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Reviews

EMBODIED LEXICAL SEMANTICS IN A SECOND LANGUAGE: A NEUROCOGNITIVE REVIEW

A.V. KARLIUKOVA[a], J. ABUTALEBI[b], Y.Y. SHTYROV[c], A.V. MYACHYKOV[d]

[a] *HSE University, 20 Myasnitskaya Str., Moscow, 101000, Russian Federation*
[b] *University Vita-Salute San Raffaele, 58 Via Olgettina, Milano, 20132, Italy*
[c] *Aarhus University, 1 Norde Ringgade, Aarhus, 8000, Denmark*
[d] *University of Macau, N21 Avenida da Universidade, Taipa, 999078, SAR Macau, China*

Воплощенная лексическая семантика во втором языке: обзор нейрокогнитивных данных

А.В. Карлюкова[a], Дж. Абуталеби[b], Ю.Ю. Штыров[c], А.В. Мячиков[d]

[a] *Национальный исследовательский университет «Высшая школа экономики», 101000, Россия, Москва, ул. Мясницкая, д. 20*
[b] *Университет Вита-Салюте Сан Раффаэле, 20132, Италия, Милан, ул. Олжеттина, стр. 58*
[c] *Орхусский университет, 8000, Дания, Орхус, ул. Нордре Ринггаде, д. 1*
[d] *Университет Макао, 999078, Китайская Народная Республика, САР Макао, Тайпа, ул. Авенида да Универсидаде, N21*

Abstract

Sensorimotor embodiment of emotional semantic representations in the second language (L2) has been largely studied through behavioral paradigms. However, most neuroscience research of embodied semantics has almost exclusively focused on the native language (L1). The representational architecture of emotive concepts (e.g., love, hate) in L2 has been explored from the neurocognitive perspective to a lesser degree. In this review,

Резюме

Сенсомоторное воплощение эмоциональных семантических репрезентаций во втором языке широко рассмотрено в рамках поведенческих парадигм. При этом большинство нейронаучных исследований по воплощенной семантике почти всегда посвящены родному языку. С нейрокогнитивной точки зрения структура репрезентаций эмотивных концептов (например, любовь, ненависть) во втором языке исследована в меньшей степени. В данном обзоре мы анализируем эмотивные концепты, выделивших

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we first scrutinize emotive concepts highlighting their main embodied features and differences from other abstract (e.g., transformation, coherence) and concrete (e.g., hat, cat) concepts. We then analyse conceptualization of lexico-semantic representations indicating that L2 proficiency plays out differently in the development of embodied features for L2 emotive lexicon. Second, we examine behavioral research in the emotive concepts' domain both in exclusively L1 and in mono- and bilingual contexts. We then summarize the main neurocognitive evidence in processing emotive semantics in L1. Finally, we review the existing neurocognitive findings regarding embodied processing of emotive concepts in L2. Thus, we discuss evidence from several recent neuroimaging (i.e., fMRI, EEG), and physiological (i.e., EML, eye-tracking) studies using healthy populations. These data provide evidence for the existence of embodied neural representations of emotive concepts in L2. However, these findings also suggest they are embodied differently than L1 words to a degree.

Keywords: emotive concepts, emotive semantics, emotions, affective abstract words, embodiment, grounding, functional magnetic resonance imaging (fMRI), electroencephalography (EEG), electromyography (EML), eye-tracking, skin conductance response (SCR)

Alina V. Karliukova — PhD Student, Research Assistant, HSE University.
Research Area: bilingualism, embodied cognition.
E-mail: av.karlyukova@hse.ru

Jubin Abutalebi — Professor, Specialist in Neurology, University Vita-Salute San Raffaele, PhD.
Research Area: cognitive science, neuropsychology, neurolinguistics.
E-mail: abutalebi.jubin@hsr.it

основные воплощенные черты и отличия от других абстрактных (например, трансформация, связность) и конкретных (например, шляпа, кот) концептов. Затем мы анализируем концептуализацию лексико-семантических репрезентаций, указывая на то, что владение вторым языком по-разному проявляется в развитии воплощенных характеристик эмотивной лексики неродного языка с точки зрения билингвальных моделей лексического доступа. Мы также рассматриваем поведенческие исследования как для родного, так и двуязычного контекстов. Мы также подводим итоги по результатам нейрокогнитивных исследований, посвященным обработке эмотивной семантики в родном языке. Наконец, мы подробно описываем существующие нейрокогнитивные исследования по воплощенной обработке эмотивных концептов в неродном языке, а также приводим данные нейровизуализационных (фМРТ, ЭЭГ) и физиоло¬гических (ЭМЛ, айтрекинг) исследований с участием здоровых участников. Результаты приведенных исследований свидетельствуют о существовании воплощенных нейронных репрезентаций эмотивных концептов во втором языке, указывая также на то, что они воплощены в некоторой степени иначе, чем слова родного языка.

Ключевые слова: эмотивные концепты, эмотивная семантика, эмоции, эмоциональные абстрактные слова, воплощение, укорененность, функциональная магнитно-резонансная томография (фМРТ), электроэнцефалография (ЭЭГ), электромиография (ЭМЛ), айтрекинг, кожно-гальваническая реакция (КГР).

Карлюкова Алина Викторовна — аспирант, стажер-исследователь, Национальный исследовательский университет «Высшая школа экономики».
Сфера научных интересов: билингвальность, воплощенное познание.
E-mail: av.karlyukova@hse.ru

Абуталеби Джубин — профессор, специалист по неврологии, Университет Вита-Салюте Сан Раффаэле (Италия), PhD.
Сфера научных интересов: когнитивные науки, нейропсихология, нейролингвистика.
E-mail: abutalebi.jubin@hsr.it

Yury Y. Shtyrov — Professor, PI, Head of MEG Group MINDLab, Centre for Functionally Integrative Neuroscience (CFIN), Aarhus University, PhD.
Research Area: neurobiology of speech and language.
E-mail: yury@cfin.au.dk

Штыров Юрий Юрьевич — профессор, заведующий лабораторией, Лаборатория магнитоэнцефалографии, электроэнцефалографии и транскраниальной магнитной стимуляции, Центр функционально-интегративной нейронауки, Орхусский университет (Дания), PhD.
Сфера научных интересов: нейробиология речи и языка.
E-mail: yury@cfin.au.dk

Andriy V. Myachykov — Professor, Centre for Cognitive and Brain Sciences, University of Macau, PhD.
Research Area: language, cognition, embodiment, bilingualism, sleep.
E-mail: amyachykov@um.edu.mo

Мячиков Андрей Викторович — профессор, Центр когнитивных наук и исследований мозга, Университет Макао (Макао), PhD.
Сфера научных интересов: язык, сознание, воплощение, билингвальность, сон
E-mail: amyachykov@um.edu.mo

Understanding the nature of lexical semantic representations from an embodied perspective presents several challenges – especially when abstract concepts are concerned (Shapiro & Spaulding, 2024). While concrete concepts (e.g., *hat*) are derived from the physical world, abstract concepts (e.g., *freedom*) refer to the entities without any 'physical or spatial constraints', as they lack direct physical referents (Barsalou, 2008; Dijkstra et al., 2014). In this review, we critically evaluate and summarize existing literature on the topic of embodied features in L2 for a specific class of abstract concepts – emotive concepts, i.e., the words denoting emotional valence and moral judgment (e.g., *love, dishonest*). Similarly to other abstract concepts, emotive concepts do not have direct referents in the physical world. At the same time, their use is commonly associated with changes in the psychophysiological state (e.g., *he's hot with rage*) and sensorimotor experiences (e.g., *flying on the wings of love*). Also, emotive concepts are more *imageable* than other abstract concepts (Connell et al., 2018). Finally, emotive concepts are arguably the most widely studied and most frequently used in behavioral and neurocognitive research on abstract semantics. However, it remains largely unclear how abstract concepts are conceptualized without any associated direct embodied experience. This is further complicated when one considers the composition of a non-native lexicon as one needs to address both the question of L2 mental lexicon *as such* and whether L2 words exhibit embodied representational features similarly to L1, and ultimately, if the embodiment process is influenced by various degrees of bilingual experience such as bilingual proficiency

Several models of bilingual lexicon scrutinize the conceptualization of lexico-semantic representations in L1 and L2. Some of them assume separate lexicons, while others suggest an integrated and parallel activation of words in L1 and L2, with the third type combining the two approaches (e.g., Sense Model; Finkbeiner et al., 2004). The most frequently cited models are Revised Hierarchical Model (RHM) and the Bilingual Interactive Activation Plus (BIA+) model. RHM suggests a separate lexical storage for L1 and L2 with a shared semantic knowledge (Kroll & Stewart, 1994). BIA+ posits an integrated access of lexico-semantic representations in two languages (Dijkstra & van Heuven, 2002). Both models assume

the role for L2 proficiency, but they differ in explaining how an L2 increase in proficiency affects the organization of the L2 lexicon. The BIA+ predicts that embodied features emerge rapidly in newly acquired L2 words via incorporating the sensorimotor features of the L1 lexicon (Ibid.). At the same time, RHM assumes a later and more gradual emergence of the embodied lexico-semantics in the L2 lexicon upon the development of L2 proficiency (Kroll & Stewart, 1994). While both theoretical proposals have some empirical support, only BIA+ predicts the existence of embodied features in lexico-semantic representations in L2. L2 proficiency is linked with immersion and exposure, determining the rapid activation of representations (Dijkstra & van Heuven, 2002; Monaco et al., 2019). Furthermore, while exposure increases proficiency, it may also hinder lexical access in L1 (Monaco et al., 2019). Compared to L2 proficiency, the age of acquisition (AoA) is more influential in syntactic knowledge than semantic processing (Ibid.).

Existing studies and meta-analyses comparing L1 and L2 embodiment of emotive semantics typically cover behavioral paradigms (Dijkstra et al., 2014; Ferré et al., 2015; Borghi et al., 2022) while neuroimaging research of emotive concepts largely focuses on the native language (Desai et al., 2018; Del Maschio et al., 2022). The aim of this review is to bring these two strands together to examine behavioral, neuroimaging (fMRI, EEG), and physiological studies (EML, skin conductance level, eye-tracking) of embodied emotive concepts in bilinguals and investigate potential differences between L1 and L2 embodiment of this class of concepts.

Behavioral Approaches to Emotive Semantics in L1

Numerous behavioral studies investigated the role of emotional experience in processing L1 words. The most frequently studied embodiment phenomenon in L1 semantics is the so-called *valence effect:* faster responses in processing emotional (positive or negative) words compared to concrete or other abstract words (Kissler & Bromberek-Dyzman, 2022; Altarriba & Bauer, 2004; Conca et al., 2021). Another widely cited embodied effect demonstrated for L1 emotional words is their *spatial-conceptual mapping* (SCM), often found for other words as well (Pitt & Casasanto, 2022). Several studies documented a two-dimensional SCM space in which positive emotive concepts (e.g., *happiness*) and evaluative judgements (morality related, e.g., *respect*) are associated with the upper part of physical space, while negative emotional words and evaluative concepts – with the lower part (Schütt et al., 2023). At the same time, positive emotional words are also associated with the right, while negative emotional stimuli – with the left space (Pitt & Casasanto, 2022). These effects are explained by an automatic activation of sensorimotor representations during emotional word comprehension. This connection allows to observe the degree to which emotive concepts automatically cue spatio-motor representation (Ibid.).

In sum, findings in behavioral studies for L1 provide evidence for faster processing of emotive concepts compared to other abstract word types. The valence and spatial-conceptual mapping effects are associated with expedited responses in congruent conditions (e.g., positive words placed in the upward position or processed with the right key) compared to incongruent ones (e.g., positive words placed in

the downward position or processed with the left key). Also, both effects are associated with positivity bias: positive concepts are processed faster than negative ones.

Neurocognitive Approach to Emotive Semantics in L1

Neuroimaging studies (fMRI, EEG), in turn, focus on neural correlates of emotive concepts. Several fMRI studies have indicated the involvement of a widely distributed brain network during the processing of emotional stimuli, including left and right orbitofrontal gyrus, bilateral inferior frontal gyrus (Herbert et al., 2009), the precentral cortex, anterior temporal cortices, mid-posterior superior and middle temporal gyrus, and temporal pole (Conca et al., 2021), left and right amygdala, left extrastriate visual cortex and the right cingulate cortex (Cato et al., 2004; Citron, 2012). Processing of evaluative concepts and moral decision-making was shown to rely on the ventrolateral prefrontal cortex, anterior cingulate, and medial prefrontal cortex (Conca et al., 2021; Kober et al., 2008; Etkin et al., 2011). EEG evidence showed that the valence effect is associated with the EPN (Early Posterior Negativity, with higher amplitudes in response to emotional stimuli around ~250 ms) and enhanced LPP/LPC (Late Positive Potential/Component, peaking around ~700 ms), which is also modulated in evaluative tasks (Kissler et al., 2007; Kissler et al., 2009; Scott et al., 2009; Herbert et al., 2006). These effects being produced by both positive and negative words (LPC, peaking around ~400 ms, LPP, peaking between 500-800 ms, EPN, around 200-400 ms) compared to neutral ones (Hinojosa et al., 2009; Citron, 2012; Schacht & Sommer, 2009; Bayer et al., 2010). Furthermore, a number of psychophysiological studies have scrutinized changes in peripheral bodily reactions during stimulus processing. These studies report changes in facial expressions (the activation of zygomatic and corrugator muscles) and increased skin conductance responses in reaction to emotive semantics in L1 (Hoemann & Feldman Barrett, 2019). For instance, reading positive words is accompanied by an activation of zygomatic muscle responsible for smiling, while reading negative emotional words is accompanied by an activation of the corrugator muscle associated with frowning (Ibid.).

To sum up, neurocognitive studies demonstrate involvement of distributed cortical regions and the limbic system (e.g., amygdala) in processing emotive semantics in L1. Evaluative (morality related) concepts appear to involve (pre)frontal networks associated with social cognition. Also, EEG studies find a range of both early and late ERP modulations for emotive vs. neutral semantics in L1. Finally, psychophysiological studies suggest changes in SCRs, facial mimicry and muscle activity in response to emotive semantics in L1.

Behavioral Approach to Emotive Semantics in L2

Unlike L1, the research on associations between emotive semantics and spatial representations in L2 is very scarce. The limited evidence available showed faster responses for positive emotional words in the upward position and for negative emotional words in the downward position for both languages, with a similar activation

of motor responses in L1 and L2, suggesting that *emotive features in L1 and L2 are embodied alike* (Dudschig et al., 2014). However, some behavioral studies have demonstrated a *differential embodiment pattern* alongside the *emotional reduction effect* in bilinguals: 'feeling less emotion' in L2 as well as a preference to express oneself emotionally in L1 rather than L2 (Dewaele, 2004; Degner et al., 2012; Pavlenko, 2017; Toivo & Scheepers, 2019). Other evidence indicates no L1 advantage (such as processing speed and accuracy effects) over L2 in processing emotive concepts (Kazanas & Altarriba, 2016; Ponari et al., 2015; El-Dakhs & Altarriba, 2019). Several studies have suggested that such discrepancies may be explained by L2 proficiency, the age of L2 acquisition, language use and other bilingual characteristics. Specifically, lower exposure and L2 proficiency predict attenuated emotional force in L2 (Dewaele, 2004) and indicate less automatized processing of emotion words in L2 (Degner et al., 2012).

Regarding *evaluative concepts* in L2, several reports have provided evidence for reduced response in L2 associated with the so-called *moral foreign language effect* (FLE) – modified emotional reactions or moral judgements when using L1 as opposed to L2, explained in either deontological ("do no harm") or utilitarian ("maximizing positive outcome when sacrificing") approaches (Stankovic et al., 2022). For instance, bilinguals show higher preference for utilitarian choices in their L2 than in L1 when solving the well-known trolley dilemma, more often choosing to pull the lever so that the trolley changes tracks and kills one person instead of allowing it to stay on its track, leading to multiple deaths (Ibid.). Other studies, however, show no such utilitarian FLE in bilinguals (Čavar & Tytus, 2018; Dylman & Champoux-Larsson, 2020) or provide inconsistent results (Chan et al., 2016; Muda et al., 2018). It has also been shown that such moral choices are moderated by L2 proficiency (Costa et al., 2014), age of L2 acquisition (Stankovic et al., 2022), linguistic distance, and other bilingualism-specific parameters (Liu et al., 2022; Circi et al., 2021).

Overall, behavioral studies indicate differences in processing emotive semantics in L1 vs. L2. These are largely manifested as foreign language and reduced emotionality effects, which are modulated by various bilingual factors including proficiency, language use, exposure, etc. However, existing research still provides insufficient and contradictory evidence. Therefore, it is important to explore embodied emotional semantics in L2 from a neurocognitive perspective.

Neurocognitive Approach to Emotive Semantics in L2

Below, we review selected articles that discuss the embodiment of L2 emotional word representations using neuroscience methods. (See Appendix [1] for the list of articles and selection criteria in Supplementary on https://psyjournal.hse.ru/data/2025/05/29/2000514597/Supplementary_materials.pdf).

EEG and fMRI Studies

Existing neuroimaging studies in this field show somewhat contradicting results. Conrad et al. (2011) used two groups of late bilinguals (German-Spanish

and Spanish-German) and a visual lexical decision task with words translated into their L2. The stimuli consisted of positive, negative, and neutral words. Although the latencies for EPN and LPC components were different for L1 and L2, ERP waves showed the effects for positive and negative emotional words irrespective of the stimulus language, providing evidence for a similar pattern in both languages. Similarly, in a study by Opitz and Degner (2012), participants performed a lexical monitoring task with emotional nouns in L1 and L2 (German/French). An enhanced EPN to emotionally valenced vs. neutral words was found. Delayed lexical access in L2 was accompanied by similarly delayed EPN to L2 words, without any other processing differences between the languages.

Further, Kissler and Bromberek-Dyzman (2021) examined mood modulations during processing positive and negative words in L1 German vs. L2 English. Results showed similar EPNs patterns in both languages. However, differential lateralization of the N1 component was discovered: more left-lateralized for L1 and right-lateralized for L2 stimuli. Furthermore, more negative N400 amplitudes in L2 vs. L1 were found indicating more effortful lexical search and/or retrieval of word meanings in L2 than L1.

In Herbert (2023), participants performed a rapid serial visual presentation (RSVP) task in German L1 and English L2. Results revealed processing differences between L1 and L2. In both languages, positive words elicited a larger N100 modulation than negative or neutral words. Interestingly, while larger EPN amplitudes for emotional words in L2 vs. L1 were found, the authors did not attribute this EPN effect to a dissimilar embodiment of L1 and L2.

Wu and Thierry (2012) examined effects of affective valence on lexical access in a translation-priming task with L1-Chinese and L2-English bilinguals as well as Chinese and English monolinguals. Affective processing was characterized by reduced automaticity in L2 compared to L1 likely due to a delayed lexical access (cf. Opitz & Degner, 2012, above). The results also showed the valence effect, which might indicate dissimilar embodiment of L1 and L2. In Chen et al. (2016), participants performed a lexical decision task in L1 and L2 (Chinese/English). The results suggested faster processing of emotional words and a larger degree of accuracy in L1 vs. L2. Furthermore, positive words elicited a larger EPN and a smaller LPC in L1, indicative of a different degree of emotive processing. Overall, the reported faster processing of positive vs. neutral words in L1 compared to L2 suggests less prominent embodied features for L2 compared to L1.

Further, in a recent EEG study (Jończyk et al., 2016), Polish–English bilinguals read sentences in L1 or L2 and decided whether their final words — positive, negative or neutral adjectives — made sense or not. Enhanced N400 associated with easier semantic integration for negative vs. positive stimuli was found for L1 as opposed to L2, pointing to differential levels of lexico-semantic integration. Interestingly, reduced LPC (associated with semantic reassessment and reallocation of attention to emotional stimuli) was found for negative sentences in L1 vs. L2, which might indicate suppressed semantic access for negative emotional words in L2, confirming differential affective processing of negative words in the bilingual's two languages.

Finally, in a study by Gao et al. (2023) combining ERPs and psychophysiological measurements of heart rate, pulse changes and skin conductance, participants performed a moral judgment task on morality and immorality related concepts (e.g.,

honesty, murder) in L1 and L2 (Chinese/English). Enhanced early frontal N400 effect was similarly found by Jończyk et al. (2016). However, L2 findings revealed a decreased N400 effect. These results, according to the authors, suggest a more pronounced embodiment of evaluative concepts in L1, with less embodied representations in L2.

Chen et al. (2016) used fMRI to explore the activation of different areas for L1 Chinese and L2 English in response to emotional words. The results supported differential embodiment of L2 vs. L1: a greater activation of the visual cortex for the L1 emotional content which was not found in L2. Additionally, the left cerebellum demonstrated a more pronounced activation for positive emotional words than for neutral ones in L2, with the opposite pattern of the neural activation found for L1, suggesting the left cerebellum's differential involvement in the valence effect for the two languages.

Overall, the reviewed studies provide rather inconclusive results. Some of them suggest the valence effect to indicate a generally reduced degree of embodiment for emotional language in L2, which is in line with L1 behavioral studies mentioned earlier. Supporting this, reduced emotionality is manifested in several ERP modulations including EPN, N1, N400, LPC, N200 (Wu & Thierry, 2012; Jończyk et al., 2016; Chen et al., 2016; Gao et al., 2023; Herbert, 2023). Others, however, either indicate similar processing patterns for emotive semantics in both languages (Conrad et al., 2011; Opitz & Degner, 2012), or do not find decisive evidence in favor of either of the two perspectives (Kissler & Bromberek-Dyzman, 2021).

EML and Eye-Tracking Studies

Psychophysiological studies in L2 usually focus on *reduced emotional resonance* arguing that dissimilar emotionality (as compared to L1) might be a sign of differential L2 embodiment. Harris et al. (2003) reported a study with L1 Turkish and L2 English bilinguals who read aversive, taboo words, reprimands, positive, and neutral words, while their skin conductance responses (SCRs) were measured. Greater responses in L1 than L2 were found to taboo words and childhood reprimands, suggesting stronger embodiment of emotive semantics in the native language. In a follow-up study by Harris (2004), participants rated identical stimuli in terms of emotional intensity in Spanish (L1) and English (L2), while their electrodermal activity was recorded. This time, the results revealed that taboo words elicited similar SCRs in L1 and L2, contradicting the finding above. Differences in phasic amplitudes of the SCR for emotional vs. neutral stimuli were still found in L2, but only for later learners. As suggested by Harris et al. (2006), differences between these two studies can be attributed to AoA, proficiency, L2 exposure, and immersion, associated with the age of arrival in the L2 country. Spanish-English bilinguals were much better immersed and earlier exposed to L2 compared with Turkish-English bilinguals who arrived later and acquired their L2 in a classroom setting. Further evidence for greater embodiment of emotional L1 semantics was obtained in a study by Caldwell-Harris and Ayçiçeği-Dinn (2009) who used a similar paradigm with Turkish-English bilinguals and found larger SCRs in L1 compared with L2.

Iacozza et al. (2017) measured pupillary responses while reading emotional sentences in L1 Spanish and L2 English. Participants were instructed to complete sentences

with emotional *adjective+noun* phrases. Results demonstrated smaller pupil dilations for sentences in L2 as opposed to L1, indicating reduced emotionality/emotional processing in L2. Also, the evidence linking reduced emotional resonance to a modulated embodiment in L2 was found by Toivo and Scheepers (2019). Two groups of bilingual participants, German-English (L1/L2) and Finnish-English (L1/L2), performed a word judgment task. Emotional words and fillers in all language pairs were presented to participants, while their pupils' dilation in response to high and low arousing words was measured. Overall, significant differences between L1 and L2 were found in pupil dilation to high arousal words, suggesting a more prominent effect in L1 embodiment.

In Eilola and Havelka (2011), two groups of native English speakers and Greek-English bilinguals completed two sessions of a Stroop task with emotional words. Different skin conductance levels (SCLs) to negative and taboo words in English were found, with native English speakers showing higher SCLs to negative stimuli and taboo words than non-native speakers, which indicates relative differences in the representations of L1 and L2. Foroni (2015) also demonstrated a weaker degree of L2 embodiment by measuring re-enactment of motor simulations (the activation of the zygomatic muscle in response to positive stimuli) during sentence processing. Participants performed a spatial-classification task with emotional images and simple sentences in Dutch (L1) and English (L2) including verbs denoting emotional reactions (e.g., *I am smiling,* etc.). L1 demonstrated a larger activation of the zygomatic major muscle to affirmative sentences and a more inhibition to negative sentences compared to L2 at five time intervals (200 ms, 400 ms, 600 ms, 800 ms, 1000 ms). It was found that emotional processing of L2 relies only on partial simulations in meaning compared to L1, with the activation of zygomatic muscle being smaller in L2.

In Sheikh and Titone (2016), speakers of French L1 and English L2 read emotional words in their L2, while their eye movements were recorded. The study found evidence for faster processing positive vs. neutral words in L2. However, the same pattern for reading negative vs. neutral words was present only for highly proficient bilinguals, which suggests emotional disembodiment of negative words in L2. Baumeister et al. (2017) examined the reduced emotionality effect using two tasks on classification and memory recognition with English (L1) and Spanish (L2) words associated with happiness and anger, while the mimetic activation of zygomatic and corrugator (associated with responses to negative stimuli) muscles and skin conductance were recorded. Zygomatic activity did not demonstrate significant L1-L2 differences. However, a stronger corrugator muscle activity in L1 was observed in response to stimuli associated with anger and happiness compared to L2, suggesting reduced the mimetic activation to emotional stimuli in L2.

Finally, in Huang and Nicoladis (2020), a mixed sample of French-English and English-French Canadian bilinguals read and listened to the stimuli from Harris et al.'s, 2003 study above while their galvanic skin responses (GSRs) were measured. Results demonstrated higher GSRs to taboo words than other word types in both languages, with no differences in emotional processing of L1 and L2. Interestingly, participants with later AoA showed higher GSRs than early bilinguals. Given the highly bilingual environment in Canada, the participants might have been very familiar with L2 (English) taboo words, reducing the differences between languages.

To conclude, psychophysiological findings are not fully in line with the behavioral and neuroimaging evidence reviewed above. Moreover, only few of them (Harris et al., 2003; Caldwell-Harris & Ayçiçeği-Dinn, 2009; Iacozza et al., 2017; Toivo & Scheepers, 2019) indicate pronounced differences in embodiment patterns for L1 and L2 emotive concepts, with some even suggesting "disembodied" emotional semantics in L2 (Huang & Nicoladis, 2020). Other studies show relatively similar embodied features for emotive semantics in bilinguals (Eilola & Havelka, 2011; Foroni, 2015; Sheikh & Titone, 2016; Baumeister et al., 2017). Importantly, this research emphasizes the role of immersion and exposure (Eilola & Havelka, 2011; Huang & Nicoladis, 2020), AoA (Harris et al., 2003; Harris et al., 2006; Harris, 2004), and other factors in affective processing in L1 and L2.

Discussion

The available evidence regarding the degree of embodiment of emotional concepts in L1 and L2 remains sparse. Nevertheless, the studies reviewed here comprise a variety of tasks including lexical decision, lexical monitoring, translation-priming, moral judgment, Emotional Phrases Task, emotional rating, reading, rapid serial visual presentation, classification, memory recognition, spatial classification, Stroop task, evaluative decision, word recognition. A stable pattern for differential embodiment of emotive semantics is demonstrated only in a few studies, while the others indicate either less embodied L2 or relative processing similarities for emotional L1 and L2. This discrepancy holds true for both psychophysiological and neuroimaging studies.

These inconsistent results can be attributed not only to the differences in the tasks and techniques applied in different studies, but also (or even more so) to variability in the bilingual samples they recruited, which may vary greatly in their L2 experience, characterized by different ages of L2 acquisition, early or late immersion to the L2 settings, exposure to either naturalistic (e.g., family, friends, etc.) or non-naturalistic (e.g., classroom) settings, etc. Some learnt L2 in a classroom with no immersion, others had high levels of L2 immersion and exposure, which may explain different degrees of attenuation of affective processing between the two languages (Conrad et al., 2011; Opitz & Degner, 2012). The existing data appear to suggest immersion as a more important modulating factor, whereas AoA, exposure and L2 proficiency may per se not play a decisive role in the degree of processing differences between emotive semantics in L1 and L2 (Harris et al., 2003; Harris et al., 2006; Harris, 2004; Eilola et al., 2007; Huang & Nicoladis, 2020).

Additionally, existing research suggests that the pattern of advantaged emotional L1 processing may derive from a stronger automatic attention capture, which is not the case with L2 (Kissler et al., 2007; Kissler et al., 2009; Schacht & Sommer, 2009; Chen et al., 2016). The attenuated effect in processing L2 emotional concepts may originate from emotional resonance reduction associated with a psychological distance when processing L2 (Harris, 2004; Dewaele, 2004; Caldwell-Harris & Ayçiçeği-Dinnf, 2009; Opitz & Degner, 2012; Pavlenko, 2017; Chen et al., 2016; Toivo & Scheepers, 2019). Overall, available data support the idea of quantitative but not qualitative differences in the nature of lexico-semantic representations in

L1 and L2. This may speak in favor of the BIA+ approach, indicating variable embodied traces in L2 lexico-semantic representations (Dijkstra & van Heuven, 2002).

To examine the discrepancies between existing psychophysiological and neuroimaging reports in the field, it will be crucial for future studies to employ larger samples with diverse languages and scrutinize a more comprehensive range of bilingual characteristics such as L2 proficiency, AoA, immersion, exposure, linguistic distance between the individual's languages, etc., as well as take into account other variables, such as age, education, socioeconomic status, general cognitive abilities, emotional intelligence, presence/absence of affective disorders, etc. By taking into consideration the richness of individual bilingual experiences, such comprehensive studies will ultimately lead to a better understanding of processing emotive semantics in bi- and multi-lingual contexts.

Conclusion

Existing theories of L2 conceptual representations and available empirical evidence diverge with regard to the embodied nature of bilingual lexicon, leaving open the question of whether emotive concepts are processed differently in L2 as opposed to L1. Future research is needed that should employ more comprehensive methodologies as well as scrutinize individual linguistic, cognitive and social differences, including individual patterns and trajectories of bilingual experience.

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