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Cognitive processes in evaluation anxiety: An experimental study based on memory bias

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ABSTRACT

The present article presents the data from an experimental research with the primary goal of exploring the presence of memory bias in participants with high levels of evaluation anxiety in comparison with a group with low evaluation anxiety, as measured by the F1 factor of the Anxiety Situations and Responses Inventory (Miguel-Tobal & Cano-Vindel, 2002). For this purpose, an experimental task based on the conception of explicit memory was carried out, specifically a free recall test, cuing the beginning of words, using words with evaluation anxiety content versus neutral words. The results and their clinical implications, as well as the limitations in the experimental study concerning the processing of threatening information, are discussed.

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Procesos cognitivos en la evaluación de la ansiedad: estudio experimental fundamentado en el sesgo de memoria

RESUMEN

En el presente artículo se presentan los datos de una investigación experimental cuyo objetivo fundamental fue explorar la presencia del sesgo de memoria en participantes con niveles elevados de ansiedad de evaluación en comparación con un grupo con baja ansiedad evaluativa medidos mediante el factor F1 del Inventario de Situaciones y Respuestas de Ansiedad (Miguel- Tobal y Cano-Vindel, 2002). Para ello se llevó a cabo una tarea experimental basada en la concepción de memoria explícita, en concreto una prueba de recuerdo libre con clave de inicio de palabras, mediante el uso de palabras con contenido de ansiedad de evaluación vs palabras neutras. Se discuten los resultados encontrados, sus implicaciones a nivel clínico y las limitaciones que se dan en el estudio experimental del procesamiento de la información amenazante.

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Determining the cognitive and metacognitive processes that operate in different psychopathological disorders is essential to understand and subsequently develop applied treatments in this field. From a cognitive perspective, some psychopathologies, such as depression or clinical anxiety, partially develop due to alterations in attentional and appraisal processes and in the individual's cognitive interpretation of a certain situation (Azais, 1995; Eysenck & Derakshan, 1997). Thus, anxious people are characterized by a biased filtering of stimulus information that is congruent with their emotional state (attentional bias) and by interpreting neutral information as threatening (interpretative bias), presenting more concrete and inflexible cognitive schemas than people who are not anxious. For some authors, negative interpretations or thoughts emerge from the activation of beliefs established in the long-term memory circuit, creating schemas in the cerebral memory structures that contain this type of information (Wells, 2000).

Throughout the past two decades, experimental evidence has very strongly supported the fact that people with anxiety disorders present attentional and interpretative biases towards threatening information. However, there is a third bias, called memory bias, which has emerged inconsistently in the different anxiety disorders and in the diverse conceptions and experimental paradigms (explicit vs. implicit recall tasks) that measure this bias (for a review, see Sanz-Blasco, Miguel-Tobal, & Casado-Morales, 2011).

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Explicit memory is considered as the tendency to recall previously presented material by means of conscious or deliberate recovery strategies. Focusing on the study topic of this article, there appears to be a memory bias in panic disorder (Boyer, Bisserbe, & Mialet, 1992; Lim & Kim, 2005) and, to a lesser extent, in posttraumatic stress disorder (Vrana, Roodman, & Beckham, 1995) and obsessive compulsive disorder (Coles & Heimberg, 2002).

The priming effect is understood as the influence of a certain stimulus (cue) on the subsequent performance of the processing system. Priming is used to assess implicit memory, which is both unconscious and unintentional, in tasks that measure the individual's mnestic performance. The results of diverse investigations are divergent, and memory bias appears in generalized anxiety disorder (Coles, Turk, & Heimberg, 2007).

In recent years and especially in the context of research on evaluation anxiety, without considering the explicit-implicit dichotomy of memory tasks, there have been positive results concerning the emergence of memory bias in the role of autobiographic memories in the course and maintenance of social phobia (Krans, de Bree, & Bryant, 2013; Morgan, 2010).

These results have been interpreted as a function of the levels of processing that are activated in each of the psychopathological entities. Whereas anxiety seems to be more closely related to automatic biases that affect early and pre-attentional levels of information processing, affective disorders such as depression are associated with elaborative and post-attentional biases, especially when the material processed is of an autobiographic nature with loss-related contents (Williams, Watts, MacLeod, & Mathews, 1997).

In the present experimental study, we shall study the presence of memory bias in individuals with high and low levels of self-reported evaluation anxiety. We shall attempt to explore the differences between the two groups in the rate of recall as a function of the type or content of the word used, specifically evaluation anxiety words versus neutral words.

As working hypotheses, we propose the following ones:

H1. People with high levels of evaluation anxiety, measured by means of the F1 factor of the Anxiety Situations and Responses Inventory-ISRA (Miguel-Tobal & Cano-Vindel, 2002), will have a tendency to recall more words with evaluation anxiety content versus neutral words in a recall task (explicit memory: free recall cued with the beginning of the word) in comparison with the group with low evaluation anxiety.

As women generally present higher levels of trait anxiety (Bowen, Offord, & Boyle, 1990; Costello, Egger, & Angold, 2005) as well as higher evaluation anxiety (greater fear of situations such as speaking with authority, in quality/performance, giving a speech in public, feeling observed while working, going into a room when everyone else is already seated, being the center of attention or speaking at a meeting) (Turk et al., 1998), our second hypothesis is:

H2. In comparison with men, women will show greater memory bias, in other words, higher recall of words of evaluative content versus neutral words.

Method

Participants

In the first stage, we assessed 175 university students from the Faculty of Psychology of the Complutense University of Madrid. According to the norms of the instrument for the F1 factor, participants scoring higher than percentile 75 made up the high evaluation anxiety group, whereas participants scoring lower than percentile 25 made up the low evaluation anxiety group. Therefore, the final sample was made up of 38 participants in the low evaluation anxiety group (M = 19.73, SD = 2.07) (low in F1), of whom 22 are women (M = 19.45, SD = 2.24) and 16 are men (M = 20.12, SD = 1.82),

and 46 participants in the high evaluation anxiety group (M = 18.82, SD = 1.33) (high in F1), of whom 31 are women (M = 18.83, SD = 1.36) and 15 are men (M = 18.80, SD = 1.32).

Design

The experiment used a mixed 2 x 2 x 2 factorial design. The between-subject factors were groups of evaluation anxiety with two levels (participants with high scores in evaluation anxiety vs. participants with low scores) and sex (men and women). The within-subject factor is the recall task with two levels (evaluation anxiety words and neutral words). The dependent variable is the recall rate (percentage) of words from each category (evaluation anxiety and neutral).

Materials

The stimuli were presented by means of the PowerPoint program of Microsoft 2007 on a compatible computer. The stimuli were presented in the center of the screen written in black on a white background, with a font size of 60 that could be selected in the program. The instructions of the test were presented in yellow on a black background (size 44).

The total of 24 adjectives, selected ad hoc for this investigation, were presented. The stimuli used in the memory tasks belonged to two differentiated categories: 8 words of evaluation anxiety (e.g., unsafe, silly) and 8 neutral words (e.g., honest, direct). The remaining 8 words, of mixed contents, were presented in groups of 4 words at the beginning and at the end of the stimulus contents in order to control for the primacy and recency effect present in any memory test.

All the participants had a workbook to record their recall on the memory test – a self-referential coding task in order to achieve the same coding level for each one of the words – which also contained the instructions to be followed, which were also presented on the computer screen along with the stimulus material.

Procedure

Participants with scores higher than or equal to percentile 75 or below percentile 25 in the Anxiety Situations and Responses Inventory- ISRA (Miguel-Tobal & Cano Vindel, 2002) were contacted by phone and requested to come to the laboratory of Human Psychology of the Faculty of Psychology of the Complutense University of Madrid. We used two Faraday cabins that were thermally, acoustically, and electromagnetically isolated.

The experimental protocol (see Annex I) was individually applied. Upon arrival, participants were instructed to sit in the Faraday cabin. After a brief adaptation period to the cabin conditions, they were requested to fill in an informed and voluntary consent form by which they agreed to the assessment of certain emotional parameters. We selected participants who did not present any recent psychopathology, were not receiving pharmacological and/or psychological treatment at that time, and did not present a relevant condition that could substantially interfere with the results of the test (substance consumption, lack of sleep, excess fatigue, pain, etc.) (for a detailed review of the experimental protocol, see Sanz-Blasco, Miguel-Tobal, & Casado-Morales, 2013).

Data Analysis

Data were analyzed with the statistical program SPSS, version 15.0 for Windows XP.

In order to ensure that the two groups were matched in the dependent variable (rate of recall), that is, that the possible group differences were due to the levels of anxiety and not to a differential

recall capacity, we included in the experimental protocol the Digit Span test from Wechsler's Intelligence Scale for adults (Wechsler, 1999). In order to verify the main hypotheses of the study, we applied Student's *t*-test for independent samples, finding no group differences in the level of recall, *t*(82) = 0.784, *p* = .436, indicating that the initial levels of recall were similar in both groups.

Although participants with high evaluation anxiety displayed greater recall of evaluative words than low anxiety participants, *t*(82) = -1.744, *p* = .085, the difference did not reach statistical significance (see Table 1). On the other hand, the opposite effect was observed in recall rate for neutral words in the two groups, and the difference was statistically significant, *t*(82) = 2.172, *p* = .033 (see Table 2). Therefore, the data indicate a slight – albeit not very consistent — tendency toward memory bias.

Figure 1. Mean recall rates of the groups

Table 1
Descriptive statistics - Hypothesis 1

	Eval. anx. level	*N*	Mean	*SD*	*SEM*
Eval. anx. words	LOW	38	30.5921	9.28043	1.50548
	HIGH	46	33.8315	7.74777	1.14235
Neutral words	LOW	38	39.3092	7.53762	1.22276
	HIGH	46	35.5978	8.00060	1.17962
Forgetting	LOW	38	30.0987	14.30065	2.31987
	HIGH	46	30.7065	12.06364	1.77869

Note. Eval. anx. words = recall rate of words with evaluation anxiety content; neutral words = recall rate of neutral words; forgetting = forgetting rate.

Table 3
Mann-Whitney *U*-test for independent samples comparing women with high vs. low scores in evaluation anxiety

	Eval. anx. words	Neutral words	Fogetting
Mann-Whitney *U*	330.000	274.500	325.500
Wilcoxon *W*	583.000	770.500	578.500
Z	-0.204	-1.238	-0.285
Asymptotic significance (two-tailed)	.838	.216	.776

Note. Grouping variable: level of evaluation anxiety; eval. anx. words = recall rate of words with evaluation anxiety content; neutral words = recall rate of neutral words. forgetting = forgetting rate.

In order to verify our second hypothesis, the influence of sex on recall rates, we performed a repeated measures analysis of variance (ANOVA) for the high and low evaluation anxiety groups.

Results

No statistically significant differences were found in the interactions recall * level of evaluation anxiety, *F*(1, 32) = 2.249, *p* = .129, recall * sex, *F*(1, 32) = 1.693, *p* = .196, and recall * level of evaluation anxiety * sex, *F*(1, 32) = 1.103, *p* = .314. This data indicates that the variables sex and levels of anxiety do not seem to determine the recall rates of each group of words. In view of these results, we cannot maintain our second working hypothesis.

Although ANOVA is pertinent to verify our hypothesis, we decided to divide the groups by sex and conduct a complementary analysis with a nonparametric difference of means for independent samples, using Mann-Whitney's *U*. In the first analysis, no differences were found in women's recall group (see Table 3).

However, following the same process, we found the opposite data in the group of men (see Table 4). As can be seen, statistically significant group differences indicating memory bias for the evaluation anxiety words (*Z* = -2.13, *p* = .033) were found, and differences clearly approached significance for the neutral words (*Z* = -1.755, *p* = .079)
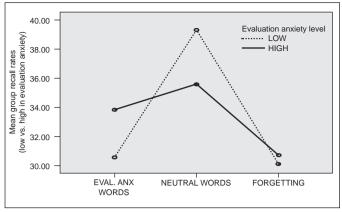
(see Table 4). However, the most interesting aspect of these results is not their statistical significance but the effect sizes of each one of the comparisons. These were high, in accordance with the recommendations of Cohen (1998), both for the evaluation anxiety words (*d* = 0.91) and for the neutral words (*d* = 0.70) (see Table 5).

Table 4
Mann-Whitney *U*-test for independent samples comparing men with high vs. low scores in evaluation anxiety

	Eval. anx. words	Neutral words	Forgetting
Mann-Whitney *U*	67.500	77.000	113.500
Wilcoxon *W*	203.500	197.000	233.500
Z	-2.131	-1.755	-0.262
Asymptotic significance (two-tailed)	.033	.079	.793
Exact significance (2*[one-tailed])	.037	.093	.800

Note. Eval. anx. words = recall rate of words with evaluation anxiety content; neutral words = recall rate of neutral words; forgetting = forgetting rate.

Table 2
Results of *t*-test for independent samples - Difference of means between both groups (low vs. high in evaluation anxiety)

		Levene's test for variance equality		*t*-test for equal means					
		F	*p*	*t*	*df*	*p* (two-tailed)	Difference of means	*SEM*	95% CI of the difference
Eval. anx. words	Variances are assumed to be equal	0.929	.338	-1.744	82	.085	-3.23942	1.85756	[-6.93470, 0.45587]
Neutral words	Variances are assumed to be equal	0.018	.893	2.172	82	.033	3.71138	1.70880	[0.31204, 7.11073]
Forgetting	Variances are assumed to be equal	0.706	.403	-0.211	82	.833	-0.60784	2.87616	[-6.32944, 5.11377]

Note. Eval. anx. words = recall rate of words with evaluation anxiety content. neutral words = recall rate of neutral words. forgetting = forgetting rate, CI = confidence interval.

Table 5
Effect size (Cohen's *d*) of the Mann-Whitney *U* contrast of men's low vs. high in evaluation anxiety

Groups (Men's low vs. high in evaluation anxiety) and type of word	Cohen's *d*
Difference of words of evaluation anxiety	0.91
Difference of neutral words	0.70
Forgetting	0.14

From these results, it can be concluded that if we had used a sample made up exclusively of males, we would have found memory bias in an explicit memory task, with large effect sizes. Contrary to our expectations, it seems that, in males, different levels of evaluation anxiety could be a mediator variable in the differential recall of evaluation anxiety words versus neutral words. Nevertheless, although it is interesting to take these results into account, given the limitations of the sample and considering the use of a nonparametric test, they should be interpreted with caution, and irrefutable conclusions cannot be extracted.

Discussion

In the present work we explored the presence of memory bias by means of an explicit recall task in participants with high evaluation anxiety. In view of the results found, we can draw the following conclusions:

1. Concerning our first hypothesis, we cannot state that there is a differential recall of threatening versus neutral content in individuals with high levels of self-reported evaluation anxiety in an explicit recall task.

2. Although the results differ as a function of the statistical analysis carried out, we cannot firmly state that sex is an important mediator variable in the emergence of memory bias when it interacts with different levels of anxiety, which leads us to reject our second hypothesis.

Considering the idea that, to a great extent, anxiety consists of attention and hypervigilance towards threatening stimuli and in view of the relation between attention and memory, people with diverse anxiety disorders or with high levels of anxiety could be expected to show a differential pattern in the recall of threatening stimuli. However, the findings of this study and other studies do not seem to point in that direction.

We think that the lack of positive results in the emergence of memory bias may be due to methodological and experimental variables that attenuate that effect. Firstly, among the most important variables we consider the high correlation between measures of anxiety and depression – correlations that are sometimes higher than those found in anxiety questionnaires – and the high comorbidity between affective and anxiety disorders. Secondly, the material used in the different experimental tasks is of a verbal nature, generally words that represent the fears of an individual with a certain disorder. However, it is very likely that the responses that accompany the presence of the stimulus words are very different from the responses to the same threats in real life, so we are faced with a problem of ecological validity.

Thirdly, the experimental tasks used could affect the individuals' differential recall. The use of certain instructions, the fact that many distractor tasks are interference tasks, or that the stimulus material is quantitatively different (e.g., words vs. images) makes it impossible to compare results found by means of different tasks.

An important limitation in many experimental studies is the small sample size, leading to a considerable loss of statistical power and a relatively weak effect, thereby increasing the probability of erroneous conclusions. As we are very probably measuring a weak effect, the data may overlap due to certain artifacts such as sample size or the type of analysis used to verify the hypotheses. If we had employed a considerably larger sample size, our results might have been different, reaching statistical significance in some important aspects that would have confirmed the presence of the bias.

Moreover, the sample is made up of normal participants without any known pathology. The data could be different in a sample made up of participants with a specific diagnosis (e.g., social phobia). As mentioned above, when addressing an effect with scarce salience, employing a clinical sample might have revealed an important impact on the emergence of memory bias.

It is necessary to remedy these difficulties in order to untangle mnestic behavior in the anxiety response. In recent years, it has been emphasized that, instead of a conception of explicit-implicit memory, research should focus on the role played by certain episodic memories in the course of different anxiety disorders and in the consequences of these results in clinical settings (Zlomuzica et al., 2014). A contributing factor to the maintenance of negative beliefs, maladaptive emotional responses, and avoidance behaviors is the dysfunctional recovery of certain episodic and autobiographical memories (Mathews & MacLeod, 2005).

Thus, at the applied level, a cognitive intervention based on restructuring certain memories that modulate the excessive recovery of aversive episodic memories could be a mechanism to improve the effectiveness the exposure-based treatments (Zlomuzica et al., 2014). For example, in the treatment of posttraumatic stress disorder and specific phobia, excessive recovery of aversive memories provokes symptoms of re-experiencing, thereby reinforcing negative beliefs, which can increase behavioral avoidance during exposure therapy (de Quervain & Margraf, 2008).

In the same vein, narrative exposure therapy (NET) represents an example of behavioral intervention whose main goal consists of reorganizing the recovery of past emotional experiences. It is a short intervention that has shown its efficacy in the treatment of posttraumatic stress disorder, especially in patients with conflicts derived from organized violence (Robjant & Fazel, 2010). The patients are repeatedly exposed to their traumatic emotional memories in chronological order, while they are trained in cognitive restructuring of those memories to reduce their emotional impact and of the cognitive organization associated with the memories. Therefore, in view of the current evidence, it seems that assessing the characteristics of the alterations of certain episodic memories should be considered when designing a cognitive treatment plan.

In spite of the limitations and the diffuse results in the study of the mnestic processes associated with anxiety disorders, we are convinced that there are certain unknown memory processes that justify continuing to investigate in this field with a view to developing cognitive interventions to reduce the emotional impact and to reorganize the emotional content associated with diverse psychopathological entities.

Conflict of Interest

The authors of this article declare no conflict of interest.

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Annex I

Outline of the experimental protocol

EXPERIMENTAL PROTOCOL
1. Seating the participants and adaptation period
2. Completing the informed consent
3. Administration of the questionnaire designed ad hoc for the inclusion of the participants
4. Brief instructions
5. Administration of the Digit Span test of the Wechsler Intelligence Scale for Adults –WAIS-III (Wechsler, 1999).
6. Emotional induction task (preparation of a public speech) during 2 minutes
7. Explicit memory task
☐ Presentation of words (self-referential coding)
☐ Distracter task (presentation of neutral images)
☐ Recall phase
8. Instructions to not reveal information about the experiment