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The effect of a foreign language on cognitive reappraisal during exposure to a phobic stimulus

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Abstract

This study investigates whether the cognitive reappraisal strategy is influenced by the participant's language (native/foreign) when confronting a fearful stimulus. Sixty participants with subclinical phobia of cockroaches were exposed to several phobic and neutral pictures while they used cognitive reappraisal in their native language or a foreign one. Electrodermal activity, pupil dilation, and self-reports of affective valence and arousal were collected. Results showed that participants in the foreign context were more effective at using reappraisal to reduce valence self-ratings compared to using no regulation. Also, participants in the foreign context showed greater pupil size when reappraising their emotions, compared to the non-regulation condition. Depending on the language, no differences were found for arousal self-reports or electrodermal activity when using reappraisal. These results suggest that using a foreign language could be advantageous in reducing the negative valence through reappraisal. Psychophysiological results are discussed in light of cognitive effort studies.

Introduction

Bilingualism or multilingualism is becoming more common as mobility between countries increases. Being in a foreign language context frequently implies searching for resources in a non-native language. These resources include mental health professionals, among many others. In this context, one could think that treatment in a non-native language may not be as effective given that it can be a barrier to communication during psychotherapy (Altarriba & Santiago-Rivera, 1994; Kitron, 1992). However, some studies have shown that confronting negative emotional material in a second language provides an emotional distancing mechanism (Pavlenko, 2012; Shin & Kim, 2017), which may facilitate the efficiency of specific psychological processes (Dewaele & Costa, 2013; Tehrani & Vaughan, 2009). This effect is known as the 'foreign language effect'. According to research, what generates this differential effect in a foreign language, and makes it distinctive from the native one, is the higher cognitive load associated with foreign language processing (Caldwell-Harris & Ayçiçeği-Dinn, 2021). Specifically, it requires a greater lexical processing demand (Ivanova & Costa, 2008). In addition, Branzi et al. (2016) indicated that using a foreign language is associated with a greater recruitment of neural areas involved in cognitive control.

The foreign effect has been widely studied in areas such as decision-making (e.g., Cipolletti et al., 2016; Costa et al., 2014), in which using a foreign language is associated with more deliberate and more impersonal reasoning and consequently more rational choices compared to using a native language. Specifically, these studies argue that using a foreign language implies a reduction of emotionality, evoking a psychological distance that would result in a 'colder' judgment compared to the familiarity of the native language. Likewise, this effect has also been found in paradigms of fear acquisition (García-Palacios et al., 2018), showing that verbal conditioning processes are affected by language context. However, this effect has not been shown in the extinction process, resulting in equal effectivity in both linguistic contexts (Ortigosa-Beltran et al., 2023). Additionally, some studies have found that bilingual speakers showed reduced skin conductance and pupil size responses when listening to or reading emotional phrases in their second language compared to their native one (Harris et al., 2003; Iacozza et al., 2017). However, Caldwell-Harris and Ayçiçeği-Dinn (2009) found electrodermal activity when participants read false statements compared to true statements in a foreign language. They explain that these results support the "double stressor" account given that lying in a foreign language requires additional cognitive resources to monitor lie production. Thus, the higher electrodermal activity would be associated with managing speech production in the non-native language.

The clinical setting has shown a preference for foreign languages on certain occasions, mainly when the content to be dealt with is emotionally charged (Dewaele, 2010; Guttfreund, 1990; Marcos, 1976). Clinical case studies with bilingual individuals provide evidence of psychotherapy in a foreign language being as effective as therapy in a native language (Griner & Smith, 2006). Also, in some cases, the foreign language proved to be even more useful than the native language to detach from traumatic memories (Aragno & Schlachet, 1996; Tehrani & Vaughan, 2009). The surmise is that foreign language can function as a protector, enabling patients to feel more distance when treating emotional experiences and, consequently, increasing their feelings of safety (Buxbaum, 1949; Movahedi, 1996).

More relevant to our research, emotion regulation strategies, which entail a large linguistic charge, are one of the main approaches used in psychology. They are commonly used to treat emotional disorders and are often combined with other therapeutic strategies, like exposure therapy, to help cope with a particular fear. Emotion regulation strategy models are based on language to transform, reinterpret, and regulate people's emotions through verbal, mental, cognitive or writing procedures. One of the main emotion regulation strategies in the field of psychology is cognitive reappraisal. This strategy refers to transforming or reinterpreting the situation to alter its emotional impact (Gross, 1998). In this line, literature seems to suggest that people using reappraisal report feeling significantly greater affective valence and less arousal when faced with negative stimuli, indexed by diminished electrodermal activity and pupil dilation (e.g., Burklund et al., 2014; Ray et al., 2010; Shahane et al., 2019). The cognitive reappraisal strategy implies a robust evaluation of the thought patterns to reinterpret their meaning (Richards et al., 2003), which involves language, usually in the form of inner speech (Salas et al., 2018). Koelsch et al. (2015) already suggested that language can function as a form of emotion regulation through reappraisal. Hence, reappraisal is a good approach to explore the mechanisms of the foreign language effect in regulating emotions.

Even though clinical records have traditionally shown some preferences for foreign languages in relation to emotional issues, there is still a lot to understand with regard to the use of emotion regulation strategies depending on the language context. Morawetz et al. (2017) propose that some emotion regulation techniques can benefit from the foreign language effect. They reported that content labeling was more effective in a foreign language, while reappraisal did not show dependence on the language context. A recent neuroimaging study by Vives et al. (2021) showed higher amygdala activation when using affect labeling in a foreign language, suggesting that using this strategy in a foreign language does not reduce emotionality. These studies suggest that the foreign language effect could be an important factor in the regulation of emotions. However, the effect of language on reappraisal deserves further exploration.

Due to the lack of research regarding the foreign language effect on processes such as extinction and emotion regulation, we aim to explore this area and go a step further. This study follows the line of a previous study in which an extinction paradigm was used (Ortigosa-Beltran et al., 2023), with a stronger focus on clinical practice. Specifically, this study aims to test whether using a different language modulates the efficacy of extinction when using the cognitive reappraisal strategy during a brief course of exposure to a fearful stimulus in people with subclinical phobia of cockroaches. According to some examples in the literature (Caldwell-Harris & Ayçiçeği-Dinn, 2009), overall greater arousal is expected when participants use a foreign language due to the additional cognitive resources associated with the effort of performing the task in a non-native language. In line with previous research (Burklund et al., 2014; Ray et al., 2010; Shahane et al., 2019), an increase in valence and a decrease in arousal measures during reappraisal, compared with non-regulation, is also expected. Also, we propose that the combination of the effects of the reappraisal strategy and the emotional distance associated with the use of a foreign language will help reduce the levels of arousal when confronting fearful stimuli, as well as reduce unpleasant ratings. Specifically, we hypothesized that reappraisal would be associated with greater valence self-reports, reduced arousal self-reports, and diminished physiological responses (pupil size and electrodermal activity), these differences being greater in the foreign context due to the distance associated with this language.

Method

Participants

Sixty participants (49 females, mean age = 22.31 years, SD = 2.73) were recruited from an initial sample of 248. The participants selected were those who scored between the second and third quartile on the Cockroaches Phobia Questionnaire (M = 67.01, SD = 31.22), adapted from the Spider Phobia Questionnaire (Klorman et al., 1974) in order to select the participants with a strong phobic response to the negative images presented. Participants had an intermediate/high level of English, according to an adaptation from Marian et al. (2007). The inclusion criteria were: native Spanish speaker; relatively proficient level of English measured with a self-perceived level of knowledge; less than one year living in an English-speaking country. The exclusion criteria were to have no psychiatric problem or immediate need of treatment, and no current alcohol or drug dependence. All participants had a normal or corrected-to-normal vision and completed several questionnaires prior to the experiment. These questionnaires included a short sociodemographic questionnaire which examined their educational level and income, a questionnaire to explore trait and state anxiety (State-Trait Anxiety Inventory; STAI; Spielberger et al., 1983), a questionnaire for depression symptoms (BDI-II; Beck et al., 1996), and one for emotion regulation abilities (Emotion Regulation Questionnaire; ERQ; Gross & John, 2003). Participants of each group did not show differences in age, education, income, nor in the level of phobia, anxiety, depressive symptoms or emotion regulation strategy skills (see Table 1). In addition, the number of participants per group and condition was similar (or above) to previous studies (García-Palacios et al., 2018). All participants gave their informed consent and were compensated with six euros.

Thirty participants were randomly assigned to the foreign language context (27 females) and 30 to the native language context (22 females). The mean level of English did not differ between the participants assigned to each group (see Table 1), nor did it differ between language skill types [Speaking: $t(58) = .79$, $p = .43$; Listening: $t(58) = 1.03$, $p = .31$; Writing: $t(58) = 1.04$, $p = .30$; Reading: $t(58) = .74$, $p = .47$]. Participants under 80% pupil validity (n = 4) were excluded from the analysis, resulting in a group of 56 participants for the final analysis of pupil size, 29 in the foreign

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Table 1. Participant´s characteristics in the native and foreign language groups (means and standard deviations).

	Native (n = 30)	Foreign (n = 30)
Females (number)	22	27
Age (in years)	23.31 (2.9)	21.95 (2.8)
English level	6.39 (1.3)	6.46 (1.42)
Speaking	5.50 (1.6)	5.83 (1.6)
Listening	6.30 (1.8)	6.77 (1.7)
Writing	6.03 (1.9)	6.50 (1.6)
Reading	6.83 (1.9)	6.96 (1.7)
Age of acquisition (years old)	6.16 (1.9)	7.17 (1.6)
Phobia	66.86 (29.8)	69.78 (35.5)
Money income (in euros)	2187.50	2732.76
STAI-S	16.95 (9.2)	14.32 (7)
STAI-T	25.68 (7.8)	16.91 (6.9)
BDI-II	12.68 (7.3)	8.86 (6.4)
ERQ Reappraisal	26.54 (5.6)	25.74 (6.3)
ERQ Suppression	12.52 (5.7)	12.00 (6.0)

Note: STAI-S = State-Trait Anxiety Inventory- State; STAI-T = State-Trait Anxiety Inventory-Trait; BDI-II = Beck Depression Inventory-II; ERQ = Emotion Regulation Questionnaire.

language group and 27 in the native one. Pupil validity was calculated with MATLAB following the criterion proposed by Kret and Sjak-Shie (2019). Also, one participant was discarded from the subjective ratings analysis due to incomplete collection of reports. Thus, the final sample resulted in 56 participants for pupil dilation analysis, 60 for electrodermal activity analyses and 59 for subjective ratings. The study was approved by the ethics committee of the author's university.

Stimuli and design

Participants were randomly assigned to the language context prior to the beginning of the experiment. The task adapted the emotion regulation strategy of reappraisal in two language contexts during a brief course of exposure to negative and neutral pictures. A total of 40 trials were performed: 20 neutral (butterflies) and 20 negative (cockroaches). Pictures were chosen from the repository of Grimaldos et al. (2021), using the normative values for affective valence and arousal in Spanish samples. Negative (valence: $M = 2.01$; $SD = 0.96$; arousal: $M = 4.67$; $SD = 1.55$); neutral (valence: $M = 4.91$; $SD = 0.97$; arousal: $M = 3.93$; $SD = 1.51$). These pictures were presented randomly to both language context groups, equally associated with the conditions of 'reappraisal' and 'non-regulation'. Right before the experiment started, a reminder with the instructions appeared on the screen in the corresponding language for 10 seconds.

The trial structure was similar to previous literature on emotion regulation strategies and language (Langeslag & Van Strien, 2018; Morawetz et al., 2017). The beginning of each trial was a fixation cross for 10 seconds, 4 seconds of which served as a baseline for posterior analysis (see Figure 1). Following Bebko et al. (2011), the emotion regulation strategy cue was presented before the picture for 2 seconds, the cue 'Look' for the non-regulation items, and 'Decrease' for the reappraisal items, in the corresponding language. Following previous studies, the instructions for the cue 'Look' were to simply view the picture on the screen without trying to avoid it or think of something else, only responding naturally to the stimulus (Fuentes-Sánchez et al., 2019; Jaén et al., 2021; Webb et al., 2012). The instructions for the trial cues with 'Decrease' were to keep in mind and say the sentence 'It cannot do anything to me' out loud in the foreign language (English), and 'No puede hacerme nada' in the native language (Spanish), in order to reduce the intensity of the negative emotion.

Generally, in monolingual studies using reappraisal the participants are trained to display a conscious and volitional strategy generating their own mental sentences to decrease the emotion (e. g. Daros et al., 2018; Fuentes-Sánchez et al., 2019). However, in this case we trained them to mentally go through the same reinterpretation, in both languages, with the purpose of having the same language content in both languages and avoiding the extra cognitive load in the foreign language group associated with the elaboration of a sentence in a non-native language. In addition, the reappraisal sentence was asked to be said out loud to avoid possible inner speech as it is a common limitation in studies using reappraisal (e.g., Morawetz et al., 2017). In this way, we ensured that each participant did so in the corresponding language.

Immediately after each cue, a picture stimulus was presented with a duration of 8 seconds. Afterwards, participants completed ratings of valence and arousal related to each picture according to the Self-Assessment Manikin (SAM; Lang, 1980) thus providing a measure of trial-by-trial emotion regulation success. In this nine-point scale, the valence figures ranged from an unhappy figure (1) to a smiling happy one (9), while the arousal dimension ranged from a relaxed figure (1) to an agitated, excited one (9). Thus, lower ratings on valence and arousal indicated more unpleasantness and more intensity of the emotion, respectively. The participant recorded the result by stating out loud the self-assessed degree of valence and arousal in the corresponding language. The trial ended with an interstimulus interval (ITI) of 10 seconds of duration.

Procedure

Participants completed an online self-perceived questionnaire related to their English level and a phobia of cockroaches questionnaire prior to attending the in-person session in order to see whether they fulfilled the inclusion criteria. Once the inclusion and exclusion criteria were checked, participants were summoned to participate in the study. When participants arrived at the laboratory, they read and signed the consent form and filled out the questionnaires related to anxiety, depression, emotion regulation strategies and sociodemographic data. Both online and in-person questionnaires were completed in the native language (e. g. Spanish) by all the participants. Next, participants were randomly assigned to one of the language contexts (native or foreign), and they were positioned in front of the computer screen where the experiment was carried out. The sensors of the electrodermal activity were placed in the middle, and the index fingers of the non-dominant hand and remained there until the signal stabilized. Afterwards, the researcher explained the concept of emotion regulation strategies, focusing on the strategy of cognitive reappraisal, with examples. The language context began when the participant started the task. First, a screen with the instructions notified the participant that a cue with the

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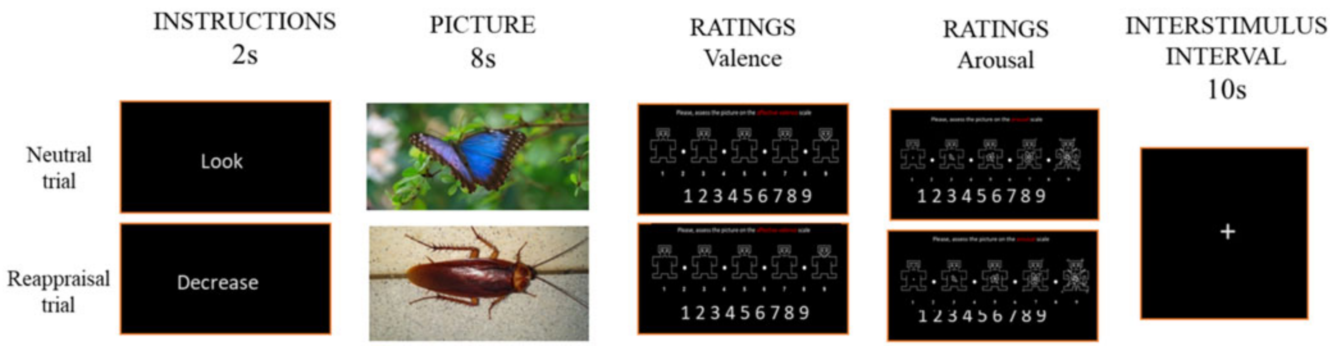

Figure 1. Trial design of the emotion regulation task.

relevant word, 'Look' or 'Decrease', would precede a picture. The instructions explained the task in each condition, with the support of the researcher reinforcing the written instructions. The instructions also informed the participants that a screen with self-reports of valence and arousal would be shown at the end of each trial, and that they would have to verbally report the self-perceived degree of arousal and valence in the corresponding language condition. After asking the participants and making sure they understood the instructions, an example trial was shown to the participant so that they could see the structure of the task. Right before starting the task, the participant's eyes were calibrated on the screen with the eye-tracker. Once the electrodermal activity signal was stable and the eye-tracking was calibrated, the task started. When the participant finished the 40 trials of the task, the sensors were removed, and they were asked to complete the form to receive the payment.

The whole session was conducted in the corresponding language context, including all the interactions, verbal and written instructions and items, in order to provide language consistency. The length of the session was divided into 10–15 minutes of questionnaires and 20–25 minutes of computer tasks, lasting around 30–40 minutes in total.

Psychophysiological data

The recorded physiological measures were the pupil size (Tobii Pro Lab) and the electrodermal activity (EDA; Shimmer3 GSR), both significant indicators of emotional charge in aversive stimuli. Pupil dilation has been shown to be a good measure of fear in the confrontation of fearful stimuli (Bradley et al., 2008; Hess & Polt, 1964), while electrodermal activity is one of the main physiological measures in automatic emotion responses (see Kreibig, 2010 for a review). The eye-tracker registered data at a sampling rate of 120 Hz. Images were displayed on a 19" monitor approximately 50 cm from the participant's eyes. The screen monitored the pupil and served to display the task to the participants. Preprocessing for pupil dilation was carried out with MATLAB, following the guidelines provided by Kret and Sjak-Shie (2019). The raw data were filtered to remove invalid pupil size samples, and artifacts and gaps in the sample were discarded in order to obtain a smooth signal with valid data. Pupil size was averaged across both eyes and reduced to the mean value across the 8-second trial. Electrodermal activity was recorded using a sampling rate of 125 Hz. The electrodes were placed in the middle fingers of the non-dominant hand and remained steady for two minutes until the signal stabilized. A data-cleaning process was performed with MATLAB before the analyses to exclude invalid data in order to attain a continuous signal. This data-cleaning consisted of removing data with values higher or lower than 3 Standard Deviations from the mean. Mean electrodermal activity was averaged for the 8-second trial. The baseline for both physiological measures was calculated by averaging the mean from the 4 seconds prior to each trial. The change scores were calculated as the difference between the mean of each trial in each condition and the mean of the baseline for both measures.

Data analysis

Four separate 2 (Stimulus Type: negative vs neutral) x 2 (Regulation Strategy: reappraisal vs non-regulation) x 2 (Language Context: native vs foreign) repeated measures ANOVAs were performed for self-reported affective valence, self-reported arousal, pupil size, and electrodermal activity. Stimulus Type (negative vs neutral) and Regulation Strategy (Reappraisal vs non-regulation) were set as within-participant factors, and Language Context (native vs foreign) was set as a between-participants factor. Means and SDs are presented in Table 2. Assumptions of normality, homoscedasticity, sphericity, and equality of variances were explored using the Mauchly test and the Greenhouse-Geisser correction was used where appropriate. Additionally, post-hoc pairwise comparisons were performed using t tests to evaluate differences between stimuli types, as well as between the reappraisal and non-regulation conditions when significant differences in main effects were found. Alpha level was set at 5% for the repeated measures ANOVAs and at 1% for t tests. Partial eta squared (η_p^2) and Cohen's d were obtained as measures of effect size. All statistical tests were conducted using SPSS IBM Statistics version 23 and graphs were made with R (R Core Team, 2016).

Results

Self-ratings

As shown in Table 3, the main effect of Stimulus Type was significant for valence self-reports. However, it was not significant for Regulation Strategy or Language Context. Specifically, valence was rated lower for negative than for neutral stimuli. The repeated measures ANOVA did not reveal differences between Stimuli Type x Language Context, Regulation Strategy x Language Context, nor Stimuli Type x Regulation Strategy. However, Stimuli Type x Regulation Strategy x Language Context was significant. Specifically, post-hoc comparisons showed that

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Table 2. Means, standard deviations and confidence intervals by Language, Strategy and Condition.

	Native Language						Foreign Language					
	Look			Reappraisal			Look			Reappraisal		
		95% CI			95% CI			95% CI			95% CI	
	Mean (SD)	Lower	Upper	Mean (SD)	Lower	Upper	Mean (SD)	Lower	Upper	Mean (SD)	Lower	Upper
Valence self-reports												
Neutral	6.94 (1.32)	6.45	7.43	7.23 (1.16)	6.75	7.71	7.04 (1.27)	6.55	7.52	6.69 (1.37)	6.21	7.17
Negative	2.93 (1.46)	2.44	3.43	3.05 (1.23)	2.62	3.48	2.36 (1.14)	1.88	2.85	2.65 (1.02)	2.23	3.07
Arousal self-reports												
Neutral	2.09 (1.24)	1.50	2.68	2.03 (1.10)	1.4	2.5	2.50 (1.80)	1.92	3.08	2.39 (1.70)	1.85	2.92
Negative	4.76 (1.92)	4.03	5.50	4.58 (1.77)	3.8	5.2	6.10 (1.96)	5.38	6.83	5.58 (1.90)	4.90	6.27
Electrodermal activity												
Neutral	-1.08 (1.32)	-1.74	-0.42	0.28 (1.23)	-0.40	0.97	-0.43 (2.16)	-1.12	0.24	0.63 (2.33)	-0.08	1.34
Negative	-0.32 (1.68)	-0.91	0.263	2.00 (3.18)	0.90	3.10	0.15 (1.47)	-0.46	0.76	1.73 (2.65)	0.60	2.87
Pupil size												
Neutral	-15.58 (5.98)	-17.61	-13.55	-15.84 (5.59)	-17.68	-13.99	-19.44 (4.20)	-21.44	-17.45	-14.10 (3.58)	-15.91	-12.30
Negative	-18.66 (6.23)	-20.78	-16.54	-16.90 (6.42)	-19.09	-14.71	-19.52 (4.40)	-21.60	-17.44	-17.65 (4.57)	-19.80	-15.51

Table 3. Results of main effects and interactions of self-ratings, pupil size and electrodermal activity

	Valence self-reports			Arousal self-reports			Electrodermal activity			Pupil size		
	F	p	η_p^2	F	p	η_p^2	F	p	η_p^2	F	p	η_p^2
Main effect Stimulus Type	63.99	<.001	.54	12.17	<.001	.18	18.32	<.001	.25	39.39	<.001	.41
Main effect Language Context	2.26	.11	.08	3.69	.03	.12	0.73	.40	.01	0.38	.54	.007
Main effect Regulation Strategy	0.07	.79	.001	0.67	.41	.01	28.52	<.001	.35	48.39	<.001	.46
Stimuli Type x Language Context	0.55	.58	.02	0.98	.38	.03	0.64	.43	.01	0.07	.79	.001
Stimuli Type x Regulation Strategy	0.14	.71	.003	0.23	.63	.004	3.00	.09	.05	3.35	.07	.06
Language Context x Regulation Strategy	2.13	.13	.07	1.51	.23	.05	0.78	.38	.01	21.34	<.001	.28
Stimuli Type x Regulation Strategy x Language Context	5.29	.008	.16	.84	.44-	.03-	0.27	.60	.005	58.90	<.001	.51

participants in the foreign context rated negative stimuli with greater valence in reappraisal compared to non-regulation [$t(29) = 2.43$, $p = .01$, $d = .27$]. Also, they rated neutral stimuli with lower valence when they were instructed to reappraise compared to non-regulate [$t(28) = 3.74$, $p < .001$, $d = 0.26$]. Participants in the native context reported greater valence when reappraising neutral pictures compared to not regulating [$t(27) = 3.00$, $p < .01$, $d = .23$], but no differences were found between reappraisal and non-regulation for negative pictures ($t < 1$) (see Figure 2 A).

In terms of arousal self-reports, the main effect of Stimuli Type and Language Context were significant, while a main effect was not found for Regulation Strategy. Specifically, negative stimuli were rated as more arousing than neutral stimuli. In addition, people in the foreign context rated images as more arousing than people in the native context. Interactions between Stimuli x Language Context and Strategy x Language Context were not significant, as well as the interaction Stimuli Type x Regulation Strategy x Language Context (see Figure 2 B).

Electrodermal activity

The overall repeated measures ANOVA revealed a significant main effect of Stimuli Type and Regulation Strategy, but did not reveal a significant main effect of Language Context (Table 3). Specifically, electrodermal activity responses were greater for the negative stimuli compared to the neutral stimuli. In addition, participants showed greater electrodermal activity responses when they used reappraisal compared to non-regulation (see Figure 3). Interactions between Stimuli Type x Strategy, Stimuli Type x Language Context, Strategy x Language Context, and Stimuli x Strategy x Group were not significant.

Pupil size

Table 3 shows that a main effect was found for Stimuli Type, and Regulation Strategy. However, the main effect of Language Context was not significant. Specifically, neutral stimuli produced greater pupil size responses compared to negative stimuli. In

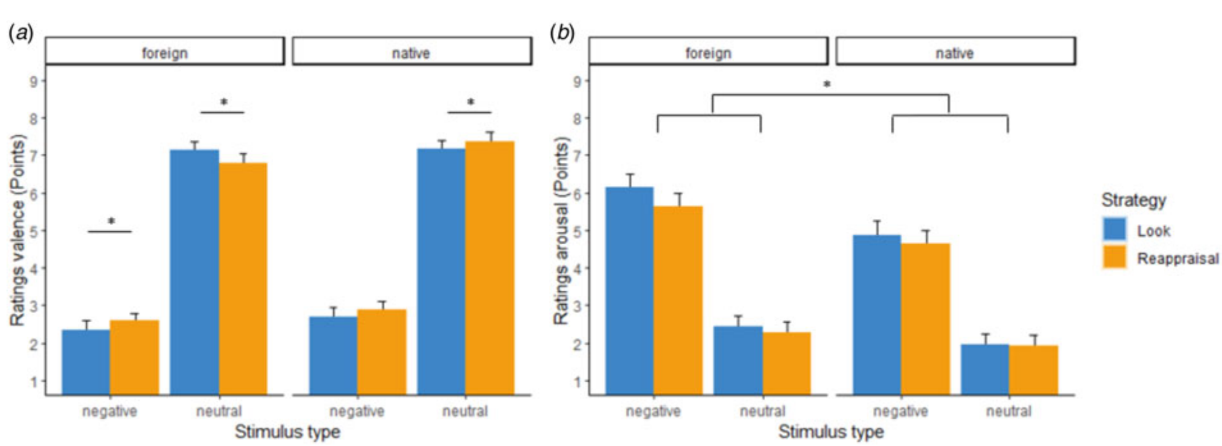

Figure 2. (A) Ratings of valence per Condition (neutral and negative) and Regulation Strategy (non-regulation in blue, reappraisal in orange), in each language group (foreign on the left, native on the right). The scale ranges from 0 (negative) to 9 (positive). **(B)** Ratings of arousal per Condition (neutral and negative) and Regulation Strategy (non-regulation in blue, reappraisal in orange), in each language group (foreign on the left, native on the right). The scale ranges from 0 (low arousal) to 9 (high arousal).

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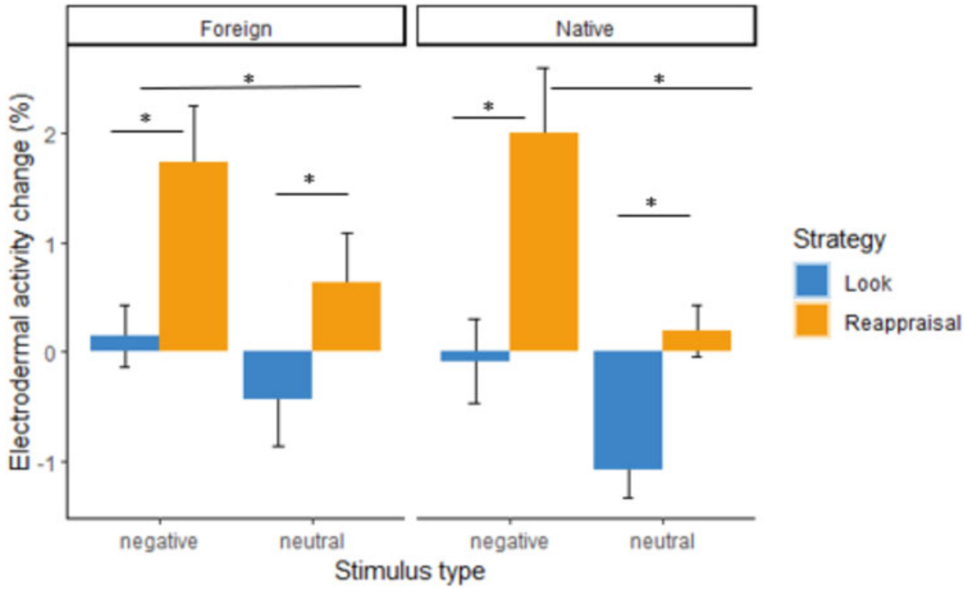

Figure 3. Electrodermal activity change in each language group with respect to the baseline epoch by Strategy and Condition. Graph on the left corresponds to the Foreign language context and graph on the right corresponds to the Native language context. Blue bars correspond to the non-regulation strategy and orange bars correspond to the reappraisal strategy. Error bars represent the standard error.

addition, the reappraisal strategy was associated with greater pupil responses compared with the non-regulation condition. Regarding the interactions, Stimuli x Strategy and Stimuli Type x Language Context were not significant. However, the Strategy Type x Language Context interaction was significant. Specifically, post-hoc comparisons showed that effects of Strategy Regulation were not found for the native group [$t(25) = 1.90$, $p = .04$, $d = .12$], while pupil size responses were higher for the foreign group when the reappraisal strategy was used compared to the non-regulation condition [$t(26) = 8.50$, $p < .001$, $d = .89$]. In addition, the Stimuli Type x Strategy x Language Context interaction was significant. As shown in Figure 4, the native group showed greater pupil size responses during reappraisal compared to non-regulation for the negative stimuli [$t(25) = 3.6$, $p < .001$, $d = .28$], but differences were not found for neutral stimuli ($t < 1$). The foreign group exhibited a significant effect of the Regulation Strategy for both negative [$t(26) = 3.83$, $p < .001$, $d = .42$] and neutral stimuli [$t(26) = 11.16$, $p < .001$, $d = 1.37$], pupil size responses being greater when participants had to reappraise their emotions.

Discussion

This work follows a line of research that aims to explore the effect of using a foreign language effect during exposure to negative stimuli. Specifically, the current study examined whether using a foreign language influenced the effect of reappraisal following an exposure to a fearful stimulus. Thus, a series of negative (cockroaches) and neutral (butterflies) pictures were presented to participants with subclinical phobia of cockroaches while physiological and self-reported measures were collected. The task consisted of using either the reappraisal strategy or a non-regulation strategy, depending on the cue prior to each picture.

Overall, self-ratings of valence and arousal showed differences between pictures of cockroaches and butterflies. Similar to previous studies using negative and neutral stimuli (Lang et al., 2008), negative pictures (i.e., cockroaches) were rated as less pleasant and more arousing than neutral pictures (i.e., butterflies). In the same line, electrodermal activity was greater during the visualization of cockroaches than butterflies, which is also associated with greater arousal during the visualization of negative pictures. For affective valence, these differences did not depend on the language context. For arousal, relative to ratings of butterflies, pictures of cockroaches were rated as more arousing for bilingual individuals when using their foreign language than when using their native language. These results are in line with our hypothesis, given that we predicted greater arousal in the foreign language group compared to the native group. Based on previous literature, these differences are explained by higher anxiety associated with performing the task using a non-native language (MacIntyre et al., 1997).

In contrast with the ratings, pupil size was higher during the trials in which butterflies were presented, compared to cockroaches. However, we believe that the significant main effect obtained for the stimuli type was driven by the paradigm used in this study. That is, the means for both stimuli categories could have been influenced by the interactions with the other factors included in the analyses. Also, it is possible that the greater arousal for butterflies compared to cockroaches could be an artifact of colors and luminance used in each picture (Kohn & Clynes, 1969), which were not controlled in this study. Future research should be conducted using grey instead of color images.

Regarding the emotion regulation effects, valence self-ratings showed that using a foreign language is more effective to reappraise negative emotions than the native language. That is participants in the foreign context rated negative pictures as less negative during the reappraisal condition than the non-regulation condition. However, the native context was less effective at down-regulating their negative emotions, revealing no significant differences between reappraisal and non-regulation conditions. These findings are in line with our hypothesis and previous research (García-Palacios et al., 2018) suggesting that foreign language

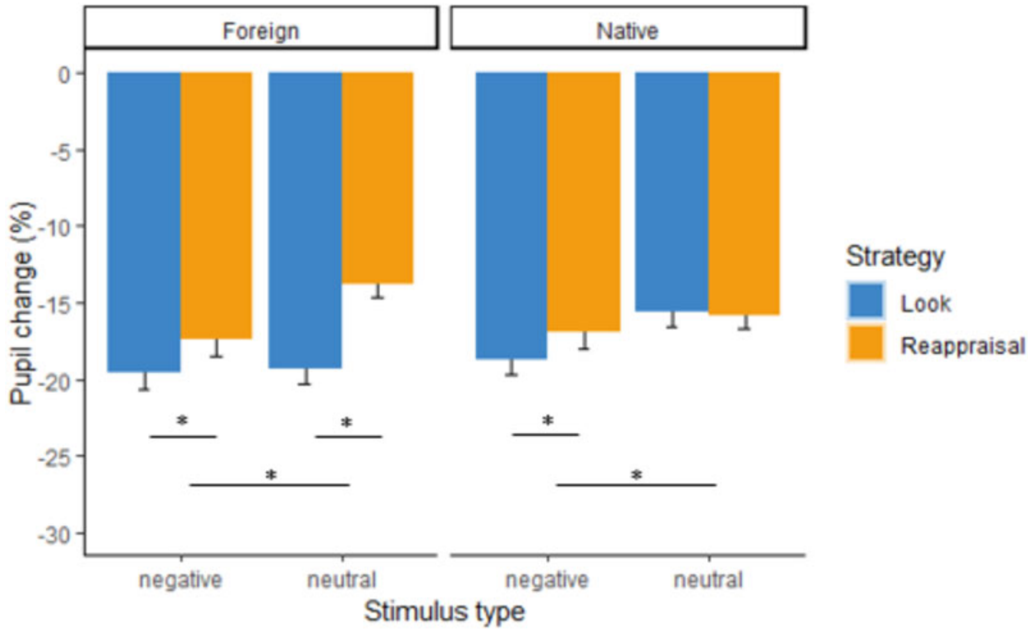

Figure 4. Pupil size change in each language group with respect to the baseline epoch by Strategy and Condition. Graph on the left corresponds to the Foreign language context and graph on the right corresponds to the Native language context. Blue bars correspond to the non-regulation strategy and orange bars correspond to the reappraisal strategy. Error bars represent the standard error.

attenuates negative emotions in terms of unpleasantness when confronting fearful stimuli.

Interestingly, this pattern was not found for neutral pictures. Although the native context showed an enhanced valence when they used reappraisal compared to non-regulation, participants in the foreign context reported lower valence when reappraising neutral pictures compared to non-regulation. These findings are also explained in terms of the foreign language effect. In this sense, it is worth noting that, in this study, valence and arousal self-ratings for butterflies were more positive (valence: M = 7.1, SD = 1.30: arousal: M = 2.24, SD = 1.49) than neutral, as previous studies had stated (Grimaldos et al., 2021; valence: M = 4.92, SD = 1.30; arousal: M = 3.93, SD = 1.51). This difference could be related to the comparisons carried out during the repository validation and our study. Grimaldos et al. (2021) included animals, such as cats, while this study only included cockroaches and butterflies. Therefore, the reappraisal strategy in this study, which was focused on decreasing negative interpretations of dysfunctional beliefs, had an undesirable effect on pictures assessed as positive. Specifically, it is possible that participants were more distanced from the positive hedonic valence and rated the pictures as less positive when using reappraisal. On the basis of the present results, we argue that the use of reappraisal in a foreign language can be beneficial to reduce negative emotions given that the cognitive load associated with the use of a less familiar language helps reduce emotionality. However, it is recommended to be cautious with the generalization of this effect given that the foreign effect could be a barrier to the use of reappraisal with the aim of increasing positive emotions.

Psychophysiological measures, however, did not show the expected results. The present study found that both electrodermal and pupillary responses were greater when participants had to reappraise their emotions compared to non-regulation, indicating increased arousal. These results are in line with the pattern observed in previous studies, in which the use of reappraisal was associated with higher arousal compared to non-regulation trials (Bernat et al., 2011; Fuentes-Sánchez et al., 2019; Jaén et al., 2021), which has been commonly explained by the cognitive effort made to regulate emotions. Following this line, the physiological results obtained in this study are explained in terms of increased arousal produced by the cognitive load associated with regulating emotions. It is worth noting that this increase in arousal during reappraisal might only indicate the cognitive effort implied in the process of regulation but not the effectivity of this regulation.

With regard to the effects of the foreign language on the reappraisal strategy, physiological effects were only found for pupil size. Specifically, participants in the foreign language group showed higher pupil size when using reappraisal compared to non-regulation for downregulating both negative and neutral pictures. However, the native language group showed emotion regulation differences only for negative pictures but not for neutral ones. Based on the studies that stated pupil dilation as a marker of both cognitive effort and emotional processing in relation to emotion regulation strategies (Kinner et al., 2017), we state that our results support the foreign language effect. Specifically, these findings support the idea of the additional cognitive load (Branzi et al., 2016; Caldwell-Harris & Ayçiçeği-Dinn, 2009; Ivanova & Costa, 2008) associated with using a non-native language when participants are instructed to regulate their emotions, especially when participants are reappraising positive ones. Nevertheless, it is worth noting that the reappraisal strategies used in this study were focused on downregulating negative emotions, and no differences were found between languages. Future studies should be carried out to determine the foreign language effect with more appropriate strategies for reappraising positive pictures.

These results contrast with the findings obtained by Morawetz et al. (2017), who reported that content labeling was more effective in a second language, while reappraisal showed no dependence on the language context. However, there are some differences

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between the study conducted by Morawetz et al. (2017) and this study that can be highlighted. First, the participants in Morawetz et al. (2017) were healthy, whereas a selection of participants with moderate scores on the Cockroaches Phobia Questionnaire were recruited in our study. Moreover, participants in the study of Morawetz et al. (2017) used their inner speech during cognitive reappraisal, while in our study participants were instructed to say the reappraisal strategy out loud. The differences between the two studies could involve more effectivity in the use of reappraisal in our study, explaining the discrepancies between them.

Furthermore, Vives et al. (2021) found that downregulation through affect labeling was not effective in the foreign language when compared to the native one. In fact, amygdala activation increased in the foreign language condition, suggesting that the cognitive load associated with the foreign language could interfere with an appropriate downregulation. In this study, however, we also obtained increased electrodermal and pupil responses associated with the cognitive load, but the findings obtained by self-reports indicated that the reappraisal strategy was effective in terms of increasing hedonic valence.

This study expands the current knowledge on the boundaries of the foreign language effect. Previous studies in this line of research have shown a weakening effect of the conditioning during the acquisition of fear produced by the foreign language effect (García-Palacios et al., 2018), as the participants distance themselves when learning the association of a possible aversive stimulus. However, this detachment effect was not found in the process of extinction when the instructions changed in order to learn new safety strategies (Ortigosa-Beltran et al., 2023). This study goes one step further, introducing verbal instructions for reappraisal during the exposure to cockroach pictures for participants with subclinical phobia. The findings obtained have important clinical implications, suggesting that foreign language could be used when using reappraisal to reduce emotionality during exposure sessions for a specific phobia. In addition, this study opens the door to future studies that aim to study the effects of using a foreign language during exposure to treat other pathologies such as prolonged grief disorder or post-traumatic stress disorder.

This study has some limitations that further studies should consider. In order to provide a more adequate context for the foreign language effect to be present, it would be recommended to provide a design with longer language involvement. In this study, the possible inner speech was eliminated to ensure that differences could not be explained by changes in the verbal content. However, this measure precludes the spontaneity of the strategy, which could reduce its effectiveness. It would be advisable to enhance spontaneity to increase the general language engagement in each language group. In addition, our study was conducted with participants with subclinical phobia. Further studies should explore the implications of this effect on a clinical group to test whether the presence of the foreign language effect could depend on the degree of anxiety or fear related to a disorder. Another limitation is the use of dark inter-stimulus screens instead of the usual grey or white screens in the study's design given that it produced decreased pupil size responses for all the conditions compared to baseline. Although it did not interfere with the interpretation of the results, it would be advisable to plan the following studies with the usual clearer screens to avoid the possible influence of brightness on the modulation of autonomic nervous system responses (Vasquez-Rosati et al., 2017). Also, given that only 12% of participants were male, an important question would be whether the current findings should be viewed as limited to females. We also suggest a deeper exploration of other types of bilingualism, varying characteristics such as the level of proficiency or the context of acquisition. Future work with emotion regulation strategies and other paradigms could examine how different groups of bilingual individuals may show different result patterns. These results cannot be generalized to other characteristics.

To conclude, the present study is the first empirical experiment on the influence of the foreign language effect on reappraisal in patients with specific subclinical phobia, showing the possible advantages of using it in the context of exposure to aversive stimuli. Thus, it contributes to the understanding of the role of foreign language in emotion regulation paradigms, an area that lacks research. Future studies are needed to shape new approaches to different disorders, such as specific phobias within the field of psychotherapy.

Competing interests. The authors declare that this study was carried out in the absence of any personal, professional or financial relationship that could be interpreted as a conflict of interest.

Availability of materials. The datasets analyzed for this study can be found in the Open Science Framework (OSF) Repository [https://osf.io/tjx3d/].

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