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Article

Languages and Psychotherapy: The Effect of Foreign Language on Fear Extinction

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ABSTRACT

Background: Using a foreign language can influence emotion modulation, but whether different psychotherapy processes would be affected by a foreign language is still unclear. The current study explored the foreign language effect on the extinction of fear. **Method:** During the conditioning phase, part of the neutral stimuli presented to the participants were associated with a threat, while they performed a countdown task in their native language. In the extinction phase, participants performed the same task either in their native/foreign language and were informed that the threat would no longer appear. We collected self-reports of fear, and pupil dilation and electrodermal activity as physiological measures of arousal. **Results:** Extinction was successful, indicated by greater self-reported fear and pupil dilation during the threat condition compared to neutral in the conditioning phase, but no significant differences during extinction. Although the foreign language group presented higher arousal, fear extinction occurred regardless of the linguistic context. **Conclusions:** Fear extinction via verbal instructions is equally effective in a foreign and a native language context. These results indicate that evidence should be continue to be gathered on the role of foreign languages using basic paradigms with clinical applications.

Lenguas y Psicoterapia: El Efecto de la Lengua Extranjera en la Extinción del Miedo

RESUMEN

Antecedentes: Usar un idioma extranjero puede influir la modulación de las emociones, pero no está claro si su uso podría influir diferentes procesos psicoterapéuticos. Este estudio explora el efecto de la lengua extranjera en la extinción del miedo. **Método:** Durante el condicionamiento, parte de los estímulos presentados se asociaron a amenaza, mientras los participantes realizaban una tarea de cuenta regresiva en un contexto de lengua nativa. En la fase de extinción, se realizó la misma tarea en su lengua nativa/extranjera, y se informó de que ya no habría amenaza. Se recogieron autoinformes de miedo, así como dilatación de pupila y actividad electrodérmica como medidas fisiológicas de excitación. **Resultados:** La extinción fue satisfactoria, como muestran una mayor dilatación pupilar y los autoinformes de miedo al comparar las condiciones de amenaza y neutral en la fase de condicionamiento, y no encontrar diferencias significativas durante la extinción. Aunque el grupo de lengua extranjera presentó una mayor excitación, la extinción del miedo ocurre independientemente del contexto lingüístico. **Conclusiones:** La extinción del miedo mediante instrucciones verbales es igualmente eficaz en contexto de lengua extranjera y nativa. Estos resultados invitan a seguir reuniendo pruebas sobre el papel de las lenguas extranjeras mediante paradigmas con aplicaciones clínicas.

Palabras clave:
Lengua extranjera
Bilingüismo
Extinción del miedo
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Miedo
Emociones

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Human beings constantly need to modulate their feelings and emotions. It has long been appreciated that language is greatly involved in many approaches to regulating these feelings. Individuals are driven to reconfigure their emotional states into some form of language, whether written or spoken. Traditional research shows that verbalizing highly emotional experiences in any form reduces the emotional response (Pennebaker & Chung, 2011 for a review). Language has been stated as a major form of communicating and embodying emotions. There are many techniques used in psychotherapy that are based on language as a vehicle to improve the patient's condition, including emotion regulation strategies (Gyurak et al., 2009), retrieving of traumatic memories (Schrauf, 2000), or any strategy that pursues re-framing the patient´s thoughts to transform their emotions within the cognitive behavioural therapies. Likewise, language can be strategically used by opting for a non-native language (e.g., a foreign language) to perform these same psychotherapeutic techniques. In a situation in which a patient could use a different language to undergo a psychotherapeutic process, the question that arises is whether it is possible to receive therapy in a foreign language with the same efficacy. Here we propose a scenario in which participants are exposed to aversive stimuli after a process of conditioning, and they are asked to perform a task in two languages (native vs foreign) during a process of extinction. Thus, we assessed how using a foreign language modulates the extinction of fear, following exposure therapy as a widely used strategy in psychotherapy.

The use of a foreign language has highlighted some astonishing effects in different fields that raise doubts about how a non-native linguistic context would affect an area that involves high emotional content, such as psychotherapy. There are some prominent examples in literature that show how the use of a non-native language in bilinguals involves a decrease in emotionality in comparison to the native one (e. g., Caldwell-Harris & Aycicegi-Dinn, 2009; Harris et al., 2003). This effect is referred to as the 'foreign language effect'. Using the native language seems to be the natural choice when attending therapy. However, studies show indications of the possible use of a foreign language to address specific parts of the therapeutic process. Particularly, clinical cases have reported bilingual patients' preference for using their second language when retrieving painful memories or coping with negative emotions (e.g., Movahedi, 1996; Pitta et al., 1978). Indeed, a second language even showed, in some cases, a softer response when rating the intensity of negative symptoms and traumatic memories (Schwanberg, 2010). These results reveal that using a native language was usually associated with a stronger and rawer emotionality than a non-native language, which could be perceived as more distant and safer (Aragno & Schlachet, 1996). Even language switching has been considered as an appropriate and effective strategy in the context of bilingual or multilingual therapy. Buxbaum (1949) already depicted the voluntary language switch in the clinical setting as a form of positive defence used by the patients to decrease their anxiety levels. In this line, Rosenblum (2011) portrays switching languages as an organic event occurring within a multilingual session, aligned with the reality of multilingual contexts in which voluntary code-switching occurs spontaneously (see de Bruin et al., 2018, 2020).

At a later stage, this differential effect between the emotionality in a native and a non-native language emerged in the decision-making field in the form of more deliberative reasoning and more rational choices in the foreign than in the native tongue (e.g., Costa et al., 2014; Keysar et al., 2012). This phenomenon has also been observed in other empirical studies beyond decision making, exploring different emotional linguistic materials in tasks involving emotional words or phrases (Anooshian & Hertel, 1994; Caldwell-Harris & Ayçiçeği-Dinn, 2009). The mechanisms behind this type of effects are still unclear, and it is unknown whether they are due to a decrease in emotionality or to an increase in the cognitive resources involved because of a greater cognitive load (see Geipel et al., 2016 for a discussion). Nonetheless, what is important is the differential effect between languages, perceived as a psychological distancing from the object or situation to be confronted, and which is manifested through different physiological and behavioural responses.

More recent studies include physiological measures, which have enlightened the impact of this effect at an objective level. Iacozza, Costa and Duñabeitia (2017) presented emotional sentences in the native and the foreign language to bilingual participants and recorded their autonomic responses associated with pupil dilation. Their study showed that reading aloud sentences with a negative content (vs neutral sentences) in the foreign language elicited lower pupil size changes in comparison with completing the same task in the native language, suggesting a reduction of the emotional impact of negative sentences when they were read in the foreign language.

In psychotherapy, only a few studies have explored this foreign language effect. Recent research tested the effects of the use of a foreign language on some emotion regulation strategies through self-reports, obtaining that the use of a foreign language could be differentially beneficial depending on the strategy and finding a more advantageous effect for the content labelling strategy (see Morawetz et al., 2017). Additionally, some precursor experiments have explored the impact of emotional processing through fear conditioning in underlying semantic mechanisms, showing that fear generalized from one language to the other (native or foreign; Grégoire & Greening, 2020). However, there is a notable lack of investigation regarding the use of a non-native language in psychological paradigms. Further research is needed to ascertain the role of language nativeness in clinical practice under the assumption of a reduced emotional attachment to foreign languages than to native languages.

Given the critical role that language plays in some psychotherapeutic paradigms and the effects that foreign language use can have on emotionality, recent research has focused on the impact of the foreign language effect on processes underlying exposure therapy. Exposure therapy is one of the most used and effective treatments for anxiety disorders. This method is described as the set of strategies in which the feared object (external or internal) is repeatedly approached rather than avoided (Craske, et al., 2018). The repeated exposure to aversive stimuli has been shown to be effective in research (Tabibnia et al., 2008) and effective in a second language context (Morawetz et al., 2017). One of the main processes underlying exposure therapy is fear conditioning. This paradigm consists of presenting a neutral stimulus, which becomes a conditioned stimulus (CS) after the paired and repeated presentation of an unconditioned stimulus (US), usually an electric shock. The result is a conditioned response of the CS. A subtype of fear conditioning through verbal instructions was referred to by Mechias et al. (2010) as instructed fear. In this type of conditioning, the stimuli are "conditioned" through verbal threats without the need for the actual presence of the US (see Mertens et al., 2018 for a review).

A first experiment conducted by our team (García-Palacios et al., 2018) explored the foreign language effect within an instructed fear paradigm. The results from this experiment showed that the linguistic context had an effect on the acquisition of fear. The foreign language diminished the acquisition of fear, showing more reduced pupil and electrodermal responses to conditioned stimuli (compared to neutral ones) in the foreign than in the native language. These results were explained in terms of the emotional distance elicited by a foreign language, which could work as a fear reducer during the acquisition process. This finding opened doors to the possibility of a foreign language functioning as a useful tool in clinical contexts such as exposure therapy, in which a foreign language could produce the same detachment effect. Thus, a logical next step in this line of research was to explore another related process analogous to exposure therapy in a laboratory context: fear extinction. Extinction of fear consists of the presentation of a conditioned stimulus (CS), previously paired with an aversive stimulus (unconditioned stimulus, US), repeatedly presented without being followed by the US, resulting in a decline of the conditioned fear responses.

Based on the preceding results in the effects of conditioning instructions on fear in a foreign language context by García-Palacios et al. (2018), here we present a new study to investigate the role of a foreign language and its associated psychological distance in the instructed extinction process. For this purpose, conditioned fear was induced in participants in their native language. Next, an instructed extinction paradigm in native vs foreign language was used to eliminate that fear, simulating a course of exposure to a threat. For assessing the effectivity of the extinction, we included self-ratings of fear, and pupil size and electrodermal activity (EDA), two measures of physiological arousal, as arousal has shown to be modulated by the foreign language effect (Fernández-López & Perea, 2020). Hence, our goal was to test whether the process of instructed extinction fear was affected by the use of a foreign language differently than in a native language. According to previous literature supporting the foreign language effect, we hypothesized that participants who used a foreign language in the extinction phase would show reduced self-reported fear and physiological measures in comparison to participants who used their native language.

As previous evidence established a new path in research involving psychological therapies and bilingualism, our purpose is to gather evidence and contribute to broadening the possibilities within psychotherapies through the effect of foreign language. A better understanding of the influence of prominent factors in therapy, such as the potential use of a foreign language, might lead to the improvement of these techniques and different ways of modulating emotions, as well as exploring more extensively the nuances of the foreign language effect.

Method

Participants

A total of 58 students were recruited from an initial sample of 132 that showed interest in participating in this experiment. The majority of the participants were women ($n = 42$), and they all had an intermediate/high level of self-perceived English proficiency. The following inclusion criteria were established: Spanish as mother tongue; relatively proficient level of English measured with the self-perceived level of knowledge; less than one year living in an English-speaking country; no psychiatric problem in immediate need of treatment; and no current alcohol or drug dependence. Sample size was calculated by G*Power (Faul et al., 2009), with an effect size of 0.25 and a power of 0.80 for repeated measures within-between interactions, obtaining a sample size of 34. Twenty-eight participants were randomly assigned to the native language context (16 females) and 30 to the foreign language context (25 females). After removing 21 participants from the analysis due to recording failure and because of lack of measurable EDA collection, the final sample was constituted of 37 participants (29 females). The participants were matched in age, income, anxiety levels (see Table 1) and education (all participants had a university level). Besides, the mean level of English did not differ between the participants assigned to each group. All participants gave consent after being informed, and the study was approved by Universitat Jaume I Ethical Committee (Ref. 25/2018).

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

	Language context			
	Native (n = 17)	Foreign (n = 20)	p value	t
Females (number)	11	18		
Age (in years)	22.9 (8.4)	21.1 (3.4)	.24	0.92
Money income (in euros)	2546 (1194)	2387 (1201)	.58	0.28
STAI-R (score)	20.8 (10.4)	22.3 (6.5)	.09	0.40
STAR-E (score)	14.6 (5.5)	16.9 (5.6)	.64	1.43
English level (score)	7.6 (0.8)	6.8 (1.2)	.26	1.8

Instruments

The questionnaires completed before the experiment included a short sociodemographic survey which examined their level of education, income, and previous experience in other experiments, a self-perception test of their knowledge of English skills, and the State-Trait Anxiety Inventory (STAI; Spielberger et al., 1983). Participants' English skills were assessed according to an adaptation from the LEAP-Q (Marian et al., 2007).

Procedure

The experiment was carried out by 3 researchers. Researcher 1 was in charge of assessing the participants with the questionnaires. Once participants had filled out the questionnaires, they were guided to a quiet room where the experiment was conducted. This study used an instructed fear and instructed extinction paradigm, with three parts: training, conditioning, and extinction. After placing the EDA sensors in the index and middle fingers of their non-dominant hand and the calibration of the eye-movement recording camera, researcher 2 explained in the native language (i.e., Spanish) the training and conditioning phases. In the training phase, participants observed 10 gray squares with a superimposed countdown from 10 to 1. The task consisted of saying the numbers out loud at the pace of 1 second. They completed two trials, one in the native language (i.e., Spanish) and the other in the foreign language (i.e., English). In the next phase (namely, the conditioning phase), the electrodes corresponding to the electric shock were attached to the other wrist to accomplish fear conditioning in the participants, and the participants were informed that the series of trials presented would consist of two color conditions: blue squares and yellow squares. Participants were verbally instructed that one of the colors (CS+) could be followed by an aversive stimulus (US), consisting of the possibility of receiving an electric shock, while the other color (CS-) would not be associated with this threat. No electric shock was actually administered, despite the association made by verbal instructions. The colors were selected according to the RGB scale and matching saturation and luminosity to avoid differences in pupil diameter. The association between color squares and the condition (threat/neutral) was counterbalanced so that half of the participants had the blue squares as the threat/neutral stimulus and the other half the yellow one. The trials started with a fixation cross for 10 seconds. After that, each colored square appeared on screen for 10 seconds. The interstimulus interval had a duration of 10 seconds. Colors were presented in a randomized order with a countdown from 10 to 1 superimposed on them, while participants had to say out loud the number at a pace of 1 second in their native language (i.e., Spanish). Each color was presented 10 times, so the instructed fear phase consisted of a total of 20 trials of 10 seconds each. (Note that this procedure mimics that of the original study by García-Palacios et al. (2018), with the only exception of the use of a single language – Spanish – during the conditioning phase). The language context manipulation was inserted in the last phase: the instructed extinction phase. In this part, participants were informed that the threat or unconditioned stimulus (US) would no longer follow the corresponding colored square or conditioned stimulus (CS) (Luck & Lipp, 2016). In this instructed extinction phase, the instructions were given by researcher 3 either in the native language or in the foreign language, depending on the experimental group assigned to each participant. Participants were informed in the corresponding language that there would be no shock in this phase, and the electric shock electrode was removed following previous research (e.g., see Luck & Lipp, 2015 for a review). The task was the same as the one in the instructed fear phase, consisting of 20 trials of 10 seconds each. However, the countdown was either in Spanish or English, according to the assigned language context group. Both phases were followed by subjective levels of fear for each condition on a scale from 0 to 100 (e.g., “On a scale from 0 to 100, how much fear do you feel right now?”), being 0 no fear at all, and 100 extreme fear. Researcher 2 and researcher 3 roles were exchanged and counterbalanced across participants. The experimental session lasted around 50 minutes in total. This paradigm was previously used by Phelps et al., (2001) to demonstrate through neuroimaging techniques that instructed fear was possible with only verbal instructions, in the absence of a real aversive stimulus. During the debriefing at the end of the study, the participants were asked whether they had felt any electric shock and how many, and were explained that they were in a non-shock condition following García-Palacios et al., (2018).

Data analysis

In order to test the effects of language context on self-reports of fear, a 2 (Phase: conditioning, extinction) x 2 (Condition: threat, neutral) x 2 (Language: native, foreign) repeated measures ANOVA was performed with Phase and Condition as within-subject factors and Language as between-subject factor. For EDA and pupil diameter, two separate 2 (Phase) x 2 (Condition) x 10 (Time: range 1 to 10) x 2 (Language) repeated measures ANOVAs were performed with Phase, Condition and Time as within-subject factors, and Language as between-subject factor. Partial eta squared (η_p^2) was reported as a measure of effect size. Means (*SD*) and confidence intervals by Phase and Condition are reported 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. Post-hoc comparisons were performed with pairwise t-tests using Cohen's *d* as a measure of effect size. All statistical tests were conducted using SPSS IBM Statistics version 23 and graphs were made with R (R Core Team, 2020).

Pupil size (Tobii Pro Lab) and EDA (Shimmer3 GSR) were registered as physiological measures. Emotional arousal is significantly related to pupil dilation, especially negative emotions such as fear, which have been reported to have a stronger influence on the increasing or decreasing size of the pupil (Bradley et al., 2008; Hess & Polt, 1960). Skin conductance is also a key indicator of automatic emotion responses (see Kreibig, 2010 for a review). Mean pupil size was averaged across both eyes and reduced to 1-second-bin periods across the 10-seconds countdown presentation estimated for each participant in each trial. The eye-tracker collected the data using a sampling rate of 120 Hz. EDA values were calculated as a mean amplitude of each second. Then mean EDA was also calculated for the whole 10-seconds and simultaneously recorded at a sampling rate of 125 Hz. Tobii Pro Lab apparatus applied a filter with a time window of 500 ms and then a mean filter with a time window of 1000 ms to remove rapid-transient artefacts and high-frequency noise. Then, the electrodes were placed in the middle fingers of the non-dominant hand and remained steady for two minutes until the signal stabilized. To obtain the baseline for both measures, the means were averaged across the 4 seconds before each trial, and the change scores were computed as the difference between each second of the trial and the baseline (see also García-Palacios et al., 2018). The percentages of change were calculated for both measures by averaging the data of each trial in each condition with respect to the baseline. The ten seconds of countdown were reduced to the mid optimal value of the mean as a reference mark for the whole trial.

Results

Self-reports of fear

The results for the repeated measure ANOVA for self-reported fear showed main effects of Phase [$F(1, 35) = 10.17$, $p = .003$, $\eta_p^2 = .23$] and Condition [$F(1, 35) = 11.57$, $p = .002$, $\eta_p^2 = .02$]. However, Language main effects were not found [$F(1, 35) = .675$, $p = .42$]. In addition, the interaction between Phase x Condition was significant [$F(1, 35) = 12.10$, $p < .001$, $\eta_p^2 = .26$]. Specifically, post-hoc analyses showed that participants reported greater fear in the threat compared to the neutral condition in the conditioning phase [$t(36) = 4.06$, $p < .001$, $d = .69$], whereas there were no differences between threat and neutral conditions in the extinction phase [$t(36) = 1.43$, $p = .08$]. These results were irrespective of the Language, being all the interaction analyses with this factor not significant (all *p's* >.10).

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

	Native Language								Foreign Language							
	Conditioning			Extinction					Conditioning			Extinction				
		95% CI			95% CI		*t* (16)	*p*		95% CI			95% CI		*t* (19)	*p*
	Mean (SD)	Lower	Upper	Mean (SD)	Lower	Upper			Mean (SD)	Lower	Upper	Mean (SD)	Lower	Upper		
Self-reports																
Neutral	26.23 (6.01)	14.03	38.43	16.35 (6.14)	3.87	28.83	1.44	.09	17 (5.53)	5.75	28.24	19.85 (5.66)	8.34	31.35	1.10	.14
Threat	46.17 (6.35)	33.28	59.07	24.88 (6.46)	11.76	38	3.37	.002	33.35 (5.85)	21.46	45.23	20.95 (5.95)	8.85	33.04	2.50	.01
Pupil size (mm)																
Neutral	0.32 (0.48)	0.23	0.42	0.28 (0.45)	0.19	0.37	2.27	.19	0.43 (0.04)	0.34	0.52	0.46 (0.04)	0.37	0.54	0.80	.22
Threat	0.45 (0.5)	0.34	0.56	0.25 (0.43)	0.16	0.34	4.42	<.001	0.51 (0.05)	0.4	0.61	0.43 (0.04)	0.35	0.51	3.21	.002
Electrodermal activity (μs)																
Neutral	0.02 (0.02)	-0.01	0.06	0.03 (0.02)	-0.01	0.08	0.44	.33	0.03 (0.02)	-0.01	0.07	0.05 (0.02)	0.01	0.1	1.97	.03
Threat	0.04 (0.05)	-0.06	0.15	0.03 (0.02)	-0.02	0.08	0.24	.41	0.14 (0.05)	0.04	0.24	0.05 (0.02)	0.01	0.1	2.44	.01

Pupil size

Main effects for pupil size are presented in Table 3. Regarding interactions, the interaction Phase x Condition was significant [$F(1, 35) = 22.96$, $p < .001$, $\eta_p^2 = .40$]. Specifically, post-hoc comparisons showed that, in the conditioning phase (see Figure 1A), pupil size was greater during the threat condition [$t(36) = 2.49$, $p = .01$, $d = .45$] as compared to the neutral condition. However, differences between conditions in the extinction phase (see Figure 2) were not found [$t(36) = .86$, $p = .20$]. In addition, Language interacted with Phase [$F(1, 35) = 7.87$, $p = .01$, $\eta_p^2 = .18$]. In particular, the native-language group showed greater pupil size in the conditioning phase, compared to the extinction phase [$t(16) = 4.60$, $p < .001$, $d = .78$], whereas the foreign-language group did not show differences between the phases [$t(19) = 1.27$, $p = .11$]. Importantly, the three-way interaction Phase x Time x Language was significant [$F(3, 112) = 9.89$, $p < .001$, $\eta_p^2 = .22$]. Post-hoc comparisons showed that participants in the native-language group showed larger pupillary responses in the conditioning compared to the extinction phase from 2 to 10 seconds [second 2, $t(16) = 3.84$, $p < .001$, $d = .68$; second 3, $t(16) = 4.89$, $p < .001$, $d = .81$; second 4, $t(16) = 4.77$, $p < .001$, d = .83; second 5, $t(16) = 5.11$, $p < .001$, $d = .87$; second 6, $t(16) = 4.75$, $p < .001$, $d = .85$; second 7, $t(16) = 4.66$, $p < .001$, $d = .81$; second 8, $t(16) = 4.45$, $p < .001$, $d = .74$; second 9, $t(16) = 4.53$, $p < .001$, $d = .64$; second 10, $t(16) = 4.16$, $p < .001$, $d = .71$], whereas participants in the foreign-language group showed differences between Phases only in four points [second 1, $t(19) = 2.48$, $p = .01$, $d = .41$, second 2, $t(19) = 2.53$, $p = .01$, $d = .30$]; second 3, $t(19) = 2.19$, $p = .02$, $d = .25$], second 10, $t(19) = 2.85$, $p = .01$, $d = .28$]. The interaction Phase x Condition x Time x Language was not significant [$F(4, 140) = 1.58$, $p = .18$].

Electrodermal activity

The analyses performed for EDA showed that the interaction Phase x Condition x Time was significant [$F(1, 54) = 3.75$, $p = .04$, $\eta_p^2 = .10$] (see Figure 1B). Post-hoc comparisons revealed that, during conditioning, the threat condition produced greater levels of EDA compared to the neutral condition [second 6, $t(36) = 2.08$, $p = .02$, $d = .40$; second 7, $t(36) = 2.35$, $p = .01$, $d = .46$; second 8, $t(36) = 1.83$, $p = .04$, $d = .37$; second 9, $t(36) = 2.01$, $p = .02$, $d = .39$; second 10, $t(36) = 1.95$, $p = .03$, $d = .34$]. However, in the extinction phase (see Figure 3), differences between threat and neutral conditions were not found in any of the time points (all *p's* > .20), indicating an effective extinction of fear. None of the interactions with Language were significant (all *p's* > .20). See Table 3 for other statistical results.

Table 3.
Results of main effects and interactions of pupil size and electrodermal activity.

	Pupil size			Electrodermal activity		
	F	*p*	ηp2	*F*	*p*	ηp2
Main effect Phase	20.22	<.001	.36	0.93	.34	-
Main effect Language	6.38	.02	.15	1.14	.29	-
Main effect Time	100.07	<.001	.75	8.90	<.001	.20
Main effect Condition	1.20	.28	-	3.15	.09	-
Phase x Language	7.87	.01	.18	0.71	.40	-
Phase x Condition	22.96	<.001	.40	3.67	.06	-
Phase x Time	7.26	.03	.17	0.32	.66	-
Language x Condition	0.16	.68	-	2.08	.16	-
Language x Time	2.50	.10	-	1.49	.24	-
Condition x Time	3.00	.04	.08	1.92	.16	-
Phase x Language x Condition	1.07	.31	-	1.70	.20	-
Phase x Language x Time	9.89	<.001	.22	0.37	.62	-
Phase x Condition x Time	9.91	<.001	.22	3.75	.04	.10
Language x Condition x Time	0.33	.76	.01	1.63	.21	-
Phase x Language x Condition x Time	1.57	.18	.04	0.91	.39	-

Conditioning Phase

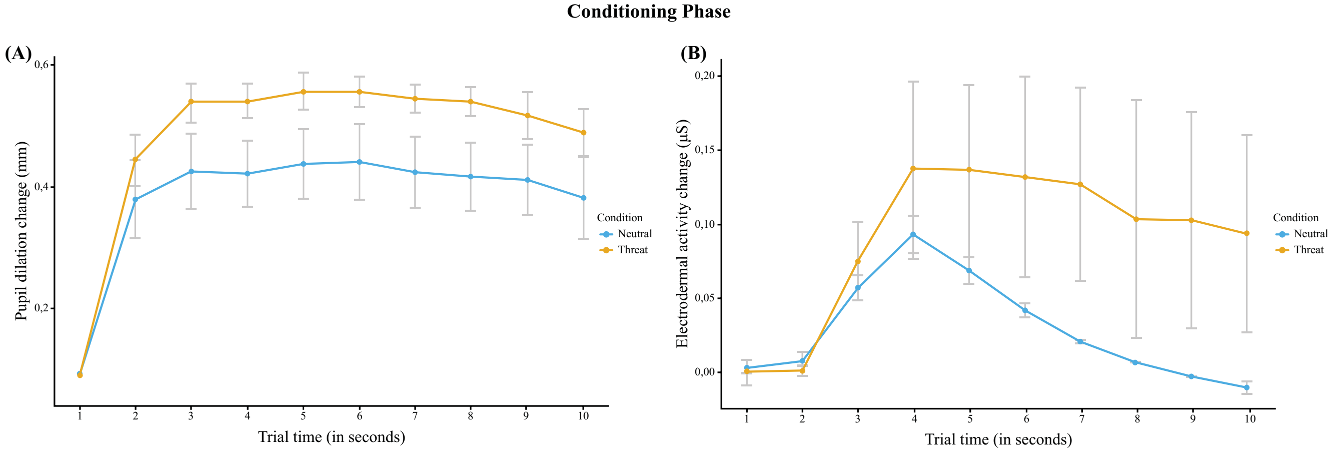

Figure 1.
Pupil size (A) and electrodermal activity (B) change in the conditioning phase.
Note: (A) Pupil change over the 10 seconds countdown. (B) Electrodermal activity change over the 10 seconds countdown.

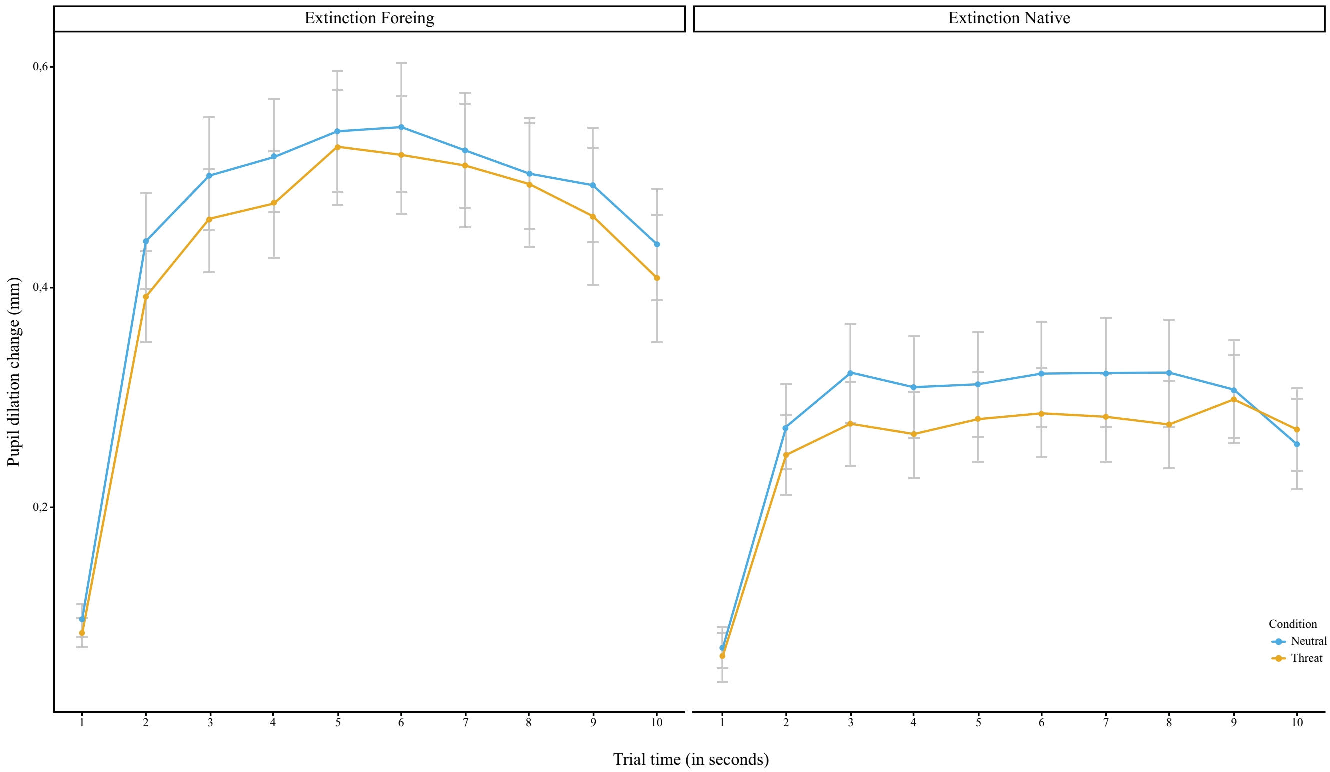

Figure 2.
Pupil size change in the extinction phase by language and condition.

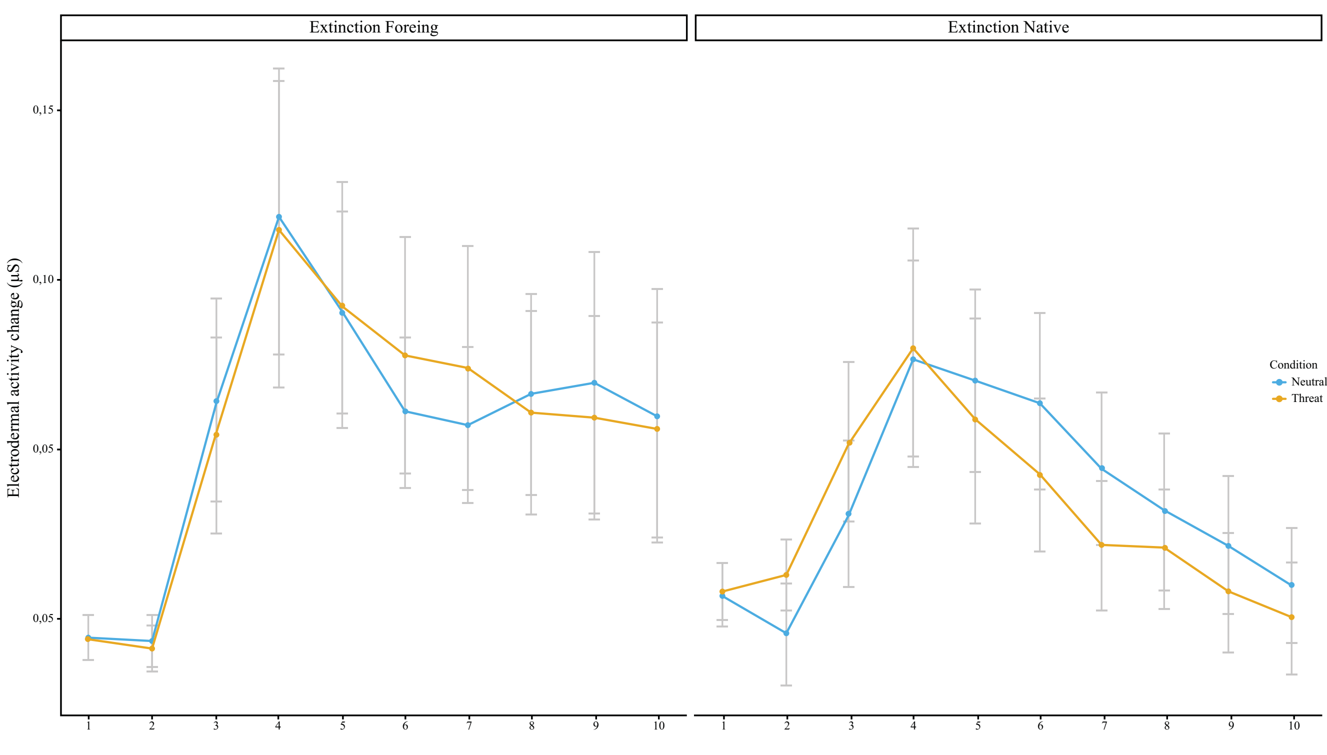

Figure 3.
Electrodermal activity change in the extinction phase by language and condition.

Discussion

The present study belongs to a line of research that aims to study the effect of a foreign language on instructed fear processes. Specifically, this study explored whether a foreign language could influence the extinction process of fear in bilinguals with a non-native level of proficiency in their foreign language. We approached this issue by using verbal instructions to accomplish the acquisition of fear and then the extinction of that fear in a group of Spanish-English bilingual participants. We assessed whether a foreign language could decrease the emotional reactivity evoked by a threat produced by the possibility of receiving electric shocks with physiological and self-reported fear-related measures. The results of this study showed that the process of extinction did not differ depending on the language context in which it occurred. In fact, the extinction effect was effective in both languages. Particularly, the effect of the instructions in the extinction phase is clearly visible in the pupil size and electrodermal responses, showing a decrease in threat after the extinction instructions in both languages. The results also show overall higher arousal in the foreign language group.

The reduced fear effect found in the acquisition phase in the study by Garcia-Palacios et al., (2018) is not found in the extinction phase tested in the current study. Based on these findings, it seems that the effect of using a foreign language may be more relevant in acquisition than extinction processes. As previous studies suggested (Caldwell-Harris, 2015; Corey et al., 2017), reduced emotional involvement in a foreign language could be softening the process of acquisition. However, this effect does not seem to be as relevant in the extinction process. This is consistent with literature signaling that the foreign language effect is present in dilemmas or situations that only affect us at a personal level (Brouwer, 2021), since the extinction process entails new learning that no longer includes the association with an emotional stimulus, as it does during conditioning. Other studies highlight the emotionality of the situation as an important factor, showing stronger effects in the foreign language when the context is emotionally negative (Caldwell-Harris & Aycicegi-Dinn, 2009). Hence, we tentatively suggest that instructions implying negative emotional content, as is the case in the conditioning, would be a suitable context to see the presence of the foreign language effect, being less receptive to instructions about safety, as occurs during extinction.

The paradigm implemented in the current experiment has been used in previous instructed fear and instructed extinction studies to prove higher-order knowledge shaping aversive learning (Atlas, 2019; see Mechias et al., 2010 for a review). To date and to the best of our knowledge, no preceding study has introduced the language context variable in the extinction of fear. In this sense, it is important to note that our results showed an effective acquisition of fear and a satisfactory extinction phase. Both pupil and electrodermal responses showed differences between neutral and threat conditions in the acquisition phase, whereas these differences vanished in the extinction phase, thus showing an effective fear extinction regardless of the language context. Likewise, fear self-reports were in line with the physiological measures, presenting slightly higher reports in the acquisition phase compared to the extinction phase and reflecting the effectiveness of extinction by showing no significant differences between threat and neutral conditions. Therefore, we can confidently conclude that the lack of differences between language contexts in the extinction phase was not due to ineffective fear conditioning.

A crucial result is the general enhancement of arousal in the foreign language, with generalized larger psychophysiological effects in the extinction phase in the foreign than in the native language across conditions. The higher arousal in a foreign language during the extinction is due to the arousal associated with a non-native language. A reasonable explanation of this enhancement of arousal in a foreign language is the additional cognitive load experienced in a non-native language, which together with the higher cognitive fluency in the native language, could contribute to the observed differences (Costa et al, 2017). In this line, previous research has associated this increased cognitive load effect with the higher attentional resources dedicated to developing a task in a language that is not the mother tongue (Alnæs et al., 2014; Duñabeitia & Costa, 2015). In this experiment, we overcome this issue by focusing on the index that signals the differences between threat and neutral stimuli in each phase (see Lonsdorf et al., 2017).

Pupil size has previously shown high sensitivity in capturing differential arousal levels associated to the use of different languages (e. g., Iacozza et al., 2017). This study showed stronger results in pupil size than in EDA, as in the previous acquisition study, although we have no certain explanation for this. Still, both physiological measures capture the effect more markedly than the self-reports (see also Iacozza et al., for a parallel situation). In this study, there is a limited collection of self-ratings, only at the end of each phase, so perhaps including more report points could extend the results. Still, it is worth noting that other studies showed this same pattern, obtaining the effect in physiological measures but not in the self-reports (Eilola & Havelka, 2011).

These results lead us to tentatively propose an ideal therapeutic scenario for a bilingual patient in which the main language is a foreign one. Obviously, such a recommendation would only apply in a clinical situation where an individual who is relatively fluent in a foreign language is set with a native-like bilingual practitioner, but these results anticipate a possible application of this dynamic in this and other paradigms in a therapeutic setting. Future research should explore this issue in further detail, and some limitations should also be considered. First, the possible influence of switching languages at the beginning of the extinction phase should be investigated. Although prior evidence in decision-making has shown that switching languages does not weaken the foreign language effect (Corey et al., 2017; Oganian et al., 2016), it should be kept in mind that one of our test groups switched the language, while the other did not, and the potential impact of this should be further explored. And second, a cautionary note should be made concerning the proficiency level attained in the participants' foreign language. Although the literature points to a non-native-like proficiency level (such as the one chosen in this study) as ideal for observing foreign language effects, the proficiency level of comprehension in the non-native language could be another possible factor influencing the foreign language effect in this context. Replicating the current results with distinct types of bilinguals would be useful for generalization purposes. This is particularly relevant considering that preceding studies have highlighted the role of immersion, the level of involvement with a language and the between-languages similarity as potentially modulating factors (see Čavar & Tytus, 2018; Driver, 2020; Dylman & Champoux-Larsson, 2020). Finally, it is important to note that language use per se has been relatively limited in this study. Future studies should include more language involvement to more accurately explore how each language influences results.

To sum up, the foreign language effect does not modulate the strategy of fear extinction in terms of emotional reactivity of arousal when the absence of the threat is verbally communicated. Fear extinction via verbal instructions in a foreign language context is as effective as in the context of a native language, demonstrated by self-reports and two physiological measures which offered evidence of a similar response pattern in both language contexts. The present experiment continues expanding the impact of the language context and its boundaries using the fear extinction paradigm underlying the exposure therapy. These results represent an invitation to continue gathering evidence on the role of foreign languages in clinical practice across techniques and paradigms.

Conflict of Interest Statement

The authors declare that this study was carried out without any personal, professional or financial relationship that could be interpreted as a conflict of interest.

Author Contributions

AG-P, AC and JD developed the concept of the study and provided ideas for the study design. IO, VC and DC prepared the physiological measures devices and necessary material. IO and VC performed the experiment design in the software and implemented the data collection and testing of the participants with IJ. The data analysis and interpretation of the physiological measures was executed by JD and IJ, and the behavioral data were analyzed by IJ. IO elaborated the manuscript along with IJ under the supervision of AG-P.

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Availability of Materials

The datasets analyzed for this study can be found in the Open Science Framework (OSF) Repository [https://osf.io/t8za7/?view_only=4f73b563b7d64997a4db92834f915dfb].

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