Fibromyalgia patients make scarce reference to pain in self-defining memories

Ksenija Vucurovic, Clémentine Dupont-Gaudin, Delphine Raucher-Chéné, Arthur Kaladjian, Christine-Vanessa Cuervo-Lombard

Fibromyalgia patients make scarce reference to pain in self-defining memories

Ksenija Vucurovic, MD[a,b*], Clémentine Dupont-Gaudin, MD[b], Delphine Raucher Chéné, MD PhD[a,b], Arthur Kaladjian, MD PhD[a,b], Christine-Vanessa Cuervo-Lombard, PhD[b,c]

[a] Laboratoire Cognition, Santé, Société (C2S), Reims Champagne-Ardenne University, Reims, France

[b] Department of Psychiatry, University Hospital, Reims, France

[c] Centre for Studies and Research on Health Psychology and Psychopathology (CERPPS), Department of Psychology, Toulouse 2 Jean Jaurès University, Toulouse, France

[*]Corresponding author: Ksenija Vucurovic, MD

Laboratoire Cognition, Santé, Société (EA 6291)

UFR Lettres et Sciences Humaines

Bâtiment 13 > RDC Haut > R224

57 rue Pierre Taittinger

51096 REIMS Cedex

France

Tel. +33 (0)3 26 91 37 76

Fax +33 (0)3 26 91 37 19

E-mail: vksenija@yahoo.com

Conflict of interest: There are no conflicts of interest to declare.

Short title: Self-defining memories in fibromyalgia

Fibromyalgia patients make scarce reference to pain in self-defining memories

1. INTRODUCTION

Chronic pain is a highly disabling medical condition that occurs in over 10% of the general population [1]. Chronic pain may have detrimental effects on one's sense of self, particularly if the underlying mechanisms are not well understood and are therefore difficult to control. While nociceptive or neuropathic chronic pain mechanisms are well understood nowadays, pain conditions involving centralized sensitization are still challenging for physicians.

Fibromyalgia (FM) can be regarded as a prototypical central chronic pain disorder [2] that occurs in 2-4% of the general population. It is characterized by widespread pain, chronic fatigue, unrefreshing sleep, cognitive dysfunction and somatic symptoms [3]. It is significantly more prevalent in women than in men [2], and induces severe pain-related disability, including difficulties in daily physical functioning and decreased quality of life. Pain perception seems to be at the centre of patients' current self-understanding and has severe negative consequences for their wellbeing. Even though an FM diagnosis can have a negative and long-lasting impact on sense of self, no study has yet been conducted on the subject.

1.1. Fibromyalgia, self and memory

Over the past 25 years, a growing number of studies have suggested that the way people remember personal past events is predictive of their psychological functioning [4]. Memory processes that specifically contribute to the construction of personal identity, such as autobiographical memory, have never been studied in patients with FM. *Autobiographical memories* are transitory mental constructions generated from an autobiographical knowledge base held at different levels of specificity [5,6]. By

explicitly referring to the self, recent models of autobiographical memory provide a new conceptual frame that underlines the close reciprocal relationships between personal identity and a particular type of memory called self-defining memories (SDMs) [7]. *SDMs* have been the subject of many studies over the past 20 years [8]. Autobiographical memories incorporate facts, knowledge about the self, and recollections of personal experiences. They reflect individuals' most enduring concerns (achievement, intimacy, spirituality, etc.) and/or unresolved conflicts [9, 10]. SDMs relate to the relationship between autobiographical memory and self-identity, and can thus be distinguished from other autobiographical memory processes insofar as they are associated with the senses of personal identity and continuity in one's individual history. SDMs are vivid, emotionally intense and well-rehearsed autobiographical memories concerning the central goals, values and conflicts of an individual's life. According to the biopsychosocial model of FM occurrence and evolution developed by Eich et al. [11], the way in which individuals remember self-relevant memories, particularly those referring to painful events, could help to precipitate and/or perpetuate the illness [12]. However, in order to understand the precise impact of memory-related intrusions on an individual's self-identity [13,14], we need to understand the relationship between memory and self.

Even though autobiographical memory has never been explored in FM, we have data from disorders (e.g., affective and chronic pain disorders) sharing psychopathological features with FM that reveal overgeneral autobiographical memory recall in these populations [15-17]. We therefore set out to identify the factors that potentially interact with or affect SDM recall in FM, drawing on the CaR-FA-X model developed by Williams [18]. This model theorizes the mechanisms behind overgeneral autobiographical memory. Williams [18] delineated three main processes: capture and

rumination, functional avoidance, and impaired executive control. This model was further consolidated by empirical data reviewed by Sumner [4]. *Capture and rumination* processes, highly prevalent in affective disorders, refer to the disruption of cognitive resources during self-relevant information searches. Previous studies of SDMs in affective disorders have suggested that psychological distress, particularly depression and anxiety, affects SDM recall [15]. Moreover, depression, anxiety, catastrophizing thoughts, neuroticism and proneness to negative interpretation of life events have been described as more prevalent in patients with FM than in those with other chronic pain conditions [19,20] or healthy individuals [21,22]. By analogy with SDM studies in affective disorders, we assumed that psychological distress in patients with FM can affect their SDM recall. *Functional avoidance* refers to the passive avoidance of traumatic-event retrieval as a means of affect regulation. A history of childhood adversity, physical or psychological abuse or neglect, and trauma-related psychopathology have been described as predisposing factors in FM [23, 24] and correlated with symptom severity [25,26]. Moreover, it has been suggested that the functional avoidance of pain is the main mechanism behind overgeneral autobiographical recall in chronic pain conditions other than FM [16, 17]. Nevertheless, Meyer et al. [17] postulated that it is current pain, rather than chronic pain per se, that induces a lack of specificity in autobiographical memory. Thus, pain severity appears to be a relevant factor that can affect or interact with SDM recall in patients. Finally, *impaired executive control*, especially deficits in the inhibition of irrelevant information [27], limits the ability to conduct successful autobiographical retrieval. Patients with FM report cognitive dysfunction as one of their core symptoms. These cognitive complaints can be divided into two categories: subjective cognitive dysfunction, known as *fibrofog* [28], and objective cognitive dysfunction

documented by impaired performance on standardized neuropsychological tests [29]. Compared with healthy controls, patients with FM underperform on cognitive tests of attention [30], verbal fluency [31], executive function [29], and social cognition [32]. Cognitive inhibition tasks indicate impaired processing speed in FM [33,34], along with reduced task-related subcortical activation [34]. Based on the CaR-FA-X model, cognitive inhibition has been identified as the executive function that most affects SDM characteristics [35]. Therefore, our review of the literature allowed us to identify the most plausible confounding factors that may affect SDM recall, namely severity of current or mean pain, depression, anxiety, reduced cognitive inhibition ability, and medication use.

SDMs provide key information about cognitive-affective-motivational representations of self, helping us to understand how future actions may be guided by past experiences [36]. These memories influence other current cognitive functions and productions, and may be valuable predictors of adaptation to long-term illness [37]. Therefore, characterizing the phenomenology of SDMs in patients with FM not only has the potential to enhance our understanding of predisposing and/or perpetuating factors of the illness, but could also be used to improve clinical interventions in this population.

Our first aim was to compare the characteristics of patients' SDMs with those of healthy participants. The first broad assumption of this study was that patients with FM would provide overgeneral and less integrated SDMs, as described in the models of autobiographical recall in mood disorders and chronic pain. Given that a painful condition is reported as being central to their current self-concept, we expected these patients to report more memories of pain and physical concerns than the healthy controls. Finally, we statistically controlled our results for the most plausible

confounding factors, namely psychological distress, pain severity, cognitive inhibition ability and medication use.

2. MATERIAL AND METHOD

2.1. Participants

Twenty-five patients (21 women) with a diagnosis of FM based on ACR 2010 criteria [2] by a rheumatologist, pain practitioner or general medicine physician, and 24 healthy controls (HC) without FM (20 women) matched for age, sex and education level, took part in the study. All patients with FM reported having pain for more than 6 months.

Our sample of patients with FM was predominantly female (84%). We decided to include men in the study because outpatients were consecutively recruited and enrolled in the study in naturalistic conditions that also included male patient management. Our sample was thus consistent with epidemiological studies reporting a higher prevalence of the disease in women, but also the existence, albeit to a lesser extent, of the FM diagnosis in men [2,38]. Other authors have recruited similar patient samples with a proportion of women varying from 70% to 95% [39,40].

HC were recruited by advertisement in social media and among employees of the university hospital, and were matched with patients for age, sex and education level. There was no monetary compensation for participation in the study.

We did not include patients or controls aged under 18 or over 65 years, or affected by any other chronic pain or severe medical condition comprising central nervous system disorders, dyslexia or illiteracy, uncorrected hearing or sight problems. In addition, no individuals who took pain medication or reported any chronic pain were included in the control group.

All participants were native French speakers and none used alcohol or illicit psychoactive substances. They were interviewed individually in a quiet standardized environment. All procedures were clearly described to the participants in the form of both oral and written information, and during the interview we checked that they fully understood all the instructions they had received. This research was conducted in accordance with the Declaration of Helsinki and was approved by the local ethics committee. All participants gave their written informed consent before being included in the study.

2.1. Depression and anxiety assessment

The severity of depression symptoms was rated using a validated French-language version of the Beck Depression Inventory – Second Edition (BDI-II; [41]), and participants' level of anxiety was assessed with a validated French-language version of the State-Trait Anxiety Inventory (STAI) [42].

2.2. Mental flexibility and inhibition assessment

Mental flexibility was evaluated with the Trail Making Test (TMT) [43]. In Part A, participants are required to connect a series of 25 circles containing numbers randomly arranged in a spatial array. This part requires attention, mental tracking, and visual searching. In Part B, participants are asked to alternate between connecting a series of circles containing numbers in increasing order and connecting a series of circles containing letters in alphabetic order. This part requires the additional process of set shifting, as participants must alternate between number and letter use. The dependent measure was the completion time (in seconds) for each part. We also calculated the difference in completion time between B and A, to gain a relatively pure indicator of set shifting [44].

The Stroop test is widely used to assess inhibitory function [45, 46]. Participants are

asked to name as quickly and as accurately as possible the colour of the ink used to print rows of *X*s (colour condition), to read colour words (word condition), and to name the ink colour of incongruous colour words (colour-word condition). It probes the speed of information processing (colour and word conditions) and the ability to inhibit a prepotent response tendency (colour-word condition). We also calculated an interference score [47] taking overall slowing into account.

2.3. Pain and symptom severity assessment

Pain intensity was assessed on a visual numerical scale (VNS) ranging from 0 (*no pain*) to 10 (*maximum pain*). We asked patients to report a measure of current pain, as well as the mean and maximum pain experienced during the week before the assessment. FM severity was assessed with the Fibromyalgia Symptom Scale (FSS) [2] combining a Widespread Pain Index (number of affected areas from 0 to 19) and a Symptom Severity Scale ranging from 0 (*no problem*) to 3 (*severe symptoms*) in four domains: fatigue, unrefreshing sleep, and cognitive and somatic symptoms. The total FSS score ranges from 0 to 31.

2.4. Medication use quantification

To quantify patients' painkiller consumption, we used the Medication Quantification Scale (MQS). This is an instrument for quantifying medication regimen use in chronic pain populations that was developed in 1992 and updated for the third and last time in 2005 by Harden et al. [48] as the MQS-III. The MQS score for an individual patient is calculated as the sum of scores derived by multiplying the detriment weight, determined by professional consensus of American Pain Association members, and the relative daily dosage of the pharmacological class for each pain-related medication. Scores relative to pharmacological classes and their detriment weights are detailed in Harden et al, [48].

2.5. Self-defining memory assessment

Five SDMs were collected with the Self-Defining Questionnaire [7], introduced by an oral definition of an SDM during a face-to-face interview. Participants were instructed to report events in their personal memory with the following specific attributes: 1) the event should have taken place at least 1 year earlier; 2) it should be important for the individual and vividly represented; 3) it should help the individual and others explain who he or she is as an individual; 4) it should be related to an important and enduring theme, issue, conflict, or concern in the individual's life, and be linked to other events on the same theme; 5) it should generate strong feelings, be they positive or a negative; and 6) it should be an event that participants had thought of many times. While listening to this definition, participants had a sheet of paper in front of them summing up the main points. Next, participants were asked to describe their five SDM events, providing a caption for each of them, their age at each occurrence, the people they were with, what happened, and how they and other people reacted to the event. They were asked to write a title or sentence summarizing each event, described with enough details to help a virtual friend visualize the scene and imagine precisely what the person or others felt. Participants then had to rate their emotional response when remembering the event on a 7-point scale ranging from -3 (*very negative*) to 3 (*very positive*), the personal importance of the SDM on a scale ranging from 1 (*not important*) to 7 (*very important*), and whether remembering this event allowed them to mentally relive it on a scale ranging from 0 (*not at all*) to 7(*completely*).

The content of each SDM was evaluated using the classification proposed by Thorne and McLean [49]. Contents were divided into seven categories: life-threatening event, recreation, relationship, achievement/mastery, guilt/shame, drug/alcohol abuse, and

not classifiable. Independently of these categories, we also compared the participants' SDMs referring to physical or psychological pain (procedure similar to that used by Cuervo-Lombard et al. [50]). A memory was coded as *specific* if the event being described happened at a particular place and time and lasted less than a day. An event was considered to be *integrated* if the individual stepped back from the event narration and added a statement or comment indicating the personal significance of the event. SDMs were also coded for the presence or absence of *tension*, which was defined as an explicit reference to discomfort, disagreement, or unease during the narration of the event. The *emotional valence* (i.e., positive, neutral, or negative) and *intensity* (i.e., absolute value of the valence rating) of the affective response to each event were also rated on a scale ranging from -3 to +3. The event was coded as *redemptive* if the narration contained a clear and explicit transformation from a decidedly negative-affect state to a positive one. Conversely, an event was classified as *contaminative* if the memory narration contained an explicit transformation from a demonstrably positive affective state to a negative one. We counted the number of memories associated with redemption or contamination.

Two raters (CC-L & CD-G) independently scored each SDM according to the criteria proposed by Blagov and Singer [36] and Thorne and McLean [49]. In the few cases where their ratings differed, the SDM was discussed until agreement was reached. The kappa interrater reliability coefficient was 0.97 for specificity, 0.97 for integrative meaning, 0.95 for content, 0.89 for both redemption and contamination, and 0.97 for tension.

2.6. Statistical analysis

Data were analysed using STATISTICA® version 13.0 for Windows.

Patients with FM were compared with HC on sociodemographic variables, symptom severity, cognitive scores and SDM scores, using independent *t* tests. To examine the influence of possible confounding factors on observed group differences for SDM characteristics, we calculated Pearson's correlation coefficients between the depression (BDI-II), anxiety (STAI), pain intensity (VNS), symptom severity (FSS), quantity of medication use (MQS) and executive function (TMT/Stroop) scores and SDM characteristics. When we found a statistically significant correlation, ran analyses of covariance (ANCOVAs) with group as the independent variable, mean SDM characteristics (i.e., specificity, integrative meaning, tension, redemption, contamination, emotional valence and intensity) as dependent variables, and correlated clinical parameters as covariates.

[INSERT TABLE 1 ABOUT HERE]

3. RESULTS

3.1. Participants' characteristics

Details of participants' sociodemographic characteristics and clinical scores are provided in Table 1. The groups did not differ on either age or years of formal education. Patients with FM scored significantly higher on the BDI-II and STAI than HC. The results of the executive function assessment showed that patients with FM performed more slowly than HC, but displayed comparable accuracy, on both the TMT and the Stroop test. The Stroop Interference score did not differ between groups.

[INSERT TABLE 2 ABOUT HERE]

3.2. Characteristics of SDMs

Details of the statistical analyses of SDM characteristics in both groups are provided in Table 2. Content classified as exploration/recreation was less common in FM than in HC, the opposite being true of relationship events. The proportion of memories concerning physical or psychological pain did not differ significantly between groups. Patients provided less specific and less integrative meanings. Taken together, SDMs were generally characterized by higher tension and a more positive valence in HC than in FM. The intensity of negative memories was significantly higher in FM than in HC. The intensity of positive memories did not differ significantly between groups. The proportion of redemptive events was lower in FM. The proportion of contaminative events was also lower in FM than HC, but the difference was not statistically significant. Participants' mean age at the time of the described event did not differ between groups.

There were no statistical correlations between the STAI-A ($p_s > 0.72$), STAI-B ($p_s > 0.07$), VNS ($p_s > 0.05$), FSS ($p_s > 0.2$), MQS ($p_s > 0.2$), TMT-A ($p_s > 0.05$), TMT-B ($p_s > 0.05$), TMT (B-A) ($p_s > 0.09$), and Stroop Interference ($p_s > 0.22$) scores and the different characteristics of the SDMs described above. However, we found a negative correlation between the depression score (BDI-II) and SDM specificity ($r = -0.31$, $p = 0.032$). An ANCOVA with BDI-II score as the covariate, group as the independent variable, and SDM specificity as the dependent variable, did not change the statistical difference between groups, $F(1, 46) = 5.18$, $p = 0.028$.

4. DISCUSSION

The present study was designed to improve our understanding of how patients with FM define themselves and how pain is integrated into their self-identity. To our

knowledge, this is the first study to have investigated SDMs in an FM population. In addition, we addressed the issue of psychological distress, pain severity, cognitive inhibitory function and medication use as potential confounding factors in patients' SDM recall. As expected, the patients with FM displayed greater psychological distress than HC. The assessment of executive function indicated slower overall performance among patients, but no impairment of cognitive inhibition. Rather than retrieve specific memories for events that occurred at a particular time and place and lasted less than a day, patients described memories that were summaries or categories of events that lasted more than a day, and these memories were more negative but less intense than those of HC. Patients' SDMs were less redemptive, less integrative, and thus contained less meaning making. By contrast, despite our initial hypothesis, patients did not report more pain-oriented memories than HC did, even though pain appeared to be the main organizer of their current existence.

4.1. Biased SDM recall and affective dysregulation in FM

Taken together, the decreased specificity and integration of patients' SDMs, together with the scant references to pain, suggest that functional avoidance is used as a means of adapting to the illness. According to Conway and Pleydell-Pearce [6], retrieving memories of negative or painful events generates less emotional distress if those memories are less specific. Reduced specificity in autobiographical memory has been associated with less effective social problem-solving and difficulty imagining specific future events [51]. Overgeneral autobiographic memory has been found to be predictive of both the onset and recurrence of depression and posttraumatic stress disorder [52,53], both highly prevalent in FM, as well as a worse course of depression [54]. Accordingly, difficulty activating specific memories, particularly memories referring to pain, could lead to maladaptive functioning in patients with FM, by

leaving them less able to benefit from the cognitive and affective information available from vivid and detailed memories. Moreover, functional avoidance as a cognitive strategy and means of negative affect regulation has previously been identified as a vulnerability factor for other chronic pain conditions [16, 17]. Patients also provided less integrated SDMs than HC did, suggesting that they failed to take advantage of experiences regarded as self-defining when constructing and adjusting their current perceptions of self-identity and daily social life. Therefore, biased SDM recall and the use of functional avoidance (i.e., a mechanism that decreases patients' ability to effectively fight current pain) could be mutually reinforcing processes. Future studies should test developmental aspects of the functional avoidance mechanism and its longitudinal relation to the self and memory in FM, in order to further improve our understanding of the disorder's precipitating factors.

A second possible explanation for the scant references to pain in patients' SDMs is the high prevalence of alexithymia that has recently been reported in a number of studies of the psychopathology of FM [55-58]. *Alexithymia* is a personality dimension defined as difficulty identifying and describing subjective feelings [59], and it is highly prevalent in psychosomatic disorders [57]. Alexithymic individuals are prone to misinterpret the somatic manifestations of emotional arousal as the signs of the disease [60]. Researchers have investigated the presence of alexithymia in patients with FM using a range of methods [55, 59, 61-64]. Their findings suggest that patients have particular difficulty identifying feelings and the affective dimension of pain [60-64]. Recently, alexithymia *per se* was found to directly contribute to poor quality of life in FM, while depressive symptoms would rather have indirect impact [65]. Thus, scarce reference to pain in the SDMs reported by patients with FM may reflect an inability to make sense of what happens during the illness at the most personal level.

Moreover, alexithymia may disrupt patients' giving of meaning to SDMs related to pain, and impair awareness of and learning from these memories. Alexithymia is described as an emotional dysregulation trait [66], and as such may play an intermediate role between biased SDM recall (particularly scarce reference to pain) and the psychopathology of FM, characterized by highly prevalent psychological distress. Tesio et al [65] brought further evidence that poor psychosocial functioning in FM is related to alexithymia, so similar mechanisms could underpin SDM recall. However, this hypothesis needs to be addressed in future studies examining SDMs and alexithymia in the same FM sample.

In addition, less redemptive SDMs with a more negative emotional valence, but paradoxically retrieved with less tension, constitute further evidence of affective dysregulation in FM. Redemptive SDMs are predictive of greater psychological wellbeing [67], while autobiographical reasoning that transforms experience into an emotionally positive situation may be a basic psychological mechanism of appropriate affective adaptation [67,68]. Less emotionally intense positive memories and more vivid negative memories have been reported in depressed patients [69,70]. Nevertheless, as major depressive disorder involves disturbances in both negative and positive memory processes [70], different mechanisms of affective dysregulation seem to be involved in FM. Consistent with our results, Van Middendorp et al. [71] reported that negative affective experience was more disturbed than positive affective experience in patients with FM, while Rosello et al. [72] found multilevel deficits in affective modulation in their FM sample. Furthermore, an abnormal emotional autonomous nervous system response has been linked to higher experimental pain response in patients with FM [72], suggesting that a negative interpretation of past events is related to unclear emotional concepts [73,74] in patients and an inability to

activate these concepts during the autobiographical recall of self-defining events. Hence, when analysed via SDM characteristics, FM can best be described as an affective disorder with emotional dysregulation as the most prominent factor, affecting and interacting with autobiographical recall.

4.2. Clinical applications and future research

The ability to give meaning to important events in our lives is a critical function that allows SDMs to be integrated into a coherent representation of self and, as such, to guide our fulfilment of current and future goals. As discussed above, patients with FM seemed to avoid painful content when describing their SDMs, at both cognitive and affective levels of regulation. Therefore, new approaches in FM management, particularly in psychotherapy, based on how pain is integrated into self-identity, could be useful. These aspects of pain perception and self have not been specifically targeted in the field of psychotherapy for FM, even though a cognitive remediation approach called *imagery rescripting* has been found to be effective in reducing adverse SDMs in a nonclinical sample [75]. A specific programme of autobiographical memory remediation could therefore help patients with FM cope better with current pain by targeting impaired meaning making from SDMs, and as such represents a potential new direction for clinical practice.

Future studies should more specifically address SDMs in chronic pain conditions with low affective dysregulation, in order to gauge the influence of FM as a chronic illness on different SDM characteristics independently of pain avoidance strategies.

5. Limitations and conclusion

Our study had several limitations. First, we had a small sample size, although as the participants were each asked to identify five SDMs, we obtained a total of 245 memories to analyse, thus increasing our data. In addition, many studies describing

SDMs have been conducted with comparable sample sizes, and we achieved enough power to observe statistically significant differences between the groups. Second, we statistically controlled our results for the most plausible confounding factors (i.e., psychological distress, pain severity, cognitive inhibition ability and medication use) identified in a systematic literature review, and none could explain (either alone or in combination) impaired SDM recall in FM. Nevertheless, we cannot exclude the possibility that the mental fatigue described by patients [76] interacted with the ability to provide optimum effort during SDM searching, and other cognitive and affective factors should also be addressed in future studies. In addition, other types of statistical analysis, such as multiple regression, would yield more information if our sample was larger. Third, our sample is consistent with prevalence of FM in women, so gender could influence SDMs characteristics, in particular emotional aspects of reported memories. Finally, the cross-sectional design of our study did not allow us to make any extrapolations about causality between FM and the characteristics of SDMs.

In conclusion, our results suggest that SDM recall is biased in patients with FM. Even though other mechanisms may be involved, we discussed functional avoidance and alexithymia as two potential factors for scant references to pain in patients' SDMs, which in turn are indicative of affective dysregulation in FM. In clinical practice, remediating the way in which pain is integrated into SDMs in FM may enhance our ability to mitigate its negative impact on patients' lives.

Acknowledgments

We would like to thank the study participants, together with the following physicians from Reims University Hospital for their invaluable help with patient recruitment: Dr Violaine Noel and Prof. Amélie Servettaz from the General Medicine Department,

and Dr Jean-Pierre Conce, Dr Ai-Thu Nguyen, Dr Frédérique Arndt and Dr Christine Chemla from the Pain Assessment and Treatment Unit.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

REFERENCES

[1] King S, Chambers CT, Huguet A, MacNevin RC, McGrath PJ, Parker L, MacDonald AJ. The epidemiology of chronic pain in children and adolescents revisited: a systematic review. Pain 2011;152(12):2729–38. doi:10.1016/j.pain.2011.07.016. Review

[2] Häuser W, Ablin J, Fitzcharles MA, Littlejohn G, Luciano JV, Usui C, Walitt B. Fibromyalgia. Nat Rev Dis Primers 2015;13(1):15022. doi:10.1038/nrdp.2015.22. Review

[3] Wolfe F, Clauw DJ, Fitzcharles M-A, Goldenberg DL, Häuser W, Katz RL, et al. 2016 revisions to the 2010/2011 fibromyalgia diagnostic criteria. Semin Arthritis Rheum 2016;46(3):319-29. doi:10.1016/j.semarthrit.2016.08.012

[4] Sumner JA. The mechanisms underlying overgeneral autobiographical memory: an evaluative review of evidence for the CaR-FA-X model. Clin Psychol Rev 2012;32(1):34-48. doi:10.1016/j.cpr.2011.10.003. Epub 2011 Nov 4. Review. PubMed PMID: 22142837; PubMed Central PMCID: PMC3246105.

[5] Conway AR, Cowan N, Bunting MF. The cocktail party phenomenon revisited: the importance of working memory capacity. Psychon Bull Rev 2001;8(2):331-5. PubMed PMID: 11495122.

[6] Conway MA, Pleydell-Pearce CW. The construction of autobiographical

memories in the self-memory system. Psychol Rev 2000;107(2):261-88.

[7] Singer JA, Moffitt KH. An experimental investigation of specificity and generality in memory narratives. Imagination, Cognition & Personality 1991;11:233-57.

[8] Werner-Seidler A, Moulds ML. Characteristics of self-defining memory in depression vulnerability. Memory 2012;20(8):935-48.

[9] Singer JA, Blagov P, Berry M, Oost KM. Self-defining memories, scripts, and the life story: narrative identity in personality and psychotherapy: healthy narrative identity. J Pers 2013;81(6):569-82.

[10] Houle I, Philippe FL, Lecours S, Roulez J. Networks of self-defining memories as a contributing factor to emotional openness. Cogn Emot. 2018;32(2):363-70. doi: 10.1080/02699931.2017.1284045.

[11] Eich W, Hartmann M, Müller A, Fischer H. The role of psychosocial factors in fibromyalgia syndrome. Scand J Rheumatol Suppl 2000;113:30-1. Review. PubMed PMID: 11028828.

[12] Van Liew C, Standridge K, Leon G, Cronan TA. A longitudinal analysis of pain experience and recall in fibromyalgia. Int J Rheum Dis. 2018; 5(11). doi:10.1111/1756-185X.13415. PubMed PMID: 30398031.

[13] Knez I. Place and the self: an autobiographical memory synthesis. Philos Psychol 2014;27(2):164-92.

[14] Mutlutürk A, Tekcan Aİ. Remembering and telling self-consistent and self-discrepant memories. Memory 2016;24(4):513-25.

[15] Lemogne C, Piolino P, Friszer S, Claret A, Girault N, Jouvent R, et al. Episodic autobiographical memory in depression: specificity, autonoetic consciousness, and self-perspective. Conscious Cogn 2006;15(2):258-68.

[16] Liu X, Liu Y, Li L, Hu Y, Wu S, Yao S. Overgeneral autobiographical memory

in patients with chronic pain. Pain Med 2014;15(3):432-9.

[17] Meyer P, Karl A, Flor H. Pain can produce systematic distortions of autobiographical memory. Pain Med 2015;16(5):905-10.

[18] Williams JMG. Capture and rumination, functional avoidance, and executive control (CaRFAX): Three processes that underlie overgeneral memory. Cognition and Emotion 2006; 20:548–68.10.1080/02699930500450465

[19] Borg C, Padovan C, Thomas-Antérion C, Chanial C, Sanchez A, Godot M, et al. Pain-related mood influences pain perception differently in fibromyalgia and multiple sclerosis. J Pain Res 2014;22;7:81-7. doi:10.2147/JPR.S49236

[20] Piccinni A, Bazzichi L, Marazziti D, Veltri A, Bombardieri S, Conversano C, et al. Subthreshold mood symptoms in patients with fibromyalgia and rheumatoid arthritis. Clin Exp Rheumatol 2011;29(6 Suppl 69):S55-9.

[21] Vural M, Berkol TD, Erdogdu Z, Kucukserat B, Aksoy C. Evaluation of personality profile in patients with fibromyalgia syndrome and healthy controls. Mod Rheumatol 2014;24(5):823-8. doi:10.3109/14397595.2013.868069

[22] Novo R, Gonzalez B, Peres R, Aguiar P. A meta-analysis of studies with the Minnesota Multiphasic Personality Inventory in fibromyalgia patients. Personal Individ Differ 2017;116:96–108.

[23]Weissbecker I, Floyd A, Dedert E, Salmon P, Sephton S. Childhood trauma and diurnal cortisol disruption in fibromyalgia syndrome. Psychoneuroendocrinology 2006;31(3):312-24.

[24] Sluka KA, Clauw DJ. Neurobiology of fibromyalgia and chronic widespread pain. Neuroscience 2016;3;338:114-29. doi:10.1016/j.neuroscience.2016.06.006. Review

[25] Lee Y-R. Fibromyalgia and childhood abuse: exploration of stress reactivity as a

developmental mediator. Dev Rev 2010;30(3):294-307.

[26] Amital D, Fostick L, Polliack ML, Segev S, Zohar J, Rubinow A, et al. Posttraumatic stress disorder, tenderness, and fibromyalgia syndrome: are they different entities? J Psychosom Res 2006;61(5):663-9.

[27] Piolino P, Coste C, Martinelli P, Macé A, Quinette P, Guillery-Girard B, Belleville S. Reduced specificity of autobiographical memory and aging: do the executive and feature binding functions of working memory have a role? Neuropsychologia 2010;48:429–40.10.1016/ j.neuropsychologia.2009.09.035. PubMed: 19804792.

[28] Kravitz HM, Katz RS. Fibrofog and fibromyalgia: a narrative review and implications for clinical practice. Rheumatol Int 2015;35(7):1115-25. doi:10.1007/s00296-014-3208-7. Review

[29] Gelonch O, Garolera M, Valls J, Rosselló L, Pifarré J. Executive function in fibromyalgia: comparing subjective and objective measures. Compr Psychiatry 2016;66:113-22. doi:10.1016/j.comppsych.2016.01.002

[30] Cherry BJ, Weiss J, Barakat BK, Rutledge DN, Jones CJ. Physical performance as a predictor of attention and processing speed in fibromyalgia. Arch Phys Med Rehabil 2009;90(12):2066-73.

[31] Kratz AL, Schilling SG, Goesling J, Williams DA. Development and initial validation of a brief self-report measure of cognitive dysfunction in fibromyalgia. J Pain 2015;16(6):527-36. doi:10.1016/j.jpain.2015.02.008

[32] Di Tella M, Castelli L, Colonna F, Fusaro E, Torta R, Ardito RB, et al. Theory of mind and emotional functioning in fibromyalgia syndrome: an investigation of the relationship between social cognition and executive function. PLoS One 2015;10(1):e0116542.

[33] Veldhuijzen DS, Sondaal SF, Oosterman JM. Intact cognitive inhibition in patients with fibromyalgia but evidence of declined processing speed. J Pain 2012;13(5):507-15. doi:10.1016/j.jpain.2012.02.011. PubMed PMID: 22564673

[34] Martinsen S, Flodin P, Berrebi J, Löfgren M, Bileviciute-Ljungar I, Ingvar M, et al. Fibromyalgia patients had normal distraction related pain inhibition but cognitive impairment reflected in caudate nucleus and hippocampus during the Stroop Color Word Test. PLoS One 2014;9(9):e108637. doi:10.1371/journal.pone.0108637. eCollection 2014. PubMed PMID: 25275449; PubMed Central PMCID: PMC4183523.

[35] Stewart TM, Hunter SC, Rhodes SM. A prospective investigation of rumination and executive control in predicting overgeneral autobiographical memory in adolescence. Mem Cognit 2018; 46(3):482-96. doi: 10.3758/s13421-017-0779-z. PubMed PMID: 29340943; PubMed Central PMCID: PMC5880861.

[36] Blagov P, Singer JA. Four dimensions of self-defining memories (specificity, meaning, content, and affect) and their relationships to self-restraint, distress, and repressive defensiveness. J Pers 2004;72(3):481-511.

[37] Nourkova VV, Vasilenko DA. On the advantage of autobiographical memory pliability: implantation of positive self-defining memories reduces trait anxiety. Memory 2018;26(7):869-881. doi: 10.1080/09658211.2017.1420195. PubMed PMID: 29284340.

[38] Yunus MB. The role of gender in fibromyalgia syndrome. Curr Rheumatol Rep 2001;3(2):128-34.

[39] Üçeyler N, Zeller D, Kahn AK, Kewenig S, Kittel-Schneider S, Schmid A, et al. Small fibre pathology in patients with fibromyalgia syndrome. Brain 2013;136(Pt6):1857-67. doi:10.1093/brain/awt053

[40] Bartley EJ, Rhudy JL, Williams AE. Experimental assessment of affective processing in fibromyalgia. J Pain 2009;10(11):1151-60. doi:10.1016/j.jpain.2009.04.008

[41] Beck AT, Steer RA, Brown, GK. Manual for Beck Depression Inventory II (BDI-II). San Antonio, TX: Psychology Corporation; 1996.

[42] Spielberger CD, Gorsuch RL, Lushene RE. STAI manual for the State-trait Anxiety Inventory ("Self-evaluation questionnaire"). Palo Alto, CA: Consulting Psychologists Press; 1984.

[43] Tombaugh TN. Trail Making Test A and B: normative data stratified by age and education. Arch Clin Neuropsychol 2004;19(2):203-14.

[44] Sánchez-Cubillo I, Periáñez JA, Adrover-Roig D, Rodríguez-Sánchez JM, Ríos-Lago M, Tirapu J, et al. Construct validity of the Trail Making Test: role of task-switching, working memory, inhibition/interference control, and visuomotor abilities. J Int Neuropsychol Soc JINS 2009;15(3):438-50.

[45] Stroop JR: Studies of interference in serial verbal reactions. J Exp Psychol 1935;18:643-62.

[46] Miyake A, Friedman NP, Emerson MJ, Witzki AH, Howerter A, Wager TD. The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: a latent variable analysis. Cogn Psychol 2000;41:49-100.

[47] Golden CJ. Diagnosis and rehabilitation in clinical neuropsychology. Springfield, IL: Charles C. Thomas: 1978.

[48] Harden RN, Weinland SR, Remble TA, Houle TT, Colio S, Steedman S, et al. Medication Quantification Scale Version III: update in medication classes and revised detriment weights by survey of American Pain Society physicians. J Pain 2005;6(6):364-71.

[49] Thorne A, McLean KC. Manual for coding events in self-defining memories. Santa Cruz, CA: University of California; Personal communication.

[50] Cuervo-Lombard C, Raucher-Chéné D, Barrière S, Van der Linden M, Kaladjian A. Self-defining memories in recently detoxified alcohol-dependent patients. Psychiatry Res 2016;30;246:533-8. doi:10.1016/j.psychres.2016.09.040

[51] McLean KC, Syed M, Yoder A, Greenhoot AF. The role of domain content in understanding identity development processes. J Res Adolesc 2016;26(1):60-75.

[52] Kleim B, Ehlers A. Reduced autobiographical memory specificity predicts depression and posttraumatic stress disorder after recent trauma. J Consult Clin Psychol 2008;76:231–42. doi:10.1037/0022-006X.76.2.231. PubMed: 18377120.

[53] Sumner JA, Griffith JW, Mineka S, Rekart KN, Zinbarg RE, Craske MG. Overgeneral autobiographical memory and chronic interpersonal stress as predictors of the course of depression in adolescents. Cogn Emot 2011;25:183–192.10.1080/02699931003741566. PubMed: 21432666.

[54] Sumner JA, Griffith JW, Mineka S. Overgeneral autobiographical memory as a predictor of the course of depression: a meta-analysis. Behav Res Ther. 2010;48:614–25. doi:10.1016/j.brat.2010.03.013. PubMed: 20399418.

[55] Di Tella M, Enrici I, Castelli L, Colonna F, Fusaro E, Ghiggia A et al. Alexithymia, not fibromyalgia, predicts the attribution of pain to anger-related facial expressions. J Affect Disord 2017;227:272-9. doi:10.1016/j.jad.2017.10.048. [Epub ahead of print] PubMed PMID: 29127814.

[56] Ghiggia A, Romeo A, Tesio V, Di Tella M, Colonna F, Geminiani GC et al. Alexithymia and depression in patients with fibromyalgia: when the whole is greater than the sum of its parts. Psychiatry Res 2017;255:195-7. doi:10.1016/j.psychres.2017.05.045. Epub 2017 May 30. PubMed PMID: 28577473

[57] Di Tella M, Castelli L. Alexithymia and fibromyalgia: clinical evidence. Front Psychol 2013;4:909. doi:10.3389/fpsyg.2013.00909. eCollection 2013. PubMed PMID: 24348453; PubMed Central PMCID: PMC3845661.

[58] Di Tella M, Tesio V, Ghiggia A, Romeo A, Colonna F, Fusaro E et al. Coping strategies and perceived social support in fibromyalgia syndrome: relationship with alexithymia. Scand J Psychol 2017. doi:10.1111/sjop.12405. [Epub ahead of print] PubMed PMID: 29110306.

[59] Taylor GJ, Bagby RM, Parker JDA. Disorders in affect regulation: alexithymia in medical and psychiatric illness. Cambridge: CambridgeUniversity Press; 1997. doi:10.1017/CBO9780511526831

[60] Lumley MA, Smith JA, Longo DJ. The relationship of alexithymia to pain severity and impairment among patients with chronic myofascial pain: comparisons with self-efficacy, catastrophizing, and depression. J Psychosom Res 2002;53(3):823-30. PubMed PMID: 12217458.

[61] Sayar K, Gulec H, Topbas M. Alexithymia and anger in patients with fibromyalgia. Clin Rheumatol 2004;23(5):441-8. Epub 2004 Jun 30. PubMed PMID: 15278756.

[62] Steinweg DL, Dallas AP, Rea WS. Fibromyalgia: unspeakable suffering, a prevalence study of alexithymia. Psychosomatics 2011;52(3):255-62. doi:10.1016/j.psym.2010.12.022. Epub 2011 Mar 24. PubMed PMID: 21565597.

[63] Tuzer V, Bulut SD, Bastug B, Kayalar G, Göka E, Beştepe E. Causal attributions and alexithymia in female patients with fibromyalgia or chronic low back pain. Nord J Psychiatry 2011;65(2):138-44. doi:10.3109/08039488.2010.522596. Epub 2010 Sep 27. PubMed PMID: 20874000.

[64] Castelli L, Tesio V, Colonna F, Molinaro S, Leombruni P, Bruzzone M, et al. Alexithymia and psychological distress in fibromyalgia: prevalence and relation with quality of life. Clin Exp Rheumatol 2012;30(6 Suppl 74):70-7. Epub 2012 Dec 14. PubMed PMID: 23110722.

[65] Tesio V, Di Tella M, Ghiggia A, Romeo A, Colonna F, Fusaro E, Geminiani GC, Castelli L. Alexithymia and Depression Affect Quality of Life in Patients With Chronic Pain: A Study on 205 Patients With Fibromyalgia. Front Psychol 2018; 4(9):442. doi: 10.3389/fpsyg.2018.00442. PubMed PMID: 29670558; PubMed Central PMCID: PMC5893813.

[66] Taylor GJ. Recent developments in alexithymia theory and research. Can J Psychiatry 2000;45(2):134-42. Review. PubMed PMID: 10742872.

[67] Liao H-W, Bluck S, Cheng CL. Young women in today's Taiwan: relation of identity status and redemptive narration to psychological well-being. Sex Roles 2015;73(5-6):258-72.

[68] Lardi Robyn C, Ghisletta P, Van der Linden M. Self-defining memories and self-defining future projections in hypomania-prone individuals. Conscious Cogn 2012;21(2):764-74.

[69] Neshat-Doost HT, Dalgleish T, Yule W, Kalantari M, Ahmadi SJ, Dyregrov A, et al. Enhancing autobiographical memory specificity through cognitive training: an intervention for depression translated from basic science. Clin Psychol Sci 2013;1(1):84-92.

[70] Werner-Seidler A, Moulds ML. Characteristics of self-defining memory in depression vulnerability. Memory 2012;20(8):935-48.

[71] Van Middendorp H, Lumley MA, Jacobs JWG, van Doornen LJP, Bijlsma JWJ, Geenen R. Emotions and emotional approach and avoidance strategies in

fibromyalgia. J Psychosom Res 2008;64(2):159-67.

[72] Rosselló F, Muñoz MA, Duschek S, Montoya P. Affective modulation of brain and autonomic responses in patients with fibromyalgia. Psychosom Med 2015;77(7):721-32.

[73] Di Simplicio M, Holmes EA, Rathbone CJ. Self-images in the present and future: role of affect and the bipolar phenotype. J Affect Disord 2015;15;187:97-100. doi:10.1016/j.jad.2015.08.042

[74] Seth AK. Interoceptive inference, emotion, and embodied self. Trends Cogn Sci 2013;17(11):565-73. doi:10.1016/j.tics.2013.09.007

[75] Çili S, Pettit S, Stopa L. Impact of imagery rescripting on adverse self-defining memories and post-recall working selves in a non-clinical sample: a pilot study. Cogn Behav Ther 2017;46(1):75-89.

[76] Bar-On Kalfon T, Gal G, Shorer R, Ablin JN. Cognitive functioning in fibromyalgia: the central role of effort. J Psychosom Res 2016;87:306.

Table 1: Participants' characteristics

	FM (n = 25)		HC (n = 24)			
	M	(*SD*)	*M*	(*SD*)	*t*	*P*
Age (years)	51.2	(7.8)	50.6	(7.6)	0.280	0.781
Education level (years)	11.8	(1.4)	11.7	(1.7)	0.212	0.833
BDI-II	29.2	(10.4)	6.1	(6.1)	9.442	<0.001***
STAI						
- STAI-State	41.3	(16.8)	29.0	(9.6)	3.143	0.003**
- STAI-Trait	56.8	(11.2)	33.5	(9.2)	7.948	<0.001***
TMT-A (time in seconds)	53.2	(21.9)	38.4	(7.4)	3.134	0.003**
TMT-A (n errors)	0.1	(0.3)	0	(0.0)	1.772	0.083
TMT-B (time in s)	97.2	(50.3)	62.6	(8.7)	3.326	0.002**
TMT-B (n errors)	0.3	(0.1)	0.1	(0.4)	1.059	0.295
TMT B-A (time in s)	44.1	(35.8)	22.2	(6.5)	2.680	0.010*
Stroop test						
Word (number)	94.3	(20.0)	109.8	(14.2)	1.991	0.003**
Colour (number)	64.8	(15.0)	76.9	(11.4)	1.708	0.003**
Colour-Word (number)	39.7	(10.0)	45.9	(9.7)	1.063	0.033*
Interference score	1.50	(6.3)	0.79	(5.8)	1.192	0.685
Age at pain onset (years)	36.4	(12.0)	-	-	-	-
VNS score						
- Current pain	5.5	(2.1)	-	-	-	-
- Mean pain (/week)	7.5	(1.5)	-	-	-	-
- Maximum pain (/week)	8.6	(1.4)	-	-	-	-
Fibromyalgia Severity Score	24.7	(7.4)	-	-	-	-
- Affected areas (n)	15.1	(4.3)	-	-	-	-
- Fatigue	2.8	(0.5)	-	-	-	-
- Unrefreshing sleep	2.4	(0.8)	-	-	-	-
- Cognitive symptoms	2.2	(0.8)	-	-	-	-
- Somatic symptoms	2.2	(1.0)	-	-	-	-
MQS-III	17	(13.4)	-	-	-	-

Note. FM = patients with fibromyalgia; HC = healthy controls; *M* = mean value; *SD* = standard deviation; *n* = number; % = percentage; BDI = Beck Depression Inventory; STAI = State Trait Anxiety Inventory; TMT = Trail Making Test; VNS = Visual Numerical Scale (0-10); MQS-III = Medication Quantification Scale - third version; NSAI: nonsteroidal anti-inflammatory drugs.

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

Table 2: Detailed SDM characteristics

	FM (n = 25)		HC (n = 24)			
	M	(*SD*)	*M*	(*SD*)	*t*	*P*
Thematic content (%)						
- Life-threatening events	30.4	(25.2)	27.5	(15.4)	0.48	0.631
- Exploration/recreation	7.2	(12.7)	20.0	(23.6)	-2.38	0.022
- Relationship events	47.2	(26.4)	31.7	(17.6)	2.41	0.020
- Achievement events	8.0	(12.9)	7.5	(12.9)	0.14	0.893
- Guilt theme	1.6	(5.5)	3.3	(9.6)	-0.78	0.441
- Drug abuse	0.8	(4)	0.0	(0.0)	0.97	0.332
- Non-classifiable events	4.8	(10.4)	10.0	(14.4)	-1.45	0.154
Reference to pain (%)						
- Physical pain	8.0	(15.6)	8.0	(11.6)	-0.086	0.932
- Psychological pain	12.0	(20.0)	20.0	(17.4)	-1.861	0.079
Specificity (%)	32.8	(27.0)	60.8	(33.6)	-3.22	0.002
Integrative meaning (%)	31.2	(23.9)	48.3	(33.8)	-2.06	0.045
Tension (%)	20.0	(18.3)	36.7	(21.8)	-2.91	0.006
Redemption (%)	2.4	(6.6)	9.2	(13.2)	-2.29	0.027
Contamination (%)	3.2	(7.5)	4.2	(10.2)	-0.38	0.706
Emotional valence	-0.03	(1.7)	0.90	(1.1)	-2.23	0.031
Emotional intensity						
- Positive valence	2.60	(0.5)	2.66	(0.3)	0.50	0.618
- Negative valence	2.69	(0.4)	2.44	(0.7)	1.54	0.131
Age at SDM (years)	24.12	(12.1)	23.17	(16.1)	0.23	0.821

Note. SDM = self-defining memory; FM = patients with fibromyalgia; HC = healthy controls; *M* = mean value; *SD* = standard deviation; *n* = number.