—the loss memory need-thwarting score and the networked memories need-thwarting score were averaged together in an index labeled *OMN need thwarting*. The same procedure was performed with valence as the loss memory valence score and the networked memories valence score were averaged together in an index labeled *OMN valence*.

Procedure. Randomly selected participants from a Canadian university received an e-mail explaining that we were conducting a study about personality and memory. The incentive was that their participation allowed them to be entered into a draw of three prizes of \$125. Participants were told that participating in this study involved completing an online questionnaire on a secure Web site. Participants were also assured that all of their responses would remain confidential and anonymous. Those who agreed to complete the questionnaire logged into a secure Web site and expressed their agreement with the terms of an informed consent by clicking a specific button. The time taken to complete the survey was calculated. All participants took a reasonable amount of time

to complete it (between 15 min and 1 hr; $M = 32.13$ min). Participants completed, in order, the neuroticism scale, the life events scale, and the emotion inventory. Finally, it is important to note that the EMNA was completed last by all participants.

Results and Discussion

Correlational results (see Table 1) showed that need thwarting in the loss memory and in the networked memories and the average of these two scores, OMN need thwarting, were positively associated with depressive and nondepressive emotions. However, the correlations between OMN need thwarting, loss memory need thwarting, or networked memories need thwarting and depressive emotions were significantly stronger than the correlations with nondepressive emotions, $t(212) > 2.83$, $p < .01$. The loss memory valence, the networked memories valence, and the average of these two scores, OMN valence, were weakly correlated with depressive emotions and unrelated to nondepressive emotions, except for networked memories valence that was weakly but significantly associated with nondepressive emotions, $p < .05$. Partial correlations showed that when nondepressive emotions were controlled for, OMN need thwarting, loss memory need thwarting, and networked memories need thwarting were positively related to depressive emotions (r_p s $> .34$, $p < .001$). However, when depressive emotions were controlled for, these variables were all unrelated to nondepressive emotions (r_p s $< .08$, ns). Finally, neuroticism was the most important predictor of both depressive and nondepressive emotions (r s $> .57$, $p < .001$). In addition, life loss events were positively associated with depressive and nondepressive negative emotions, but they were unrelated to OMN need thwarting and OMN need valence and the separate components of these scores.

Regression analyses were conducted to examine the additional role of networked memories need thwarting (i.e., the memories associated with the main loss-related memory) in the prediction of depressive emotions over and above the need-thwarting score of the loss-related main memory. Results of the regression analysis revealed that need thwarting in networked memories predicted an additional 6.4% of the variance in depressive emotions, over and above the main memory related to loss, $F(1, 212) = 16.12$, $p < .001$. Thus, networked memories appear to have an incremental predictive value over the main memory with respect to emotional experiences. This further supports the position that the whole autobiographical memory network is important and not only a single main memory.

Regression analyses also examined the preferential use of need thwarting over valence in an autobiographical memory network related to loss. Results revealed that when both OMN valence and

¹ Our research approach used to ask participants to provide a maximum of seven linked memories (see Philippe et al., 2009). However, we found out that only the first three linked memories had a predictive value for some outcomes. The subsequent four memories were rarely fully completed by all participants and their variance was either redundant or equivalent to that of the first three memories. This finding is in line with past research suggesting that only the first few answers that spontaneously come to an individual's mind in response to a question are considered representative of his or her most influential constructs (Higgins, King, & Mavin, 1982).

Table 1

Means, Standard Deviations, and Correlations Among Overall Memory Networks (OMN) Need Thwarting and Valence, Depressive and Nondepressive Emotions, Neuroticism, and Life Loss Events: Study 1

Variable	Mean	SD	1	2	3	4	5	6	7	8	9
1. OMN need thwarting ^a	0.08	0.98	—								
2. Loss memory need thwarting	-0.15	1.21	.85*	—							
3. Networked memories need thwarting	0.30	1.13	.83*	.40*	—						
4. OMN valence ^b	-0.82	1.42	-.45*	-.18*	-.59*	—					
5. Loss memory valence	-1.46	1.72	-.27*	-.25*	-.22*	.65*	—				
6. Networked memories valence	-0.55	1.65	-.44*	-.12	-.64*	.94*	.37*	—			
7. Depressive emotions	2.27	0.66	.40*	.32*	.36*	-.21*	-.17*	-.20*	—		
8. Nondepressive emotions	2.11	0.59	.24*	.18*	.22*	-.11	-.04	-.14	.71*	—	
9. Neuroticism	3.95	1.43	.31*	.21*	.32*	-.24*	-.11	-.25*	.64*	.57*	—
10. Life loss events ^c	0.00	0.71	.08	.05	.09	-.05	.01	-.06	.21*	.25*	.28*

Note. N = 215.

^a This score is equal to the combination of Variables 2 and 3. ^b This score is equal to the combination of Variables 5 and 6. ^c This index is the standardization of the number of yes-rated loss events (M = 6.14, SD = 2.30) and of the average of all effect ratings for each yes-rated event (M = 3.70, SD = 0.92).

* p < .01.

OMN need thwarting were examined concurrently, OMN need thwarting was the only significant predictor of depressive emotions, accounting for 11.9% of the variance over and above valence, $F(1, 212) > 30.16, p < .001$. This finding suggests that need thwarting in memory is a better predictor of negative emotional experiences than valence in memory.

A path analysis was conducted with OMN need thwarting, neuroticism, and life loss events as exogenous variables and depressive and nondepressive emotions as the two endogenous variables, controlling for the covariance between these two types of negative emotions (which is why a path analysis was used). Paths were drawn from all exogenous variables to all endogenous variables to control for all of their effects. The fit indices of this just-identified model were uninformative, as just-identified models yield perfect fit. However, the path coefficients are of interest. Figure 1 shows the final model. As can be seen, OMN need thwarting was positively associated with depressive emotions, even after controlling for neuroticism, life loss events, and the shared variance between depressive and nondepressive emotions. In addition, as hypothesized, OMN need thwarting was unrelated to nondepressive emotions. The path coefficient for the relation-

ship between OMN need thwarting and depressive emotions was significantly different from the path coefficient for the relationship between OMN need thwarting and nondepressive emotions, $t(213) = 2.46, p < .05$. These results support our hypotheses that need thwarting in memory networks related to the theme of loss would be significantly associated with depressive emotions, but not with negative emotional experiences theoretically unrelated to loss.² Finally, controlling for age or gender did not alter the results. Furthermore, there were no significant interactions between OMN need thwarting and either neuroticism or life loss events.

Taken together, results of Study 1 support our hypotheses. First, need thwarting in loss-related memory networks was found to be distinctively associated with depressive emotions, but not with nondepressive negative emotions. Although the design of Study 1 is correlational and the direction of these relationships remains unclear, this finding nonetheless suggests that autobiographical memory networks may influence people's emotional experience. Furthermore, it also supports the postulate that autobiographical memories are context-dependent and that theme-specific autobiographical memory networks are associated with specific theme-related emotional experiences, but not with theme-unrelated ones. Furthermore, the theme-dependent hypothesis held even after controlling for neuroticism and life loss events. Finally, Study 1 showed that need thwarting in memory was more strongly associated with negative emotions than valence in memory.

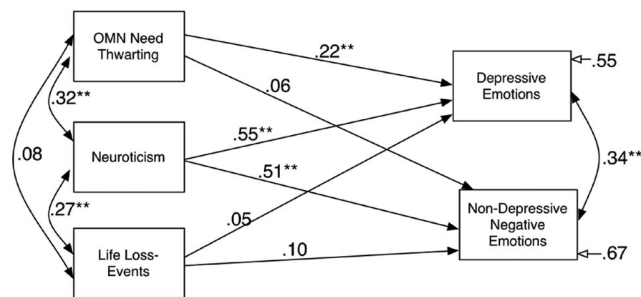


Figure 1. Path analysis of neuroticism, life loss events, and overall memory network (OMN) need thwarting predicting nondepressive negative and depressive emotions: Study 1. Double-headed arrows are covariances, one-headed black arrows are paths, and one-headed white arrows represent measurement errors. ** p < .01.

² Correlations between OMN need thwarting and each separate emotion were also examined. Results revealed that OMN need thwarting was correlated between .15 and .22 with each of the six nondepressive negative emotions and between .25 and .34 with each of the five depressive emotions. These results highlight that the correlations for OMN need thwarting were consistently lower with nondepressive negative emotions and consistently higher with depressive emotions. There were no instances of a correlation between OMN need thwarting and a specific emotion that could have dramatically lowered or increased the correlations between OMN need thwarting and one of the two indexes of emotion.

Study 2

Study 1 showed that need thwarting in loss-related autobiographical memory networks was associated with depressive emotions. As stated in the introduction, we believe that memories can prospectively influence emotional experiences as they inform the appraisal processes and determine how to react to situations. However, the design of Study 1 did not allow us to draw any conclusion with respect to this directive function of memories as only cross-sectional relationships were examined as well as measures of emotions experienced in general. Study 2 improves on this issue by examining how participants' memory network can predict their emotional reactivity 2 weeks later in response to a trigger related to the theme of their memory network. A second purpose of Study 2 was to examine the experience of a specific emotion. Although Study 1 differentiated depressive and nondepressive emotions, both types of emotion comprised a large number of different emotions. Study 2 specifically tapped the emotional experience of anger. Finally, we postulated in the introduction that a specific cue should trigger memory networks specifically related to this cue, but not cue-unrelated memory networks. Therefore, Study 2 compared an anger-related memory network with a guilt-related memory network in the prediction of anger reactivity following a trigger.

More specifically, a first group of participants was asked to describe a main memory about an event in which they had been treated unjustly, a theme largely evoking anger (Eisenberg, 2000). A second group of participants described a main memory about an event in which they committed an important error, a theme mostly evoking guilt (Lazarus, 1991). Both groups also described networked memories related to their main memory and rated their level of need satisfaction for each memory. A between-groups design instead of a repeated measures design was used to ensure that the description of the first memory network was not influencing the description or the retrieval of memories of the second memory network. Two weeks later, in an ostensibly unrelated study, all participants were shown a film excerpt depicting someone being treated unjustly. Anger elicitation to the film excerpt was collected. Because the film excerpt was about unfair treatment, this film clip was expected to automatically activate a memory network related to this theme in the participants' mind. Consequently, the level of need thwarting in this specific memory network should increase participants' anger reactivity to the film excerpt. However, the memory network pertaining to having committed an important error should not be activated by the film clip and therefore should not have any effect on anger reactivity because it is irrelevant to the theme of unfair treatment. Therefore, we hypothesized that need thwarting in the memory network related to having been treated unjustly would predict anger reactivity to a related film excerpt shown 2 weeks later. In addition, it was expected that need thwarting in the memory network related to having committed an important error would be unrelated to anger reactivity to the film excerpt. Need thwarting was expected to lead to anger because need thwarting should activate self-mechanisms that seek to defend the self against the potential need-thwarting situation. Indeed, anger has been shown to be frequently evoked in order to protect oneself against a threatening target (e.g., Izard, 1971).

Study 1 showed that the strongest predictor of negative emotional experience was neuroticism. Therefore, we controlled again for this trait in this study. In addition, because self-control has been shown to be particularly involved in the regulation of anger (e.g., Gottfredson & Hirschi, 1990), we also controlled for this trait. As in Study 1, we expected that the main hypothesis would hold, even after controlling for these two traits.

In sum, the design of Study 2 improves on Study 1 in three ways. First, Study 2 used a prospective design; thus, the direction of the relationship between OMN need thwarting and emotional experience can be investigated in terms of the predictive validity of autobiographical memory networks. Second, Study 2 used a target and a nontarget autobiographical memory network, allowing us to rule out the possibility that all types of OMN need thwarting significantly predict some negative emotional experiences. A third improvement is that the present design allowed us to control for the exact moment at which the OMN should be presumably activated (with the film excerpt), predicting the direct situational consequence of this activation on emotional reactivity.

Method

Participants and procedure. Participants were undergraduate students and were recruited in classrooms. A female experimenter introduced herself and asked the students to take part in a study about personal memories. Participants who agreed to participate in the study completed demographic information, neuroticism and self-control scales, and one of the two following versions of the EMNA. In the target version of the EMNA, participants were asked to describe a personal memory of an event in which someone treated them unjustly. In the nontarget version of the EMNA, participants were asked to describe a personal memory of an event in which they committed an important error. These two themes—being treated unjustly and committing an error—were chosen as they both represent negative events potentially accompanied by high levels of emotional arousal. However, they tap into very different emotions—the former evoking anger and the latter guilt (Izard, 1977; Lazarus, 1991). Two weeks later, a male experimenter went to the same classroom to introduce himself and asked the participants to take part in an ostensibly unrelated experiment about emotions. This second experiment was presented without any mention of the previous study and participants were led to believe that the two experimenters were part of different research laboratories. Participants were first asked to rate their current emotional experience using an emotional inventory (Time 1) and were then shown a film excerpt depicting someone being treated unjustly. After watching the film clip, participants were asked to rate again their current emotional experience (Time 2). Participants were then prompted for their suspicion that the two studies might have been related, were fully debriefed, and thanked for their participation. No participants guessed that the two studies were related to each other. The final sample was composed of 73 (target group—unfair-treatment memory network: $n = 35$; nontarget group—committed-error memory network: $n = 38$) students (55 women, 18 men). Mean age was 23.76 years ($SD = 6.77$). Ninety-four percent of the participants who completed the first phase of the experiment took part in the second phase 2 weeks later.

Film excerpt. A short film excerpt from the TV series *Six Feet Under* (Ball, 2002) lasting 1:12 min was shown to the participants to induce anger by depicting someone being treated unjustly. The excerpt contains an intense verbal fight between a daughter and her mother. The mother speaks harshly to her daughter, and it is understood that the mother refuses to give her daughter the money she owes her. The scene ends with the daughter running out of the house, slamming the door behind her. Participants were probed for their familiarity with the series and this particular episode. Only four participants reported to have previously watched the episode. Deleting these participants from the analyses did not affect the results.

Measures.

Neuroticism. Participants completed a 12-item version of the Neuroticism subscale of the NEO Personality Inventory—Revised (Costa & McCrae, 1992) on a 5-point Likert scale (1 = *strongly disagree*, 5 = *strongly agree*). Cronbach's alpha coefficient in this study was .76.

Self-control. The Brief Self-Control Scale (Tangney, Baumeister, & Boone, 2004) was used to assess self-control. This scale comprises 13 items responded to on a 5-point Likert scale format (1 = *not at all*, 5 = *very much*). Cronbach's alpha coefficient was .75 in this study.

EMNA. The EMNA (Philippe et al., 2009) used in Study 1 was again used in Study 2. In this study, the people who were part of the target group were asked to describe “. . . a personal memory of an event in which you were treated unjustly by somebody.” Participants in the nontarget group were asked to describe “. . . a personal memory of an event in which you committed an important error.” They also recalled and listed networked memories that they found to be directly or indirectly related to their main memory. Participants were asked to rate the psychological need satisfaction ($\alpha = .69$) and emotional content of each of their reported memories. However, in this study, instead of using a one-item valence measure, we used an extensive measure of emotional content. Participants were asked to rate the emotions they felt when the event of each of their reported memories occurred using a 14-item scale used in past research (Philippe et al., 2009, Study 2). This scale included five positive emotions (e.g., determined; $\alpha = .72$), five negative emotions (e.g., scared; $\alpha = .61$) and four anger-related emotions (i.e., angry, disgusted, scornful, and hostile; $\alpha = .72$). Valence and need-thwarting OMN scores calculations were identical to those used in Study 1 with the difference that in this study, a separate OMN valence score was computed for positive, negative, and anger-related emotions, in addition to the global OMN valence composite score.

Emotional inventory. Emotional adjective items included the full 20-item Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), seven of the 11 basic emotions of Izard in the form of adjectives (Blumberg & Izard, 1985: the emotions of interest, guilt, shame, and fear already being assessed by the PANAS), and four other emotional items used in past research (angry, happy, amused, and disappointed; Tugade & Fredrickson, 2004, Study 1). These emotional items were used to assess participants' emotions before (Time 1) and after the film excerpt (Time 2). In the present study, we were particularly interested in anger-related emotions. The anger-related emotions used were scornful, irritable, disgusted, hostile, mad, and angry. Cron-

bach's alphas for these six anger-related emotions were .82 and .78 before and after the film excerpt, respectively. Because we were assessing emotions at two different time points, we used an extensive emotional inventory to prevent participants from guessing the types of emotion of interest in this study. Indexes composed of positive emotions (Time 1: $\alpha = .88$; Time 2: $\alpha = .89$) and of non-anger-related negative emotions (Time 1: $\alpha = .70$; Time 2: $\alpha = .84$) were also computed.

Results and Discussion

Manipulation checks. Analysis of the anger-related emotions before and after the film excerpt confirmed that the induction of anger was successful. A paired *t* test between the anger measure at Times 1 and 2 was significant, $t(72) = 2.25, p < .05$. Effect size was medium ($d = 0.53$). This result suggests that the anger induction was sufficiently effective. In addition, there were no differences across the two groups on the reported anger levels, either before or after the induction, $t(71) < 0.20, p = .84$. The induction was also specific to anger as there was no significant change between Times 1 and 2 with respect to non-anger-related negative emotions, $t(72) = -0.22, ns$. Participants experienced, however, significantly reduced positive emotions after the film clip, $t(72) = 3.04, p < .05, d = 0.72$, which is not surprising as anger naturally inhibits the experience of positive emotions (e.g., Diener & Emmons, 1985).

OMN need thwarting and anger elicitation. Because memory networks are believed to be theme-specific, that is, activated by specific situations, we hypothesized that the OMN related to unfair treatment would be triggered by the film excerpt and that need thwarting in this specific OMN would positively predict anger reactivity to the film excerpt. Conversely, OMN need thwarting related to having committed an important error should be unrelated to the anger reactivity to the film excerpt because this network is irrelevant to the situation depicted in the film clip and should not be activated by this cue.

To test these hypotheses, we conducted a multiple regression analysis with anger levels at Time 2 as the dependent variable. Independent variables were anger levels at Time 1, group condition (0 = committed-error OMN, 1 = unfair-treatment OMN), OMN need thwarting, and the interaction term Group \times OMN Need Thwarting. In addition, control variables of neuroticism and self-control were added to the model. Results revealed that while controlling for anger levels at Time 1 ($\beta = .70, p < .001$), the interaction term Group \times OMN Need Thwarting emerged as a significant predictor of anger levels at Time 2 ($\beta = -.28, p < .05$). No other effects emerged as significant, including those of neuroticism and self-control or their interaction term with group condition or their third order interaction term Group \times OMN. In addition, controlling for age or gender did not alter the present results.

Figure 2 shows the significant interaction plot, in line with Aiken and West's (1991) recommendations for plotting interactions. As can be seen, in the unfair-treatment memory network group, when OMN need thwarting related to having been treated unjustly was equal to -1 standard deviation to the mean (in other words, when the OMN was showing low need thwarting), anger reactivity was low. When OMN need thwarting related to having been treated unjustly was equal to $+1$ standard deviation to the mean (in other words, when the OMN was showing high need

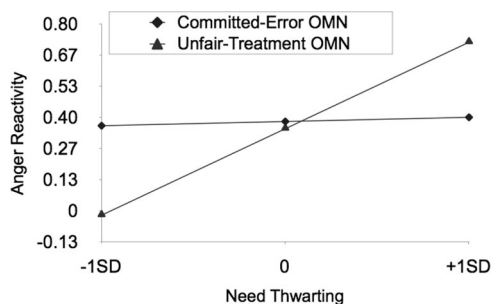


Figure 2. Plot of the interaction of anger reactivity and need thwarting in the committed-error and unfair-treatment overall memory networks (OMN): Study 2.

thwarting), anger reactivity was high. In the committed-error memory network group, however, all levels of OMN need thwarting related to having committed an important error were unrelated to anger reactivity. Examination of the simple effects revealed that the slope of the unfair-treatment memory network group was significant, $t(71) = -2.56, p < .05$. These results suggest that need thwarting in the OMN related to being treated unjustly facilitated the anger reactivity toward a film excerpt related to such a theme. Finally, the slope of the committed-error memory network group was not significant, $t(71) = 0.27, ns$, suggesting that need thwarting in the OMN related to having committed an important error had no effect on the expression of anger as elicited by a film excerpt related to unfair treatment.

The difference between the main emotional memory and the networked memories was examined. Although these two components are assumed to reach their highest level of prediction when they are combined—because it is the output of the overall memory network that is important and less each of its constituents taken separately—it is still interesting to examine whether one of these two components had a stronger impact on anger reactivity than the other. Therefore, we conducted two additional regression analyses, one with need thwarting in the main emotional memory and its interaction term with group conditions and another with need thwarting in the networked memories and its interaction term with group condition. The dependent variable and control variables were the same as above. Results showed that the interaction between either need thwarting in the Main Memory \times Group or need thwarting in the Networked Memories \times Group was significant, $\beta = -.21, p < .10$, and $\beta = -.26, p < .05$, respectively. These results suggest that both the main memory and the networked memories are contributive.

Further analyses were conducted to examine the role of valence. The global OMN valence score, the positive emotions OMN score, the negative emotions OMN score, and the anger-related OMN score were each entered in separate regression analyses. For each of these variables, their interaction term with group conditions was also entered in the regression. The other variables in the model were the same as those presented above. Results revealed no significant interaction or main effect for any OMN valence-related variables. In addition, their inclusion in the model did not affect the significance of the interaction term OMN Need Thwarting \times Group. These results thus suggest that OMN need thwarting is a more comprehensive predictor of anger reactivity than OMN va-

lence or emotion. We also examined whether OMN need thwarting or OMN valence could predict positive emotional or non-anger-related emotional reactivity. Both OMN need thwarting and OMN valence (including all types of OMN emotion score examined above) and their interaction term with group condition failed to significantly predict reactivity to these other types of emotions ($ps > .32$). Finally, controlling for age and gender did not affect any of the above results.

Thus, overall, results showed that OMN need thwarting has an important influence on situational emotional reactivity. In addition, the present findings suggest that memory networks are relatively theme-dependent, such that only memory networks related to the theme of the film excerpt were presumably activated during the film clip and influenced the situational emotional reactivity. Other memory networks related to other themes or situations were not activated and, therefore, did not influence the situational emotional reactivity. These findings also support the idea that need thwarting in memory networks is not a proxy variable for people's global negative functioning. Indeed, people in the nontarget group who reported high levels of need thwarting in an OMN related to having committed an important error were not those who expressed the highest level of anger in response to the theme of being treated unjustly. Furthermore, results held even after controlling for general traits such as neuroticism and self-control.

General Discussion

The purpose of the present research was to examine the automatic directive function of autobiographical memories on negative emotional experiences. Results from two studies suggest that autobiographical memories contribute to people's negative emotional experience in specific situations. More striking, it appears that need-thwarting representations encoded within these autobiographical memories are associated with negative emotions experienced when these memories are triggered by theme-relevant cues and that this mechanism can have both enduring and general emotional consequences (Study 1) as well as situational emotional consequences (Study 2). In addition, these results do not appear to be due to common affect-related traits, such as neuroticism or self-control. Overall, activation of need-thwarting autobiographical memories would appear to be a way to influence one's appraisal and negative emotional experience.

The present research constitutes a first set of studies showing that theme-specific autobiographical memories can have an automatic directive function on negative emotional experiences theoretically related to such themes. Study 1 showed that need thwarting in a memory network related to loss was associated with depressive emotional experiences, but not with other nondepressive negative emotions. One explanation for this result is that loss-related memory networks are relatively frequently activated by various cues in life events and experiences. Whenever such a situation is faced or such a cue is encountered, loss-related memory networks become activated and inform the appraisal processes that a need-satisfying or need-thwarting situation is occurring. If a loss-related situation is appraised as need thwarting based on the information contained in the activated memory network, depressive emotions should be experienced. Over time, people with need-thwarting loss-related memory networks would come to experience a high frequency of depressive emotions in their life.

Conversely, people with loss-related memory networks that are lower in need thwarting (or that even contain need-satisfying representations) would experience a lower frequency of depressive emotions.

Study 2 examined this thematic effect more specifically and convincingly. The results of Study 2 showed that need-thwarting memory components in a memory network related to a specific theme (being treated unjustly) predicted the elicitation of a specific emotion (anger) following the viewing of a film clip activating this specific theme. In addition, Study 2 also showed that memory networks unrelated to the theme of a cue (i.e., having committed an important error) were presumably not activated and thus exerted no effect on emotional reactivity. Indeed, Study 2 highlighted that need thwarting in memory networks related to having committed an important error was unrelated to anger elicitation following a film clip activating the theme of being treated unjustly. These findings highlight not only the theme-specific but also the discriminant role of autobiographical memories on emotional experiences. Taken together, Studies 1 and 2 showed that autobiographical memory networks possess considerable predictive value with respect to specific emotional outcomes.

An important implication of the present research is that although a single autobiographical memory may predict emotional outcomes, the influence of its related networked memories is not negligible. Indeed, networked memories were shown to add over and above the variance captured by the main memory (i.e., the main memory directly related to the assessed theme) in the prediction of negative emotions. The most intriguing aspect with respect to networked memories is that these memories do not need to be logically and holistically related to the main memory's central theme. For instance, networked memories can pertain to various themes or they can contain other emotional aspects that are unrelated to the central aspect of the main memory. Yet, it was shown that these networked memories do contribute to the experience of specific negative emotions as a function of the need-thwarting level characterizing them because of their association with the main memory based on shared features. Networked memories may thus act as a buffer or enhancer with respect to difficult emotional events. The extent to which the network of memories is need thwarting or need satisfying may alter how the difficult event is perceived and the intensity of the negative emotional experience when this event is reactivated. Future research will be needed to examine the potential buffer or enhancing effect of networked memories.

The present studies showed that need thwarting in autobiographical memory networks was a better predictor of emotional experiences than valence or specific emotions characterizing the memory networks. Similar results were also obtained elsewhere with respect to well-being (Philippe et al., in press). Why is need satisfaction/thwarting more important than the valence or emotion in memory? First, it should be noted that psychological needs and emotion are closely related (e.g., Sheldon et al., 2001). However, psychological needs reflect a primary motivation or goal, and goals are known to saturate autobiographical memories (e.g., Conway, 2003). These needs are intertwined with people's overarching psychological growth goal and life situations are automatically appraised in line with such a goal—that is, the extent to which the external situation is contributive to the individual's well-being (Lazarus, 1991). In addition, in appraisal theories, goals are ex-

pected to predict emotional elicitation. Past need satisfaction or need thwarting should thus have a more profound impact on people's current appraisal processes and emotional experience than the past positive or negative emotions they may have subjectively felt as a consequence of a goal. Enthusiasm, for instance, is less closely related to a goal and is best seen as a consequence of one's actual or potential goal achievement. Therefore, need satisfaction in memory assessments may capture a more profound cognitive and emotional trace than emotion in memories.

Some limitations of the present research need to be highlighted. First, only self-reported emotional inventories were used as outcome variables. Future research should use physiological measures or informant assessments in order to present a different angle of validity. A second limitation of the present research is that only emotional experience was assessed, whereas a number of emotional processes influencing people's emotional experience have been highlighted in past research, including emotion regulation (e.g., Gross, 1999), coping strategies (e.g., Carver, Scheier, & Weintraub, 1989), or different types of appraisal (e.g., Lazarus, 1991). It is unclear whether need-satisfying memory networks activate one or more of these emotional processes to regulate the experience of negative emotions, whether it is only that negative emotions are not activated when need-satisfying memory networks are at play, or whether both circumstances can occur. Future research should examine this issue. Third, the two present studies relied on the assumption that memory networks are actually automatically triggered in people's mind whenever specific cues are encountered. However, the present research provides no direct evidence of this fact. Neuropsychological studies may be needed to test this assumption. Finally, our samples did not include a large proportion of male participants, perhaps lowering the power to detect significant gender moderations. Therefore, our findings with respect to gender should be interpreted with caution.

In sum, the present research is the first to highlight that theme-specific autobiographical memory networks may have an automatic directive function on certain theme-related negative emotional experiences. In addition, need thwarting in autobiographical memories and memory organization into networks appear to be critical processes influencing people's emotional experience. Examining the role of need-thwarting representations in autobiographical memory networks thus appears to be a fruitful avenue for the broad field of emotion research.

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