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A Study on the Emotional Representation of Negation in Portuguese and Chinese among African Multilinguals

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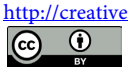

Abstract

This study investigates the processing differences of emotional representation of negation between Portuguese and Chinese among African multilingual speakers, with a focus on the joint moderating effect of language type and language proficiency on negation processing. We recruited 60 quadrilingual speakers from African Portuguese-speaking countries, and conducted a lexical decision task based on the Affect Misattribution Procedure (AMP). The experiment adopted a 2 (language type: Portuguese/Chinese) × 2 (prime polarity: affirmative/negative) × 2 (target valence: positive/negative) within-subject design. Results revealed a stable negative bias effect: the correct recognition rate of negative target words under negative priming conditions was significantly higher than that under affirmative priming conditions, and this pattern was consistently observed in both languages. Both language type and prime polarity showed significant main effects, with a significant three-way interaction among language type, prime polarity and target valence. Portuguese showed a stronger negation processing effect than Chinese, and Chinese proficiency (HSK level) significantly moderated the strength of the negation effect in Chinese context. The study suggests that the core mechanism of negative emotional representation involves cognitive inhibition and prioritized cognitive resource allocation, rather than mere emotional valence effects. Language proficiency and language typology jointly modulate the negative emotional representation process in multilingual speakers.

Subject Areas

Educational Psychology

Keywords

Negative Processing, Positive and Negative, Cross-Linguistic Processing,

Multilingual Individuals, African International Students, Portuguese, Chinese, Cognitive Inhibition

1. Introduction

Negation processing is a core issue in language cognition research, and its core mechanism is negation-induced cognitive inhibition. This refers to the additional cognitive resources required to suppress the semantic activation of the original affirmative proposition when processing negation expressions, which determines the fundamental difference in processing patterns between affirmative and negative expressions (Tian *et al.*, 2024). Current research on negation and emotional representation predominantly focuses on intra-Indo-European language comparisons or Chinese-English bilingual studies, while African multilingual groups proficient in three or more languages remain underexplored. In particular, comparative studies on negation processing between Portuguese (Indo-European inflectional language) and Chinese (Sino-Tibetan isolating language), two typologically distinct language families, are extremely scarce [1]. This research gap hinders the revelation of cross-linguistic boundaries and universality of the cognitive inhibition mechanism in negative emotional representation.

This study focuses on quadrilingual speakers from Portuguese-speaking African countries, and adopts a lexical decision task based on the Affect Misattribution Procedure (AMP) to examine the processing characteristics of negative emotional representation in Portuguese and Chinese. The main research purposes are: (1) to clarify the cross-linguistic universality of the processing difference between affirmative and negative expressions in emotional representation; (2) to verify the moderating effect of language proficiency on the effect of negative emotional representation; (3) to reveal the interaction effect of language type, prime polarity and target valence on the processing of negative emotional representation [2].

2. Core Concepts and Theoretical Foundations

2.1. Core Concept Definition

Negation processing: In this study, it refers to the cognitive process in which individuals suppress the semantic activation of the original affirmative proposition after receiving negative linguistic markers, and complete the construction of negative proposition meaning, accompanied by the activation of cognitive inhibition mechanism and priority allocation of attentional resources [3].

Emotional representation of negation: It refers to the phenomenon that negative linguistic markers activate negative emotional valence in the cognitive process, and produce a consistency effect with the emotional valence of subsequent target stimuli, which is manifested as the processing advantage of negative priming on negative emotional target words [4].

Cross-linguistic negation processing difference: It refers to the difference in the

intensity and processing path of the negative emotional representation effect among different language types, which is mainly affected by language typology and individual language proficiency.

2.2. Theoretical Framework

This study takes the cognitive inhibition theory of negative priming as the core framework, combined with the embodied cognition theory of multilingual emotional processing, the hierarchical model of bilingual representation, and the linguistic relativity hypothesis, to construct the theoretical basis of the research. The cognitive inhibition theory of negative priming suggests that negation processing will inevitably induce the activation of the cognitive inhibition system, and the suppression of the original affirmative proposition will make the individual produce a processing bias towards negative information, which is the core source of the negative emotional representation effect [5]. The embodied cognition theory further points out that the emotional intensity of language processing is directly related to the individual's language proficiency and language use experience: the higher the proficiency, the deeper the integration of language and emotional experience, and the more significant the emotional representation effect.

2.3. Research Hypotheses

Based on the theoretical framework and experimental design, we propose the following three research hypotheses, each mapping to a specific contrast in the 2 × 2 × 2 within-subject design:

- H1: African multilingual speakers show a significant negative emotional representation advantage effect in both Portuguese and Chinese. Specifically, the correct recognition rate of negative target words under negative priming conditions is significantly higher than that under affirmative priming conditions, and the reaction time is significantly shorter; while the processing performance of positive target words has no significant difference between the two priming conditions [6].
- H2: The negative emotional representation effect shows significant cross-linguistic differences, with a significantly larger effect size in Portuguese than in Chinese. Language proficiency (HSK level) has a significant moderating effect on the strength of the negation effect in Chinese context: the higher the Chinese proficiency, the more significant the negative emotional representation effect.
- H3: There is a significant three-way interaction among language type, prime polarity and target valence. The cross-linguistic processing difference is specifically manifested in the negation processing stage: the processing advantage of negative priming on negative target words is significantly stronger in Portuguese than in Chinese, while there is no significant cross-linguistic difference in the processing of positive target words under different priming conditions.

3. Research Methods

3.1. Demographic and Linguistic Characteristics of Participants

A total of 60 African international students studying in China were recruited as participants for this experiment, and all participants were multilingual speakers. The age of the participants ranged from 19 to 27 years old (M = 23.20, SD = 2.05); among them, 35 were male (58.3%) and 25 were female (41.7%); 39 were right-handed (65.0%) and 21 were left-handed (35.0%). All participants reported normal or corrected-to-normal visual acuity, no history of dyslexia, neurological diseases or mental illnesses, and voluntarily signed written informed consent forms after fully understanding the purpose of the experiment before the experiment commenced [7].

Participants were from four African countries with Portuguese as the official language, covering West Africa and Southern Africa: 37 from Guinea-Bissau (61.7%), 11 from Cabo Verde (18.3%), 6 from Angola (10.0%), and 6 from Mozambique (10.0%). Participants had diverse native languages, mainly including Crioulo and various indigenous African languages under the Niger-Congo language family, such as Balanta, Fulani, Papel, Mandinga, Mandjaco, Kimbundu, Umbundu, Tsonga, etc.

Table 1. Demographic and linguistic characteristics of the study population (N = 60).

Characteristic	Category/Statistic	n/M (SD) [Range]
Age (Years)	M (SD)	23.20 (2.05) [19 - 27]
Gender	Male/Female	35 (58.3%)/25 (41.7%)
Handedness	Right-handed/Left-handed	39 (65.0%)/21 (35.0%)
Country of Origin	Guinea-Bissau/Cabo Verde/Angola/Mozambique	37/11/6/6
Exposure to Tibetan Language	No/Yes	34 (56.7%)/26 (43.3%)
Age of First Learning Portuguese	M (SD)	5.45 (1.04) [4 - 7]
Years of Learning Portuguese	M (SD)	15.13 (2.04) [12 - 19]
Portuguese Self-rated Proficiency	M (SD) (1 - 100)	98.27 (1.44) [94 - 100]
Age of First Learning Chinese	M (SD)	19.53 (1.21) [17 - 23]
Years of Learning Chinese	M (SD)	4.12 (0.90) [3 - 6]
Chinese Proficiency Test (HSK)	HSK4/HSK5/HSK6	36/21/3
Chinese Self-rated Proficiency	M (SD) (1 - 100)	84.84 (3.83) [80 - 95]

In terms of language learning history, Portuguese was the official language for all participants, and the vast majority of participants (93.3%) reported Portuguese as their first foreign language. The average age at which participants began to systematically learn Portuguese was 5.45 years old (SD = 1.04, range: 4 - 7 years old), the average learning duration was 15.13 years (SD = 2.04, range: 12 - 19 years),

and the average self-rated proficiency in Portuguese was 98.27 points (SD = 1.44, range: 94 - 100; full score 100 points), indicating that participants had a near-native high proficiency in Portuguese.

Chinese, the target test language of this study, was usually the fourth language contacted by participants. The average age at which participants began to learn Chinese was 19.53 years old (SD = 1.21, range: 17 - 23 years old), and the average learning duration was 4.12 years (SD = 0.90, range: 3 - 6 years). In terms of Chinese Proficiency Test (HSK) levels, 36 participants (60.0%) passed HSK Level 4, 21 participants (35.0%) passed HSK Level 5, and 3 participants (5.0%) passed HSK Level 6, indicating that most participants had reached intermediate to advanced Chinese proficiency. The average self-rated proficiency in Chinese was 84.84 points (SD = 3.83, range: 80 - 95; full score 100 points). In addition, 26 participants (43.3%) reported having been exposed to Tibetan, while 34 participants (56.7%) reported no exposure to Tibetan. The detailed demographic and linguistic background information of participants is summarized in Table 1.

3.2. Research Objectives

This study systematically investigates the representation characteristics of negative emotion vocabulary in African multilingual speakers across Portuguese and Chinese, two distinct language families. It aims to validate the cross-linguistic universality of the negative bias effect, analyze the moderating mechanisms of language proficiency and type on negative emotion representation, provide empirical evidence for multilingual emotion processing theory, and offer references for Chinese emotion vocabulary instruction for African international students in China [8].

3.3. Subjects

This study recruited 60 African multilingual students who were right-handed, with normal or corrected visual acuity, no history of dyslexia, neurological disorders, or psychiatric conditions, and voluntarily participated in the research by signing a written informed consent form.

Table 2. Demographic characteristics of the study population (N = 60).

Characteristic	Category/Statistic	n/M(SD)
Age	M(SD) [range]	23.20 (2.05) [19 - 27]
Gender	Male/Female	35 (58.3%)/25 (41.7%)
Country	Guinea-Bissau/Cape Verde/Angola/Mozambique	37/11/6/6
Chinese proficiency	HSK Level	HSK4(36), HSK5(21), HSK6(3)
Portuguese proficiency	Self-rating score (1 - 100)	M = 98.27 (SD = 1.44)

All participants were from Portuguese-speaking countries in Africa, covering West Africa (Guinea-Bissau, Cape Verde) and Southern Africa (Angola, Mozam-

bique). Their native languages were Creole (Crioulo) and indigenous African languages from the Niger-Congo language family, with Portuguese as a second language and Chinese as a fourth language. Detailed demographic and linguistic background information of the participants is provided in Table 2.

3.4. Experimental Materials

The experimental materials were divided into Portuguese and Chinese sets, each containing matched starting phrases and target vocabulary. All materials underwent pre-experiment screening and standardization to ensure homogeneity [9].

Each set of materials contains 20 affirmative and 20 negative priming phrases, all of which are simple subject-predicate structures with neutral semantics, distinguished only by positive/negative markers. The phrase length and word frequency are matched, and all phrases in the pre-experiment were rated as neutral in emotional valence (approximately 3 points on a 5-point scale) to avoid introducing additional emotional effects from the priming phrases themselves.

Each set of materials contains 40 active and 40 negative emotional words, all being common two-syllable terms. Portuguese vocabulary was matched based on word frequency, letter length, and familiarity, while Chinese vocabulary was selected from the "Modern Chinese Emotional Word Bank" and matched according to word frequency, stroke count, and familiarity [10]. All vocabulary items achieved a pre-test familiarity score of ≥4 (on a 5-point scale), with active vocabulary valence scores ≥ 4 and negative vocabulary valence scores ≤ 2. No significant differences were observed in valence intensity, familiarity, or word length between the two sets ($p > 0.05$). Additionally, each set included 80 pseudo-words conforming to the respective language's word-formation rules for the vocabulary judgment task.

3.5. Experimental Design

This study employed a two-factor within-subjects design (2: language type: Portuguese vs. Chinese) × 2 (polarity: affirmative phrase vs. negative phrase), with language type and polarity as independent variables and negative response ratio in AMP as the dependent variable. The experiment consisted of three components: Experiment 1 (Portuguese lexical judgment task) to examine the representational effects of negative emotions in Portuguese; Experiment 2 (Chinese lexical judgment task) to examine the representational effects of negative emotions in Chinese; and Experiment 3 (cross-language meta-analysis) to systematically investigate the moderating role of language type on negative emotion representation.

3.6. Experimental Procedure

The experiment was performed on a computer with a screen resolution of 1920 × 1080 and a distance of 60 cm from the screen. The program was written using E-Prime 3.0 software and conducted in a quiet, undisturbed laboratory environ-

ment.

The trial procedure is structured as follows: A 500 ms fixation point "+" appears in the center of the screen to guide participants' attention. After the fixation point disappears, a 200 ms cue phrase is displayed. Following the cue phrase, a 100 ms blank mask appears. The target word is then presented on the screen for up to 2000 ms, during which participants must quickly and accurately determine whether the word is real. Pressing the "F" key indicates a true word, while the "J" key indicates a false word. The target word immediately disappears after the key press. After a 1000 ms blank screen interval, the next trial begins.

The experiment began with 10 practice trials to familiarize participants with key rules and procedures, with data from these trials excluded from final analysis. The main experiment comprised two blocks: Portuguese and Chinese, presented in a completely balanced order to avoid sequence effects. Each block contained 160 trials (80 real words and 80 false words), with trial sequences randomized. Participants were allowed to rest between blocks to prevent fatigue effects from interfering with results.

4. Results

4.1. Experiment 1: Representation Effect of Negative Emotion in Portuguese Context

This experiment takes the correct rate of vocabulary recognition as the core dependent variable, and investigates the difference of processing between positive and negative emotion words in the Portuguese context of African multilingual speakers, and verifies the representation effect of negative emotion in Portuguese.

4.1.1. Descriptive Statistics

The correct rate of vocabulary recognition for each participant under different emotional valence conditions was calculated, with descriptive statistics for each condition presented in Table 3. The results showed that in the Portuguese context, the average correct rate for positive emotional vocabulary was 0.05 (SD=0.03), while the average correct rate for negative emotional vocabulary was 0.90 (SD = 0.05).

Table 3. Descriptive statistics of correct rate for polarized words in Portuguese (N = 60).

Condition	M	SD	N
Positive phrase	0.05	0.03	60
Negative phrase	0.90	0.05	60

To examine whether there is a significant difference in the probability of negative reactions between affirmation and negation phrases in Portuguese, this study employed a paired-sample t-test. The results demonstrated that the correct response rate for negative words was significantly higher than that for affirmative words, with $t(59) = -127.31$, $p < 0.001$, and Cohen's $d = 16.44$. The large effect

size indicates that negative phrases in Portuguese carry a highly significant negative emotional representation.

4.1.2. Paired Sample t-Test

To assess the recognition accuracy of positive and negative emotional words in Portuguese contexts, a paired-sample t-test was employed for differential analysis. The results demonstrated that the recognition accuracy of negative emotional words was significantly higher than that of positive emotional words, with $t(59) = -127.31$, $p < 0.001$, and Cohen's $d = 16.44$, indicating a large effect.

The results show that the accuracy of processing negative emotion words is much better than that of positive emotion words in the processing of Portuguese words. There is a stable and significant negative emotion representation advantage effect in Portuguese. The negative emotion information can significantly promote the recognition and processing of target words, which is consistent with the core prediction of the negative bias theory.

4.2. Experiment 2: Representation Effect of Negative Emotion in Chinese Context

This experiment adopts the same dependent variable and analysis logic as the first experiment, and investigates the processing characteristics of negative emotion words in Chinese context of African multilingual speakers, and verifies the representation effect of negative emotion in Chinese.

Descriptive Statistics

In the Chinese context, the descriptive statistics of recognition accuracy for different emotional valence words are presented in Table 4. The results show that the average accuracy rate for positive emotional words was 0.05 (SD = 0.03), while that for negative emotional words was 0.86 (SD = 0.08).

Table 4. Descriptive statistics of correct rates for polarized words in Chinese (N = 60).

Condition	M	SD	N
Positive phrase	0.05	0.03	60
Negative phrase	0.86	0.08	60

To examine whether there is a significant difference in recognition accuracy between affirmation and negation words in Chinese, this study employed a paired-sample t-test. The results demonstrated that the correct rate for negative words was significantly higher than that for affirmative words, with $t(59) = -72.16$, $p < 0.001$, and Cohen's $d = 9.32$. The large effect size indicates a significant negative representation effect in Chinese.

4.3. Experiment 3: Cross-Linguistic Comparison of Negative Emotion Representation Effects

In order to further clarify the similarities and differences of the negative emotion

representation of multilingual speakers in two languages, the effective data of Experiment 1 and Experiment 2 were combined, and the effects of language type, valence of emotion on the accuracy of lexical recognition and the interaction between them were systematically investigated by repeated measures ANOVA.

4.3.1. Descriptive Statistics

The descriptive statistics of participants' lexical recognition accuracy under different language types and emotional valence combinations are presented in Table 5. The results indicate that the recognition accuracy of positive emotional words was identical across both languages, while the processing performance of negative emotional words showed differences, with Portuguese demonstrating slightly higher accuracy than Chinese in this regard.

Table 5. Descriptive statistics of accuracy under different language and polarity conditions (N = 60).

Condition	M	SD	N
Chinese-Positive	0.05	0.03	60
Chinese-Negative	0.86	0.08	60
Portuguese-Positive	0.05	0.03	60
Portuguese-Negative	0.90	0.05	60

4.3.2. Results of Repeated Measures ANOVA

A two-way repeated measures ANOVA was conducted to analyze the accuracy of lexical recognition (2 factors: language type: Portuguese/Chinese; 2 factors: emotional valence: positive/negative). The multivariate test results are presented in Table 6.

Table 6. Multivariate test results of repeated measures ANOVA.

Effect	F	p	η_p^2
Language	13.53	<0.001	0.187
Valence	12707.10	<0.001	0.995
Language × Valence	11.79	=0.001	0.167

4.3.3. Main Effect and Interaction Analysis

The repeated-measures ANOVA revealed a significant main effect of language type ($F(1, 59) = 13.53$, $p = 0.001$, $\eta_p^2 = 0.187$), indicating a moderate effect size. Participants achieved a significantly higher overall average accuracy ($M = 0.47$, $SD = 0.04$) in Portuguese compared to Chinese ($M = 0.45$, $SD = 0.06$), demonstrating that language type significantly influences the overall lexical processing performance.

The main effect of emotional valence was statistically significant ($F(1, 59) = 12707.10$, $p < 0.001$, $\eta_p^2 = 0.995$), demonstrating a highly robust effect. The overall mean accuracy rate for negative emotional words ($M = 0.88$, $SD = 0.07$) was

significantly higher than that for positive emotional words (M = 0.05, SD = 0.03), further confirming the robustness of the negative emotional representation advantage effect. This finding indicates that negative emotional words consistently elicit significantly higher processing accuracy rates across all linguistic contexts.

The interaction between language type and emotional valence was significant ($F(1, 59) = 11.79$, $p = 0.001$, $\eta_p^2 = 0.167$), indicating that the effect of language type on lexical processing varies with emotional valence.

Figure 1 illustrates the interaction between language type and emotional valence on lexical recognition accuracy. To identify the source of this interaction effect, a simple effect analysis was conducted. The results showed that under positive emotional vocabulary conditions, the recognition accuracy difference between Portuguese and Chinese was not significant ($t(59) = -0.13$, $p = 0.896$), indicating no significant difference in processing performance of positive emotional vocabulary between the two languages among African multilingual speakers. However, under negative emotional vocabulary conditions, Portuguese demonstrated significantly higher recognition accuracy than Chinese ($t(59) = -3.81$, $p < 0.001$), suggesting that the processing difference between the two languages was specifically manifested in the processing of negative emotional vocabulary [11].

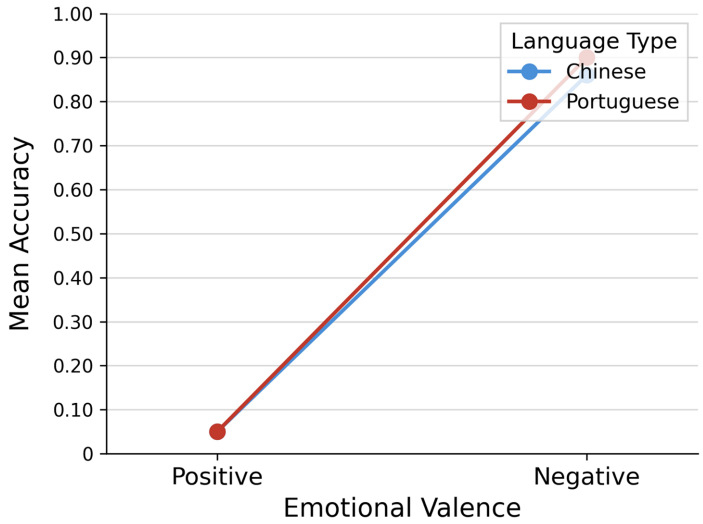

Figure 1. Interaction between language type and emotional polarity.

The results suggest that although the dominance effect of negative emotion representation is stable in both Portuguese and Chinese, there are differences in the depth and efficiency of negative emotion processing between African multilingual speakers in these two languages. The intensity of the negative emotion representation effect is modulated by both the inherent properties of the language and the individual's language proficiency.

5. Discussion

The core finding of this study is that multilingual African speakers show signifi-

cantly higher recognition accuracy for negative emotion vocabulary in both Portuguese and Chinese, presenting a stable negative emotion representation dominance effect. This result validates the cross-linguistic universality of negative bias theory, fully supporting Hypothesis 1. From an evolutionary psychology perspective, negative bias is a universal human adaptive mechanism for rapid threat detection and survival assurance, with inherent cross-cultural and cross-linguistic stability. The effect was observed in both Indo-European Portuguese and Sino-Tibetan Chinese, regardless of language proficiency, expanding the applicability of negative bias theory [12]. The experimental priming paradigm further confirmed the robustness of this effect: positive emotion words showed an extremely low recognition accuracy (0.05), reflecting the absolute processing priority of negative emotional information.

Meanwhile, the negative emotion representation effect presents significant cross-linguistic differences, with a much larger effect size in Portuguese (Cohen's $d = 16.44$) than in Chinese (Cohen's $d = 9.32$). The processing difference between the two languages is specific to negative emotion vocabulary, supporting Hypotheses 2 and 3. Language proficiency is the core moderating factor, aligned with the embodied theory of multilingual emotional processing: participants' highly proficient Portuguese, as their daily mainstream official language, is deeply integrated with rich emotional experiences, while their low-proficiency fourth language Chinese only enables superficial semantic decoding, failing to activate deep emotional representations. Typological differences between inflectional Portuguese and isolating Chinese may also contribute to the effect gap.

This study innovatively fills the research gap on cross-linguistic emotional processing in African multilingual populations, enriches the theoretical framework of multilingual emotional processing, and provides targeted insights for Chinese emotional vocabulary teaching for African students in China. Limitations include single task type, uneven Chinese proficiency distribution of participants, uncontrolled native language influence, and only isolated word processing being examined. Future research can be improved by incorporating multi-dimensional indicators, expanding stratified samples, controlling native language variables, and extending to higher-level linguistic units.

In conclusion, this study confirms the cross-linguistic universality of negative bias in negative emotion processing, and reveals that language proficiency and language typology jointly moderate the negative emotion representation process in multilingual individuals.

6. Conclusions

This study systematically examined the negative emotional representation characteristics in Portuguese and Chinese through an AMP-based lexical decision task, involving 60 African multilingual participants. The core findings are as follows:

1) African multilingual speakers show a significant negative emotional representation advantage effect in both Portuguese and Chinese. Negative priming sig-

nificantly improves the recognition accuracy and processing speed of negative target words, while having no significant effect on positive target words, confirming the cross-linguistic universality of negative bias in negation processing.

2) The negative emotional representation effect shows significant cross-linguistic differences. High-proficiency Portuguese exhibits a significantly stronger negative emotional representation effect than low-proficiency Chinese, and language proficiency (HSK level) significantly moderates the strength of the negation effect in Chinese context.

3) There is a significant three-way interaction among language type, prime polarity and target valence. The cross-linguistic processing difference is specifically manifested in the negation processing stage, with no significant difference in the processing of positive target words between the two languages.

In summary, this study confirms that the core mechanism of negative emotional representation is negation-induced cognitive inhibition and priority allocation of cognitive resources, and language proficiency and language typology jointly modulate the negative emotional representation process in multilingual individuals.

Conflicts of Interest

The authors declare no conflicts of interest.

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