

# Relationship Between Emotion Regulation and Memory in a Competitive Cued-Recall Task

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## ABSTRACT

Emotion regulation might have an impact on memory performance. Nevertheless, there is still no clear relationship between the type of emotion regulation strategy and the type of information recalled. An experiment was conducted involving 194 participants that performed an online task in which they had to recall three kinds of words (positive, negative, and neutral), with competitive recall cues (first letter), as the same cue was used for a word in each emotional category. They also answered three instruments for measuring emotion regulation (Emotion Regulation Questionnaire, ERQ), deficits in emotion regulation (Difficulties in Emotion Regulation Scale, DERS), and affective state (Positive and Negative Affect Schedule, PANAS). The results showed that participants with higher (vs. lower) levels in cognitive reappraisal performed better at recalling positive words. In turn, deficits in emotion regulation were linked to a weaker performance when recalling words with an emotional content, particularly the dimension of interference in recalling negative words. The results are discussed from the perspective of the processes involved in emotion regulation, while also considering the more stable skill-related aspects when controlling emotions.

## KEYWORDS

emotion regulation  
memory  
cued recall

## INTRODUCTION

The relationship between emotion and cognition is the key to understanding human adaptive capabilities (Bocanegra, 2016; Kret & Bocanegra, 2016). This has prompted the study of the effect emotions have on different cognitive processes (Lemaire, 2021; Niedenthal & Wood, 2019), attention (Yiend, 2010), memory and learning (Phelps, 2004; Um et al., 2012), reasoning (Jung et al., 2014), problem-solving (Isen et al., 1987; Politis & Houtz, 2015), divergent thinking and creativity (Mastria et al., 2019), and decision-making (Lerner et al., 2015). Overall, the results of studies on this relationship reveal that emotion and cognition are profoundly interwoven and that cognitive and emotional brain structures mutually influence each other through a complex network of connections that inform adaptive and maladaptive behaviours (Okon-Singer et al., 2015).

There is also an interest in the impact that capabilities in emotional control and management have on cognitive processes. Emotion regulation (ER) analyses the processes that enable individuals to decide when and how emotions are experienced and expressed (Gross, 1998a). Different approaches have been used to address the study of ER. The skills model focuses on how individuals adopt an adaptive response to negative emotions (Gratz & Roemer, 2004) and proposes four facets of ER: (a) emotional awareness and understanding, (b) emotional acceptance, (c) ability to control impulses and uphold objectives in the presence of negative affect, and (d) access to ER strategies that are considered effective for feeling better (Hallion et al., 2018). A widely used

instrument for measuring ER within this approach is the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004).

Other models have focused on studying the process involved and the strategies used to regulate emotions. The information-processing model of emotion regulation (Gross, 1999, 2015) propounds that ER may be studied depending on when the regulation strategy is used during the generation of emotion (Situation → Attention → Interpretation → Response). Some strategies may work in the initial stages, channelling or avoiding the choice of emotional stimuli and blocking the generation of further emotions (Gabrys et al., 2018; Malooly et al., 2013). Other strategies come into play in later stages and do so in the appraisal of the stimuli the emotion has generated. They thereby reinterpret its meaning and modify the initial emotional response (cognitive reappraisal strategy; Gross, 1998b). It is also possible to act on the emotional response in later stages (suppression strategy), or blocking or eliminating the emotion once it has emerged (Gross, 2015). Within this approach, the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) is often used to measure cognitive appraisal and expressive suppression strategies.

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Emotional dysregulation has been linked to lower levels of well-being and increased psychopathology (Levin & Rawana, 2022). More specifically, it has been directly related to personality disorders (Gratz et al., 2006; Van Rheezen et al., 2015), generalized anxiety (Mennin et al., 2002), insomnia (Zakiei et al., 2020), drug and alcohol abuse (Gratz & Tull, 2010; Ram et al., 2018), social anxiety (Sung et al., 2012), health anxiety (Bardeen & Fergus, 2014), and post-traumatic stress disorder (Ehring & Quack, 2010). The nonclinical population has also showed an association between emotional dysregulation and personality traits (Velotti & Garofalo, 2015). In turn, adaptive ER strategies such as cognitive reappraisal have positive effects on several domains, such as individuals' personal, social, and labor performance. In particular, being highly skilled in ER has been associated with better quality social relations and subjective wellbeing (Extremera et al., 2003; Gross et al., 2006; John & Gross, 2004; Leible & Snell, 2004). On the other hand, maladaptive strategies such as expressive suppression have the opposite effect (Levin & Rawana, 2022). In short, ER deficits are involved in the development, persistence, and treatment of various mental disorders (Berking & Wupperman, 2012), and most of these complaints lead to diminished cognitive functions that may prompt emotional dysregulation (Holley et al., 2015; Joormann & Siemer, 2011; Schmeichel & Tang, 2014). Therefore, the differences in cognitive capabilities may be partly explained by the differences in capabilities when coping with emotions. This assumption leads directly to the study of the relationship between ER and cognitive processes, and specifically, memory.

## Emotion Regulation and Memory

Cognitive reappraisal and expressive suppression are two processes with the biggest impact on cognition (Dillon et al., 2007; Hayes et al., 2010; Knight & Ponzio, 2013). Specifically, and as regards memory, it seems that expressive suppression has an impact on memory with an emotional content because it further compromises cognitive resources, whereas cognitive reappraisal does not (Richards & Gross, 2000). Cognitive reappraisal is the strategy that contributes more to raising performance in recalling emotional episodes as compared to other kinds of passive strategies (Dillon et al., 2007; Hayes et al., 2010; Kim & Hamann, 2012; Richards et al., 2003). Expressive suppression has the opposite effect (Binder et al., 2012; Bonanno et al., 2004; Dillon et al., 2007; Hayes et al., 2010; Richards & Gross, 2000). In particular, cognitive reappraisal facilitates the recall of negatives images, whereas expressive suppression impairs it (Dillon et al., 2007; Hayes et al., 2010; Kim & Hamann, 2012). A beneficial effect of cognitive reappraisal (up-regulation) has also been found on the recall of images with a positive content (Knight & Ponzio, 2013). The results are not clear when participants are divided into high and low in cognitive reappraisal and expressive suppression. Furthermore, it appears that the results with emotional images differ depending on the type of memory task (recognition vs. free recall; Wang et al., 2017).

Furthermore, it should be noted that emotional dysregulation means that high levels of emotion, which are commonly negative, cease to be regulated by cognitive processes. This relationship between emotion and cognition is a two-way one, and it feeds back off of the

lack of efficacy of the cognitive processes that regulate emotions and the effects that emotion has on cognition (McRae & Zorolia, 2020). A possible explanation for the influence that ER has on memory stems from the notion that the emotional content of information automatically attracts attentional resources and increases the cognitive effort required to redirect one's attention (Banich et al., 2009). Emotional stimuli thereby interfere with the processing of information, engaging the resources involved in cognitive control (Fynes-Clinton et al., 2022; Song et al., 2017). Emotion dysregulation is therefore related to lower cognitive control when processing emotional information (hot task), which might influence information recall and coding processes. This effect is greater when the information is negative, and recovers within a context of interference (e.g., García-Pacios et al., 2015). Therefore, it may be affirmed that the incongruencies between the results are related to the methodology used (type of task, stimuli used, kind of strategy). What is more, as reported by Hayes et al. (2010), the mechanism through which ER affects memory is not apparent.

## Research Objectives and Hypotheses

Therefore, the current study analyzed the relationship between ER (strategies and dysregulation) and the recall of words with an emotional content in a cued-recall task. Few studies have addressed this relationship involving words with an emotional content within a context of interference. First, verbal stimuli have certain advantages over visual material, and could partly correct the methodological issues present in other studies. Compared to other kinds of stimuli, verbal ones may be better controlled by physical characteristics (Bayer et al., 2012), psycholinguistic ones (Tse & Altarriba, 2009), and by belonging to a category (White et al., 2014). Their levels of activation and valence may also be controlled for (e.g., Hinojosa et al., 2016). Therefore, they might be a suitable tool for studying the impact of emotion on memory within a more ecological context (Riegel et al., 2016). The relationship between ER and memory may be considered from the perspective provided by the models that understand ER as skills or traits (Gratz & Roemer, 2004), and the model that focuses on the process and strategies (Gross, 1999). Both approaches may be used to study the influence of ER on memory, which is, in turn, a reconstructive cognitive process (Bartlett, 1932), affected both by an individual's more stable traits (Luchetti et al., 2021) and by the phases that determine the processing of information (Bisaz et al., 2015).

Considering the above theoretical review and the research goals, the current study formulated the following hypotheses: a significant relationship was expected between ER and the recall of emotional words (hot task), but not neutral words (cold task); participants with higher levels of cognitive reappraisal would recall more emotional words. In turn, participants with higher levels of expressive suppression would recall fewer emotional words. Finally, deficits in ER were expected to have a negative impact on the recall of words with an emotional content. Moreover, this effect would be more consistent in the dimension of interference with words with a negative content.

## METHOD

### Participants

The sample consisted of 194 undergraduates (88.7% female), aged between 18 and 30 ( $M = 18.46$ ,  $SD = 1.53$ ), studying at Salamanca University (Spain). They all agreed to take part in the study in exchange for an increase of 0.25 points out of 10 in the mark for a subject, and they signed a written consent form.

### Materials and Instruments

#### WORDS WITH AN EMOTIONAL CONTENT

Thirty words were taken from the normative study on the affective value of 478 words in Spanish by Redondo et al. (2005), out of which a selection was made of 10 positive words, 10 negative ones, and 10 neutral ones, which were controlled for the levels of arousal and frequency of use. No significant differences were found between the positive and negative words in either arousal ( $t = -1.02$ ,  $p = .319$ ) or frequency of use ( $t = .62$ ,  $p = .544$ ; see the Appendix).

#### EMOTION REGULATION QUESTIONNAIRE

The Emotion Regulation Questionnaire (ERQ; Gross & John, 2003), adapted into Spanish by Cabello et al. (2013), with an adequate internal consistency (Cronbach's  $\alpha$ ) for the dimension of reappraisal ( $\alpha = .79$ ) and suppression ( $\alpha = .75$ ), assesses the tendency to regulate emotions based on two possible strategies: cognitive reappraisal and expressive suppression. The former contains six items, while the latter has four, with a Likert-type response format (1 = *fully disagree*, 7 = *fully agree*). The higher the score, the more this regulation strategy is used. The questionnaire's internal consistency in the sample was .55 for cognitive reappraisal and .76 for suppression.

#### DIFFICULTIES IN EMOTION REGULATION SCALE

The Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004), adapted to the Spanish population by Hervás and Jódar (2008), with good internal consistency (Cronbach's  $\alpha$ ) in all the subscales (between  $\alpha = .73$  and  $\alpha = .71$ ), measures clinically significant difficulties in ER. The number of items in the Spanish version was reduced to 28 (from 36), with five subscales: (a) emotion dysregulation (inattention): difficulties in attending to and being aware of emotions; (b) confusion: difficulty in understanding and describing the emotions being experienced; (c) emotion rejection: reactions of nonacceptance toward one's own distress; (d) interference: difficulties in concentrating and performing tasks when dealing with negative emotions; and (d) emotion dyscontrol (uncontrolled): difficulties in keeping control when experiencing negative emotions. A Likert-type format was also used for these responses (1 = *almost never*, 5 = *almost always*), where a higher score indicates more difficulties. The reliability of the scale in the current sample proved to be adequate for all the subscales:  $\alpha = .789$  for inattention,  $\alpha = .891$  for confusion,  $\alpha = .863$  for rejection,  $\alpha = .853$  for interference, and  $\alpha = .839$  for dyscontrol.

### POSITIVE AND NEGATIVE AFFECT SCHEDULE

The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). This is a self-report scale that measures positive and negative mood states. The Spanish adaptation by López-Gómez et al. (2015), which records suitable internal consistency (Cronbach's  $\alpha$ ) both in positive affect ( $\alpha = .92$ ) and in negative affect ( $\alpha = .88$ ), was used in the current study. The reliability of the scale in the current sample was also adequate for both positive ( $\alpha = .756$ ) and negative affect ( $\alpha = .812$ ) subscales.

### Procedure

Both the experimental task and the questionnaires were administered online through an ad hoc instrument created with Google Forms. The students were asked to perform the task in a quiet, well-lit environment. They were also instructed to complete the task without any interruptions. Initially, and after signing their informed consent forms, the participants had to rate 30 words displayed randomly as positive, negative, or neutral. One word in each category had the same first letter: A, C, G, I, L, M, O, P, S, or T (see Appendix). The aim of this stage was to ensure that the subjects processed the information on a semantic level. They were then asked to recall the words based on each word's first (initial) letter. They were randomly presented with 10 items, for which they had to write down all the words they recalled from the previous list that began with the letter "A", and so on with all the other letters used as recall cues. They were then administered the DERS, ERQ, and PANAS. The questionnaires were administered after the task to ensure their content did not interfere with the recall of words during the memory task.

### Data Analysis

An analysis of the data distribution in each one of the variables recorded values of  $ps < .05$  in the Kolmogorov-Smirnov test, except for positive affect ( $p = .094$ , see Figure 1). Therefore, the decision was made to perform nonparametric analyses to study the relationship between the variables (Spearman's Rho). This analysis included positive and negative affect as a control measure for analyzing the possible influence of the participants' affective state on the relationship between ER and memory. The next step involved comparing the groups with higher and lower scores in ER (ERQ; reappraisal and suppression) and difficulties in ER (DERS; inattention, confusion, rejection, interference, and dyscontrol) in memory performance (positive, negative, and neutral words). The criterion for forming the groups in each one of the dimensions of the ERQ and the DERS involved solely those participants that scored a standard deviation lower than the average or higher than it, respectively ( $M \pm 1 SD$ ). The data were distributed into groups (higher or lower) by conducting analyses with the Shapiro-Wilk test. Based on the results, the decision was made to use Student's  $t$  test (if  $p > .05$ ) or Mann-Whitney's  $U$  test (if  $p < .05$ ), for verifying the hypotheses.

RESULTS

Descriptive Analysis

Significant relationships were found between all the ER variables (ERQ, DERS) and the recall of words with an emotional content. In turn, no significant relationships with memory performance were observed for the PANAS (see Table 1 and Figure 1).

Differences Between Groups with Higher or Lower Levels of ER (ERQ, DERS)

No statistically significant differences were observed in terms of age between the groups with higher or lower levels of cognitive reappraisal ( $z = -.93, p = .355$ ), expressive suppression ( $z = -.80, p = .423$ ), dysregulation ( $z = -.39, p = .694$ ), rejection ( $z = -.46, p = .649$ ), interference ( $z = -.45, p = .656$ ), and dyscontrol ( $z = -.03, p = .975$ ). Statistically sig-

TABLE 1.

Descriptives and Correlation Analysis of the Subscales of the Measures and the Words Remembered.

Variables	M	SD	Min-Max	Variables	M	SD	Min-Max
ERQ Cognitive reappraisal	28.13	5.27	10-42	DERS (total)	66.74	17.40	36-119
ERQ Suppression	13.64	5.06	4-25	PANAS Positive	27.08	6.22	14-43
DERS Inattention	9.71	3.67	4-18	PANAS Negative	24.33	6.91	10-42
DERS Confusion	9.65	3.80	4-20	Positive words	3.63	1.78	0-8
DERS Rejection	16.52	6.56	7-35	Negative words	3.49	1.90	0-9
DERS Interference	12.78	4.01	4-20	Neutral words	2.54	1.54	0-6
DERS Uncontrolled	18.09	6.45	9-43	Words (total)	9.65	3.38	1-19

	Positive words	Negative words	Neutral words	Total words
ERQ Cognitive reappraisal	.194**	.007	-.077	.043
ERQ Suppression	-.142*	-.020	.104	-.067
DERS Inattention	-.222**	-.105	-.035	-.198**
DERS Confusion	-.143*	-.204**	-.109	-.254***
DERS Rejection	-.105	-.054	-.039	-.118*
DERS Interference	-.088	-.319***	.002	-.237**
DERS Uncontrolled	-.140*	-.200**	-.042	-.215**
DERS (total)	-.194**	-.231**	-.075	-.284***
PANAS Positive	.024	.054	-.094	-.000
PANAS Negative	.030	.003	-.068	-.034

Note. ERQ = Emotional Regulation Questionnaire, DERS = Scale of Difficulties in Emotional Regulation, PANAS = Positive and Negative Affect Scale

\* $p < .05$ , \*\* $p < .005$ , \*\*\* $p < .0001$ .

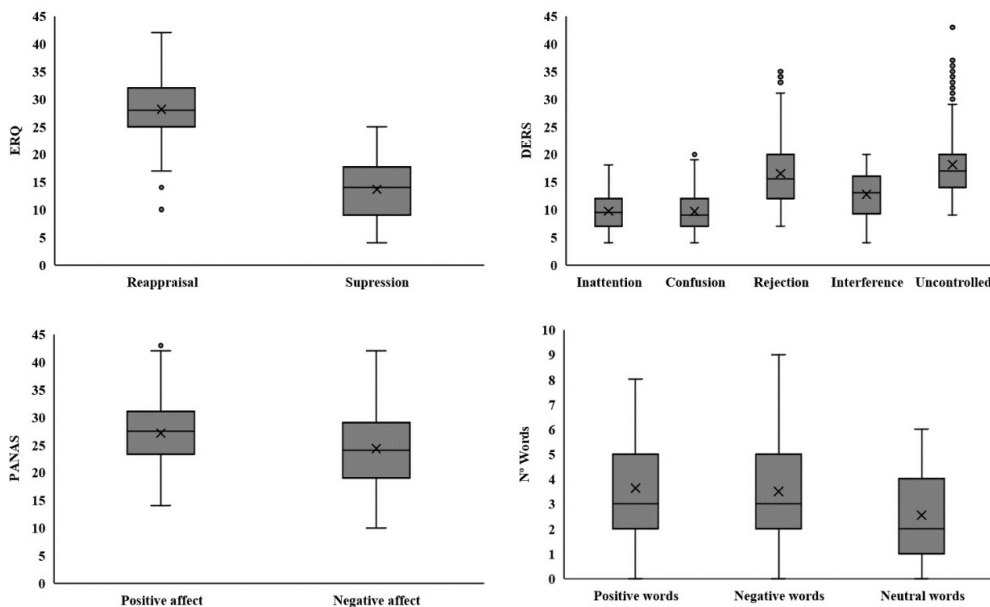


FIGURE 1.

Average values obtained by the participants in the different subscales of the instruments used. The bottom right graph represents the averages of words remembered according to their emotional content (positive, negative or neutral).

nificant differences were observed for confusion ( $z = -2.07, p = .039$ ). No statistically significant differences were found for the percentage of males and females in the groups formed on the basis of cognitive reappraisal ( $\chi^2 = .30, p = .859$ ), expressive suppression ( $\chi^2 = .50, p = .777$ ), dysregulation ( $\chi^2 = 35, p = .841$ ), confusion ( $\chi^2 = 4.59, p = .101$ ), rejection ( $\chi^2 = 2.28, p = .320$ ), interference ( $\chi^2 = .06, p = .972$ ), and dyscontrol ( $\chi^2 = 2.00, p = .367$ ; see Table 2).

There were statistically significant differences between the groups with higher and lower levels of cognitive reappraisal in the recall of positive words (see Table 3).

There were also statistically significant differences between the groups with higher and lower dysregulation in the recall of positive words, and between the groups with higher and lower levels of confusion, interference, and dyscontrol in the recall of negative words. There were no statistically significant differences between the groups in the recall of neutral words (see Table 4).

## DISCUSSION AND CONCLUSIONS

The aim of the current study was to analyze the role of ER in memory in a cued-recall task that generated interference between emotional categories. The results confirmed the first hypothesis: there was a

statistically significant relationship between ER (regulation and dysregulation strategies) and memory solely in the recall of emotional words (hot task) but not in neutral ones (cold task). It is generally found that the higher the level of emotion dysregulation, the fewer the number of positive and negative words recalled. As regards ER strategies, only cognitive reappraisal showed a direct and statistically significant relationship with the recall of positive words. Furthermore, this relationship was not influenced by the sample's levels of positive and negative affect, as no statistically significant relationship has been found between affect and performance in the memory tasks (Table 1).

Likewise, participants with higher levels of cognitive reappraisal (vs. lower ones) performed better when recalling positive words, but not so with negative or neutral words (the second hypothesis). In turn, participants with lower levels of suppression (vs. higher ones) did not perform better on the memory task. These results are consistent with those in other studies that reported the positive effect of cognitive reappraisal on memory (Binder et al., 2012; Bonanno et al., 2004; Dillon et al., 2007; Hayes et al., 2010; Kim & Hamann, 2012; Richards & Gross, 2000; Richards et al., 2003). Nevertheless, cognitive reappraisal only improved the recall of positive words, but not of negative or neutral ones. This might explain why cognitive reappraisal involves the construction or creation of new meanings to neutralize the negative im-

**TABLE 2.**

Descriptive Data of the Extreme Comparison Groups (Lower:  $M - 1 SD$ ; Higher:  $M + 1 SD$ ) in the ERQ and DERS Subscales.

Variable	Lower	N	Gender (F/M)	Age	Higher	N	Gender (F/M)	Age
ERQ Cognitive reappraisal	19.66 (2.66)	29	25/4	18.14 (0.74)	35.63 (2.06)	32	28/4	18.38 (1.41)
ERQ Suppression	6.79 (1.17)	39	34/5	18.54 (1.34)	21.08 (1.78)	36	31/5	18.39 (1.42)
DERS Inattention	5.31 (0.72)	48	42/6	18.29 (0.94)	15.57 (1.29)	35	32/3	18.40 (1.06)
DERS Confusion	4.45 (0.51)	20	19/1	18.75 (1.48)	15.94 (2.14)	35	34/1	18.17 (0.62)
DERS Rejection	8.20 (0.87)	25	22/3	18.32 (0.99)	28.10 (3.85)	30	29/1	18.47 (1.41)
DERS Interference	7.05 (1.08)	39	35/4	18.69 (2.17)	18.05 (1.07)	43	38/5	18.51 (1.49)
DERS Uncontrolled	10.25 (0.85)	20	16/4	18.40 (0.94)	31.04 (3.99)	28	26/2	18.64 (1.62)
DERS (total)	45.25 (3.35)	32	28/4	18.78 (2.28)	98.07 (8.57)	30	30/0	18.63 (1.56)

Note. ERQ = Emotional Regulation Questionnaire, DERS = Scale of Difficulties in Emotional Regulation. The *SD* is presented in parenthesis.

**TABLE 3.**

Differences Between Lower and Higher Reappraisal and Suppression (ERQ) Groups in Word Recall.

ERQ	Lower	Higher	<i>t/z</i>	<i>p</i>	<i>d/r</i>	Shapiro-Wilk
Positive words						
Cognitive reappraisal	2.76 (1.35)	4.13 (1.79)	-3.05	.002	0.39	< .05
Suppression	3.97 (1.90)	3.17 (1.91)	-1.87	.061	0.22	< .05
Negative words						
Cognitive reappraisal	3.48 (1.84)	3.50 (1.90)	-0.31	.759	0.04	< .05
Suppression	3.26 (2.19)	3.19 (1.82)	-0.11	.914	0.01	< .05
Neutral words						
Cognitive reappraisal	3.00 (1.56)	2.38 (1.54)	-1.58	.114	0.20	< .05
Suppression	2.41 (1.53)	2.67 (1.39)	-0.69	.492	0.08	< .05
Total words						
Cognitive reappraisal	9.24 (2.70)	10.00 (3.65)	-.92	.364	0.24	> .05
Suppression	9.64 (3.68)	9.03 (3.77)	-1.03	.302	0.12	< .05

Note. ERQ = Emotional Regulation Questionnaire. The *SD* is presented in parenthesis.

**TABLE 4.** Differences Between Lower and Higher Inattention, Confusion, Rejection, Interference and Uncontrolled Groups in Word Recall.

DERS	Lower	Higher	<i>t/z</i>	<i>p</i>	<i>d/r</i>	Shapiro–Wilk
Positive words						
Inattention	4.08 (1.80)	2.97 (1.56)	−2.83	.005	0.31	< .05
Confusion	3.50 (1.88)	3.49 (1.67)	−.05	.965	0.01	> .05
Rejection	4.04 (1.81)	3.33 (1.69)	−1.51	.132	0.20	< .05
Interference	4.21 (1.87)	3.53 (1.45)	−1.54	.125	0.17	< .05
Uncontrolled	4.15 (1.84)	3.36 (1.87)	1.46	.152	0.43	> .05
Total_DERS	4.19 (1.82)	3.60 (1.87)	−1.27	.205	0.16	< .05
Negative words						
Inattention	3.92 (2.08)	3.20 (1.64)	−1.54	.125	0.17	< .05
Confusion	4.30 (1.84)	2.77 (1.59)	−3.07	.002	0.41	< .05
Rejection	3.96 (2.25)	3.40 (1.81)	−0.84	.400	0.11	< .05
Interference	4.13 (1.94)	2.40 (1.53)	−4.21	< .0001	0.46	< .05
Uncontrolled	4.20 (2.48)	2.82 (1.54)	−2.02	.044	0.29	< .05
Total_DERS	4.31 (2.22)	2.83 (1.64)	−2.81	.005	0.36	< .05
Neutral words						
Inattention	2.67 (1.68)	2.51 (1.62)	−0.45	.653	0.05	< .05
Confusion	3.20 (1.85)	2.26 (1.58)	−1.95	.051	0.26	< .05
Rejection	2.68 (1.41)	2.40 (1.50)	−.88	.378	0.12	< .05
Interference	2.64 (1.56)	2.51 (1.33)	−0.25	.805	0.03	< .05
Uncontrolled	2.65 (1.31)	2.61 (1.34)	−0.12	.906	0.02	< .05
Total_DERS	3.00 (1.65)	2.53 (1.57)	−1.17	.242	0.15	< .05
Total words						
Inattention	10.67 (3.69)	8.69 (2.91)	2.63	.010	0.29	> .05
Confusion	11.00 (3.55)	8.51 (3.37)	−2.78	.005	0.37	< .05
Rejection	10.68 (3.22)	9.13 (3.56)	−1.87	.062	0.25	< .05
Interference	10.97 (3.76)	8.44 (2.87)	−3.35	.001	0.37	< .05
Uncontrolled	11.00 (3.16)	8.79 (3.25)	−2.48	.013	0.36	< .05
Total_DERS	11.50 (3.57)	8.97 (3.56)	−2.89	.004	0.37	< .05

Note. ERQ = Emotional Regulation Questionnaire, DERS = Scale of Difficulties in Emotional Regulation. The *SD* is presented in parenthesis.

fact, with this process triggering positive cognitive schema that mainly filter positive rather than negative or neutral information. This might lead to a bias toward positive information. Although an affective bias in attention is not usually considered a form of ER, the tendency to pay attention to a certain category of stimuli is a significant component of ER (Todd et al., 2012). Along these lines, some studies contend that the homeostatic mechanism of wellbeing is regulated by positive biases linked to self-esteem, control, and optimism (Cummins & Nistico, 2002). However, as far as we know, the positive bias prompted by the cognitive reappraisal strategy has not been reported in other studies.

The current results do not reveal any relationship between expressive suppression and memory. According to the scientific literature consulted, we expected expressive suppression to compromise the recall of emotional information, as reported in other studies (Binder et al., 2012; Bonanno et al., 2004; Dillon et al., 2007; Hayes et al., 2010; Richards & Gross, 2000). Prior research has often used images with emotional content taken from the International Affective Picture System (IAPS; Lang et al., 2008), with a moderate affective valence and intensity, and promoted the processes of expressive suppression during coding. The current study used a subjective measure, namely,

questionnaires and stimuli that might not be effective when activating an expressive suppression strategy at the time of coding.

Finally, the third hypothesis can also be accepted, as generally speaking, the deficits in ER affected the recall of words with an emotional content but not neutral ones. The most consistent effects were those derived from levels of interference (higher vs. lower) on the recall of negative words (see Table 4). The reason for this is that subjects with higher levels of interference have less inhibitory control, thereby impairing their performance in tasks in which recall cues interfere. Nonetheless, this would apply solely to words with a negative content, probably because, as reported in certain studies, negative emotional content reduces inhibitory control more than any other kind of information (Yang et al., 2016). As mentioned earlier, cognitive control may be compromised by the emotional content of the stimuli, with this being especially true for negative stimuli, for example, those that trigger a moderate degree of fear (Eippert et al., 2007).

The limitations of the current study are related to the task presentation format (online) and the type of sample used (university students), which might restrict the control of the variables and the generalization of the results. Future research could adjust the levels of affective valence and intensity of the words used, forming groups with high, medium,

and low levels, which would provide a better understanding of the relationship between ER and memory.

Despite the close relationship between the neurocognitive mechanisms that underpin the control of memory and ER (Engen & Anderson, 2018), not enough time has been spent on seeking to understand it. This is despite knowing that the ability to modulate access to memories might alter the emotional responses generated in an endogenous or exogenous manner through ER processes (Gross & Barret, 2011; Gross et al., 2011). This would have a clear impact on individuals' emotional lives, as reflected in the role that self-generated emotional states play in the etiology stress and anxiety. One of the main implications of this issue is the possibility of modulating access to memories, thereby controlling possible endogenous and exogenous responses, which ultimately inform emotions (Gross & Barrett, 2011; Gross et al., 2011).

Based on the current results, it may be concluded that motivational, emotional, and cognitive processes are separate modules, with their own characteristics, albeit in interaction (Fodor, 1985). Through this view of the workings of basic psychological processes, we are invoking another feature of the human mind, namely, its holistic functioning, given the extremely close relationship between all its capabilities. Only in this way can we understand the functional feedback between emotional control strategies and cognitive processes, where through the control of emotions people can influence what they recall, at the same conditioning the emotion present at that moment. This is particularly relevant because of what it means in different ambits, where such skills might be a good predictor of performance (Andrés et al., 2017).

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All the procedures involving human participants complied with the ethical standards of the corresponding institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent was obtained from all the individual participants included in the study.

The authors declare no conflict of interest.

#### DATA AVAILABILITY

The datasets generated and analysed during the current study are available at this link: [https://osf.io/w7mku/?view\\_only=dc1ce5acc71343539aaa6ec7ef5eab78](https://osf.io/w7mku/?view_only=dc1ce5acc71343539aaa6ec7ef5eab78)

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## APPENDIX

**TABLE A1.**  
Scores of Words in Valence, Arousal, and Frequency of Use.

	Valence	Arousal	Frequency
Positive words			
Aventura / Adventure	7.42	6.56	40
Campeón / Champion	6.97	5.54	28
Gracia / Grace	6.81	4.32	55
Ilusión / Illusion	7.79	5.49	38
Lealtad / Loyalty	7.58	4.26	9
Manantial / Source	7.00	2.86	5
Optimismo / Optimism	7.60	4.74	14
Piropo / Compliment	7.07	5.31	2
Sentimiento / Feeling	7.19	5.41	51
Tesoro / Treasure	7.30	5.18	16
AVERAGE (SD)	7.27 (.32)	4.97 (.99)	25.8 (19.32)
Negative words			
Abandono / Abandonment	2.03	6.68	26
Calavera / Skull	3.06	5.58	6
Gasto / Expense	3.52	5.30	21
Impuesto / Tax	3.21	4.90	25
Lejanía / Remoteness	3.41	5.52	8
Martirio / Martyrdom	4.70	3.73	5
Obligación / Obligation	3.70	5.44	29
Pleito / Lawsuit	3.09	5.91	6
Soledad / Loneliness	2.52	5.68	63
Trance / Trance	3.98	4.99	18
AVERAGE (SD)	3.32 (.74)	5.37 (.76)	20.7 (17.49)
Neutral words			
Agencia / Agency	5.00	3.24	31
Código / Code	4.82	3.11	26
Gestión / Management	4.66	4.13	39
Institución / Institution	4.66	3.81	25
Linaje / Lineage	4.78	3.52	5
Manejo / Handling	4.91	3.51	9
Oficina / Office	4.93	3.84	28
Pedazo / Piece	5.04	3.17	12
Sombrero / Hat	5.21	2.97	31
Título / Title	5.46	3.57	64
M (SD)	4.95 (.25)	3.49 (.37)	27.0 (16.94)