Russian Journal of Linguistics
ISSN 2687-0088 (print), ISSN 2686-8024 (online)

2023 Vol. 27 No. 2 316–333
http://journals.rudn.ru/linguistics

https://doi.org/10.22363/2687-0088-30464
EDN: LWOAOJ

Research article / Научная статья

Lateralization of emotion word in the first and second language: Evidence from Turkish-English bilinguals

Filiz MERGEN[1] ✉ **and Gulmira KURUOGLU**[2]

[1]*Izmir University of Economics, Izmir, Turkey*
[2]*Dokuz Eylul University, Izmir, Turkey*
✉filiz.mergen@ieu.edu.tr

Abstract
As interest in cognitive sciences has grown over the years, language representation in the brain has increasingly become the subject of psycholinguistic studies. In contrast to the relatively clear picture in monolingual language processing, there is still much controversy over bilinguals' processing of their two languages. The goal of this paper is therefore to provide more evidence on the way emotion words are processed and represented in the brain in late bilinguals. The study seeks to answer three questions: 1. Are positive words processed faster than negative and neutral words in both languages of bilinguals? 2. Is there a difference in the speed in which emotion words are processed in the first (L1) and second language (L2) of bilinguals? 3. How are emotion words represented in the bilingual brain? Participants were late Turkish-English bilinguals (N = 57). We used a visual hemi-field paradigm, in which the stimuli were presented either on the right or left of a computer screen. By pressing the designated keys, the participants performed a lexical decision task in which they determined whether the visually presented L1 and L2 words were real words or non-words. The first result showed that positive words are processed faster than negative and neutral words in both languages of bilinguals, providing further support for the differential processing of emotion words. Second, longer response times were found for L2 as compared to L1. Finally, we found bilateral hemispheric representation for both English and Turkish. These results contribute to the psycholinguistic literature by providing evidence from the relatively understudied language pairs such as English and Turkish.
Keywords: *late bilinguals, emotion words, lateralization, psycholinguistics, English, Turkish*

For citation:
Mergen, Filiz & Gulmira Kuruoglu. 2023. Lateralization of emotion word in the first and second language: Evidence from Turkish-English bilinguals. *Russian Journal of Linguistics* 27 (2). 316–333. https://doi.org/10.22363/2687-0088-30464

Латерализация эмоционально окрашенных слов в родном и иностранном языках (на материале исследования турецко-английских билингвов)

Филиз МЕРГЕН[1] ✉, Гюльмира САДИЕВА-КУРУОГЛУ[2]

[1] *Измирский университет экономики, Измир, Турция*
[2] *Университет Докуз Эйлюль, Измир, Турция*
✉filiz.mergen@ieu.edu.tr

Аннотация
По мере роста интереса к когнитивным исследованиям психолингвисты все чаще обращаются к проблеме репрезентации языка в мозгу человека. Если картина обработки естественного языка монолингвами более-менее ясна, ситуация с билингвами остается дискуссионной. В связи с этим цель статьи – расширить знания о том, каким образом происходит обработка и репрезентация эмоционально окрашенных слов в мозгу поздних билингвов. В процессе исследования предполагается дать ответы на следующие вопросы: 1. Обрабатываются ли позитивно окрашенные слова быстрее, чем негативные и нейтральные, в обоих языках, которыми владеет билингв? 2. Есть ли разница в скорости обработки эмоционально окрашенных слов в родном и иностранном языках? 3. Как эмоционально окрашенные слова репрезентированы в мозгу билингва? В качестве участников выступали поздние турецко-английские билингвы (N = 57). Мы использовали визуальную парадигму полуполя, в которой стимулы предъявлялись в правой или левой половине экрана компьютера. Нажимая нужную клавишу, участник выполнял лексическое задание, а именно решал, являются ли визуально предъявляемые слова на родном и иностранном языках действительно словами. Было получено три основных результата. Во-первых, было доказано, что положительно окрашенные слова обрабатываются быстрее, чем отрицательные и нейтральные, как в родном, так и в иностранном языке, что подтверждает идею о дифференциации эмоционально окрашенных слов. Во-вторых, время ответа на иностранном языке оказалось больше, чем в родном. И, наконец, мы обнаружили репрезентацию как английского, так и турецкого языка в обоих полушариях. Полученные результаты вносят вклад в психолингвистику, предоставляя данные о малоизученной паре языков – английский и турецкий.
Ключевые слова: *поздние билингвы, эмоционально окрашенные слова, латерализация, психолингвистика, английский язык, турецкий язык*

Для цитирования:
Mergen F., Kuruoglu G. Lateralization of emotion word in the first and second language: Evidence from Turkish-English bilinguals. *Russian Journal of Linguistics.* 2023. V. 27. № 2. P. 316–333. https://doi.org/10.22363/2687-0088-30464

1. Introduction

Bilingualism is a multi-faceted phenomenon influenced by numerous interacting factors, the most controversial being age of acquisition (AoA). Apart from the controversy over the AoA cutoff (Paradis 2004: 59, Hull & Vaid 2007), it is well-established that there are noticeable differences between the two languages in terms of various criteria including speed and accuracy of processing (Lehtonen et al 2012), grammatical competence (Meir et al. 2021), emotional load (Dewaele 2004, Pavlenko 2004), or hemispheric organization (Hull & Vaid 2005, 2007).

However, it has also been maintained that differences in performance between the native and the later learned languages will narrow over time, but the extent of this depends on the learning context, proficiency level or length and amount of exposure (Grabitz et al. 2016, Kazanas & Altarriba 2016, Ong et al. 2017).

With the emergence of psycholinguistics at the interface of psychology and linguistics, new areas of academic interest emerged. One of these was the storage of words in the mental lexicon, and how these were made available during language production and comprehension. Accordingly, as bilingualism became a more common phenomena, bilinguals' word processing became a topic of interest in the bilingual literature. For example, De Groot (1992) attempted to explain the structure of the bilingual lexicon in The Distributed Features Model. In another pioneering study, Kroll and Stewart (1994) suggested The Hierarchical Model, which explains word production in bilinguals. Dijkstra and van Heuven (2002) introduced The Bilingual Interactive Activation (BIA) model, and later revised it as BIA+. These models were tested via a variety of methods in experimental studies. A well-established finding obtained from these studies is that bilinguals are slower in word retrieval as compared to monolinguals due to the larger mental lexicon. This has been associated with greater cognitive workload when choosing among many alternatives (Gollan et al. 2008, Lehtonen et al. 2012). According to the *Bilingual Interactive Activation Model* (Dijkstra & van Heuven 2002), this discrepancy results from frequency of use of each language, which determines the extent of facilitation or inhibition. This model has been supported by experimental studies. In Gollan et al. (2008) study, faster response times were reported for the frequently used language. Similarly, Lehtonen et al. (2012) argued that frequency effects are more pronounced in bilinguals than in monolinguals. Also, de Bruin, Sala and Bak (2016) compared two groups of bilinguals and found that frequency of language use was associated with faster processing times.

The goal of this study is to investigate how emotion words are processed and represented in the brain in late bilinguals. The three research questions in the study are as follows: 1. Do positive words have a processing advantage over negative and neutral words in the second language, in addition to the first language of Turkish-English bilinguals? 2. Do processing times for emotion words differ in the late learned language of bilinguals as compared to their L1? 3. Building on the previous laterality literature, do late bilinguals have a balanced hemispheric representation for word processing? In the current study, we first review the psycholinguistic literature on processing and representation of emotion words. We focus on the emotion phenomena and its relevance to human survival, and give examples from both the monolingual and the bilingual literature. We then consider the studies that focused on the brain correlates of emotions, and discuss various hypotheses put forth to explain the location of emotions in the brain. Finally, we discuss bilinguals' two languages in terms of brain organization and emotional content.

2. Literature review

2.1. Emotion word processing

The increase in the interest in emotions and bilingualism led to the study of emotion word processing in bilinguals. It is known that emotions are critical to our survival; positive emotions foster happiness and well-being, while negative emotions are associated with threat. As established in the monolingual word processing literature, emotion words have a processing advantage over neutral words, but the nature of this advantage is disputed. One line of research maintains that emotion words, regardless of positive or negative valence, have a processing advantage over neutral words (Kousta et al. 2009). A different line of research, on the other hand, proposes faster processing for positive words as compared to negative words, which may involve a threat, and thus entail a more detailed analysis, increasing cognitive workload and processing time (Estes & Adelman 2008). Despite the diverging findings, however, there is a great deal of evidence that emotion words enjoy a processing advantage over neutral words. Extensive investigations of differential processing of emotion words in both languages of bilinguals have obtained similar results. For example, Sianipar, Middelburg and Dijkstra's (2015) longitudinal study with German-Dutch bilinguals found results supporting the privileged status of positive words in the participants' second language. Mergen and Kuruoglu (2017), employed a lexical decision task in a visual hemi-field paradigm, and reported that simultaneous bilinguals processed positive words faster than negative and neutral words in both languages. In another lexical decision task study, Ferre, Anglada-Tort and Guash (2018) reported faster response times for positive, but not for negative words for highly proficient bilinguals.

In the bilingual literature, emotion word processing has also been examined within the context of emotional resonance of the two languages. Considering the neural network underlying emotional processing matures early in infancy, a great deal of research has been devoted to the degree of emotionality in each of bilinguals' languages, particularly when one is acquired at different times and contexts. The literature abounds with evidence that the first learned language is more emotional than the later-learned second language, especially when the latter is learned in formal settings. For example, based on the results of an extensive online questionnaire, Dewaele (2004) argued that the first learned language, being more emotionally resonant, is preferred in the expression of emotion. Similarly, Winskel (2013) reported that late bilinguals did not show responses in their second language to the same extent as in their first language. Support for these results come from studies in which automatic physiological responses are recorded. For example, Toivo and Scheepers (2019) reported stronger physiological responses in the participants' first language as compared to the late-learned second language. More recent research, on the other hand, examines whether the differential processing of emotional content in the late-learned language arises from the lexical processing strategies employed by bilinguals, or reduced emotionality per se. Therefore, reduced emotional feeling in the late-learned language can be attributed to the cognitive effort incurred by the processing strategies of two languages. For example, studies that employed cognitive paradigms failed to find reduced emotionality, which can be taken as support for this view (Kazanas & Altarriba 2016).

2.2. Brain representations of emotion words

Manifold work has also discussed the interrelation between emotions, language and hemispheric organization. A variety of hypotheses have been put forward to explain hemispheric organization of emotion words in monolinguals, such as *Valence Hypothesis,* which maintains that positive emotion words are processed in the left hemisphere, and negative words, in the right (Martin & Altarriba 2017). According to the *Right Hemisphere Hypothesis*, emotional stimuli is predominantly processed in the right hemisphere (Sato & Aoki 2006). *Approach and Withdrawal Hypothesis* (Davidson 2003), on the other hand, holds that approach-inducing emotions, such as anger, are processed in the left hemisphere, and emotions associated with withdrawal (i.e. fear and disgust), in the right. In the bilingual literature, although the extent of emotionality in the two languages of bilinguals and potential differences in the brain correlates of emotionality in each language of bilinguals have been extensively investigated, the relatively fewer studies conducted on the hemispheric representation of emotionality in the two languages have produced conflicting evidence. In a visual hemi-field study, Jonczyk (2015) highlighted the role of the right hemisphere for processing negative words in the late-learned language of bilinguals. In a brain imaging study, Chen et al. (2015) found greater activation in the left hemisphere for L2 than for L1 emotion words, and associated this result with the greater need for cognitive and attentional resources entailed by L2. In simultaneous bilinguals, on the other hand, bilateral representation of both languages has been reported (Kuruoglu & Mergen 2016, Mergen & Kuruoglu 2021).

The number of bilingual studies on hemispheric organization of emotion words are relatively reduced. In the same vein, language pairs and scripts studied in the literature are restricted to either those descended from different branches of Indo-European languages, such as English, French and Spanish, or from languages with different writing systems such as logographic (Chinese), cyrillic (Russian) and arabic (Arabic) (Chen et al. 2015, Pavlenko 2004, El-Dakhs & Altarriba 2019). There is therefore an underrepresentation of the brain bases of emotion word processing in Turkish, which is an Altaic language written in Latin script. This study aims to fill the literature gap as regards emotion word processing in Turkish-English late bilinguals.

3. Data and methodology

3.1. Participants

Fifty-seven Turkish-English bilinguals (22 males, 35 females) took part in the study. In order to determine the adequacy of the sample size, a power analysis was applied by using PANGEA (Power ANalysis for GEneral Anova designs, v0.2; Westfall 2016). The analysis showed that, with a medium effect size (d = .60), the current experimental design provides a power > .99 with 57 participants. All were native speakers of Turkish who learned their L2 (English) between 9-11 years in formal settings. They completed a questionnaire on their age and context of L2 learning, amount of exposure to L2, their handedness, and health problems, if any. They had similar proficiency levels, having completed a one-year preparatory language program and taken a proficiency test at B1 level. Also, they were asked to self-report on their L2 proficiency via a questionnaire adapted from *Common European Framework for Languages*, which yielded no significant difference among L2 proficiency levels (all *p*'s > .05). Also, all were translation trainees at the same university in Izmir, Turkey. They reported Turkish as their first and dominant language, and were right-handed as assessed by *Edinburgh Handedness Inventory* (Oldfield 1971). All participated voluntarily, with no course credit or participation fee. The University Ethical Committee gave its approval for the study.

Table 1. **Demographic information and language background**

	Mean
Age	18.93
Age of L2 Acquisition	9.95
Self-reported proficiency	
Listening	3.49
Speaking	3.71
Reading	4.60
Writing	4.03

3.2. Stimuli

The stimuli were taken from a previous study on emotion word processing in simultaneous bilinguals (Mergen & Kuruoglu 2017). We used two sets of words. For the Turkish word set, we formed a pool of 300 words selected from *Yazılı Türkçe'nin Kelime Sözlüğü* (Göz 2003). From this pool, based on the ratings of 100 native speakers of Turkish, three sets of words were formed, consisting of 10 positive, 10 negative and 10 neutral words respectively. The assessment criteria used by the raters were valence and frequency of words. An ANOVA was performed on the data and the results revealed significant difference in valence, $F(2,27) = 98.01$, $p < .001$, $\eta^2 = .879$, but not in frequency, $F(2,27) = 0.83$, $p > .05$, $\eta^2 = .058$. Thirty non-words were formed by changing one or two letters of real words, all of which were phonologically and orthographically legal in Turkish. All word and non-word stimuli had either two or three syllables.

Table 2. **Comparison of valence and frequency of the Turkish words**

Words	N	Valence		Frequency	
		Mean	Standard Deviation	Mean	Standard Deviation
positive	10	3.60	0.24	3.21	0.36
negative	10	2.19	0.30	3.22	0.37
neutral	10	2.92	.05	3.06	0.21
p		.000*		.449	

A similar procedure was followed in forming the English word stimuli. 300 words were selected from *Affective Norms for English Words* (Bradley & Lang *1999*). After 30 native speakers of English rated the words according to their valence and frequency, a total of 10 positive, 10 negative and 10 neutral words were selected as stimuli. An ANOVA showed a significant difference according to valence, $F(2,27) = 1183.11$, $p = .000$, $\eta^2 = .989$, but not according to frequency, $F(2,27) = 0.46$, $p = .638$, $\eta^2 = .033$. Thirty non-words were created by changing one or two letters of real words, so that they complied with the phonotactics and orthography of English. All word and non-word stimuli had either two or three syllables.

Table 3. **Comparison of valence and frequency of the English words**

Words	N	Valence		Frequency	
		Mean	Standard Deviation	Mean	Standard Deviation
positive	10	4.12	0.09	3.05	0.47
negative	10	1.44	0.12	3.20	0.41
neutral	10	3.11	0.15	3.05	0.34
p		.000*		.638	

A paired samples *t*-test was conducted to see whether the stimuli in each language differed in frequency and valence. No significant difference was found. (Frequency: $t(2) = 1.31$, $p = .321$, $r = .55$, Valence: $t(2) = .04$, $p = .969$, $r = .99$).

3.3. Procedure

The current study aims to investigate the hemispheric organization of word processing in bilinguals and how emotional content modulates this process. To this end, we employed a visual hemi-field paradigm, which is frequently used as a reliable and valid measurement to reveal lateralization patterns in the psycholinguistic literature (Hausmann et al. 2019). To explore word processing, we used a lexical decision task. The letter strings were presented randomly either from the right or left visual field of the participants, and they were asked to decide whether the visually presented letter strings were real words or non-words.

The experiment was conducted in a quiet, dimly-lit room, with one participant at a time. Before the experiment, participants were given a practice trial so that they would be familiar with the procedure, and the results were not included in the analysis. They were seated in front of a 15.6-inch laptop computer at a distance of

40 cm, using a chin rest to prevent head movements, and were told to fixate on the central cross on the screen. Using the right hand, they pressed the designated keys ("1" for "real word", "2" for "non-word") on the keyboard to indicate whether they considered the letter strings to be real words or non-words, and were encouraged to be as fast and accurate as possible. Their response times and the accuracy of their answers were recorded via SuperLab 4.0 software and the SPSS 18.0 was performed to analyse the data.

After a bell sound, a cross appeared and remained in the middle of the screen for 1000 ms. Next, the stimuli were presented, in random order, vertically for 200 ms on the right or left of the screen with an eccentricity of 2-degree visual angle. They were in black letters on a white background in 20 pts font size and Century Gothic style. Finally, to eliminate the afterimage of the stimuli, a mask was shown on the screen until the next trial started (Interstimulus Interval: 1000 ms). Turkish and English stimuli were presented in two separate sessions. Language blocks were counterbalanced across participants. Each testing session took about 20–25 minutes. Figure 1 shows the test procedure.

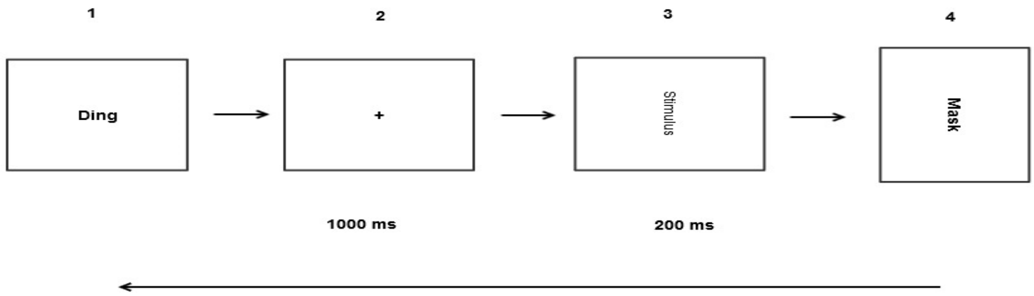

Figure 1. The experiment

4. Results

Mean Reaction Times (RTs) were calculated for accurate responses (94 % of all data). None of the participants had missing responses. For each participant, response times shorter than 300 milliseconds (ms) and longer than 1500 ms were removed. Data on the non-words were regarded as fillers and not used in the analysis. A 2 (language) x 3 (valence) x 2 (visual field) design repeated-measures ANOVA was performed on the data. A separate *t*-test was run to reveal differences in emotion word latencies.

First, the analysis revealed significant valence effect, $F(2,112) = 12.29$, $p = .001$, $ŋ^2 = .180$). It was seen that the participants were faster in their responses to positive words ($M = 530.65$, $SE = 13.44$) followed by neutral ($M = 552.82$, $SE = 14.01$) and negative ($M = 576.44$, $SE = 14.29$) words. Post hoc tests revealed that the difference between the response times for positive and negative words ($p = .001$) and that between positive and neutral ($p = .020$) words were significant. Similarly, neutral words word processed significantly faster than negative words ($p = .046$).

As expected, language effect was also significant, $F(1,56) = 22.31$, $p = .001$, $\eta^2 = .285$. The participants responded faster to Turkish words ($M = 527.35$ ms, $SE = 13.47$) than to English words ($M = 579.25$ ms, $SE = 14.47$). To be more specific on the processing of emotion words in each language, we conducted a paired samples *t*-test on the emotion words (positive and negative words) only. We found that emotion words in L2 ($M = 581.55$, $SD = 112.88$) had longer latencies than those in L1 ($M = 525.54$, $SD = 100.51$). The difference was found statistically significant (t (56) = 4.76, $p = .001$). This result gives further support for the differential processing of emotion words in L1 and L2 of late bilinguals.

The third main effect for visual field (VF) was not significant, $F(1,56) = 3.81$, $p = .056$, $\eta^2 = .064$, suggesting that lexical processing in late bilinguals is bilaterally represented. Also, no significant interaction was found between language x valence ($F(2,112) = 2.13$, $p = .124$, $\eta^2 = .037$), language x visual field ($F(1,56) = .68$, $p = .415$, $\eta^2 = .012$), valence x visual field ($F(2,112) = .21$, $p = .812$, $\eta^2 = .004$) and language x valence x visual field ($F(2,112) = .21$, $p = .808$, $\eta^2 = .004$). Response times for each word type are given in Table 4.

Table 4. **Bilinguals' response times to Turkish and English words presented in the Right Visual Field (RVF) and the Left Visual Field (LVF)**

Language	Turkish				English			
Words	RVF *M* (ms)	*SD*	LVF *M* (ms)	*SD*	RVF *M* (ms)	*SD*	LVF *M* (ms)	*SD*
Positive Words	502.52	112.08	520.18	122.27	541.60		558.31	127.94
Negative Words	535.46	121.61	543.99	130.68	598.85	161.93	627.44	167.28
Neutral Words	530.67	110.96	531.30	154.80	566.18	138.64	583.14	138.29

5. Discussion

In the current study, we investigated the brain representation of bilingual word processing and the impact of emotional content of words in the two languages of late bilinguals. Our participants performed a lexical decision task in a visual hemi-field paradigm. We replicated some results obtained in previous studies.

The first result obtained in the current study showed that valence of words influences lexical processing in both languages of late bilinguals. We found shorter response times for positive words than for negative and neutral words in Turkish and English. In line with the literature, we showed that positive words have a processing advantage over negative and neutral words. This result is supportive of the positivity bias, according to which humans are inherently more open to positive emotions as they offer happiness, well-being and prosperity, as well as they strengthen social bonds (Kousta, Vinson & Vigliocco 2009). Our results also revealed longer latencies for negative words than for neutral words, which also has considerable support in the literature. An overwhelming amount of research indicates that detection of negative stimuli slows processing, as it may be potentially harmful for the organism (Estes & Adelman 2008), resulting in increased response times in the experiments. Also, it is argued in the psycholinguistic literature that the relatively lower frequency of negative words accounts for the delays in processing due to possible novelty effect (Larsen et al. 2006).

In the bilingual literature, similar results were obtained, regardless of different task paradigms and participants with different language backgrounds. For example, in a primed lexical decision study, Sianipar, Middelburg and Dijkstra (2015) showed that late learners were more sensitive to positive words than neutral words in L2. Similarly, Ponari et al. (2015) reported faster response times for positive words in early and late bilinguals' L2 as well as the native speakers in their study. Kazanas and Altarriba (2016) investigated the effects of valence in emotion and emotion-laden words in both languages of bilinguals, finding priority in processing positive words in both categories. Jonckzyk et al. (2016) presented positive and negative stimuli in sentential context and reported shorter RT's for positive words as compared to negative words in both languages of late bilinguals, although with shorter RT's for those in L1 than in L2. In Ferre, Anglada-Tort and Guash (2018) study in which early and late bilinguals performed a lexical decision task in their L1 and L2, the authors argued that positive words had a processing advantage as compared to negative and neutral words in the L1 and L2 of both groups of participants. The current study with Turkish-English bilinguals further supports these firmly-established results.

Language-wise comparisons revealed discrepancies in bilingual participants' responses to words in L1 and L2; regardless of the field of presentation and valence of words, L2 words elicited longer response times. First, our results regarding an overall L1 and L2 word processing replicate findings in the word processing literature. This result can be interpreted in light of evidence in the literature regarding L1 privilege in word processing. Studies that employed a wide range of tasks have reported faster L1 than L2 response times. It is argued in the psycholinguistic models of bilingual word processing that frequency of use of each language accounts for this discrepancy. For example, *Bilingual Interactive Activation Model* (Dijkstra & van Heuven 2002) predicts faster processing times in L1 as compared to late learned L2. It is maintained in this model that lexical selection is either facilitated or inhibited, depending on how frequently each language is used. Our results can therefore be considered in line with this model. As the participants in our study were late learners of L2, and used their L1 more frequently, faster responses in L1 was an expected outcome. Experimental data also lend support to these models. For example, Gollan et al. (2008) reported frequency effects on the bilingual word processing, and de Bruin, Sala and Bak (2016) revealed the role of frequency of language use based on a comparison of two groups of bilinguals. Lehtonen et al. (2012) argued that frequency effects are more pronounced in bilinguals than on monolinguals.

The second point to consider in evaluating this result is that the emotional content did not affect response times in L2 word processing. Although we found no interaction between language and valence, *t*-test results obtained by the emotion word analysis only confirmed that our participants performed better in L1 emotion word processing as compared to L2 processing, as revealed by faster response times in the former. When neutral words were excluded in the analysis, this discrepancy in processing L1 and L2 words may be attributed to limitations of semantic processing of emotion words in the late learned language. In other words, the emotional content of the words had no facilitative effect on the processing speed of L2 words. This result is supportive of Faust, Ben-Artzi and Vardi (2012), who maintained that the native language is represented in a fuller and richer semantic network as compared to L2 learned later in life. Similarly, studies with late bilinguals learning their L2 in formal settings have consistently reported slower response times for L2 words. Segalowitz et al. (2008) reported longer latencies for emotion word recognition in L2 as compared to L1. In the same vein, studies that employed different experimental designs such as psycholinguistic (Winskel 2013), psychophysiological (Harris 2004), electrophysiological (Opitz & Degner 2012) and imaging (Chen et al. 2015) studies lend further support. In line with the literature, our participants' slower processing in L2 may be interpreted as revealing a lack of rich conceptual links between L2 words and the emotion concepts they refer to.

Our last aim was to investigate whether the field of presentation of the words in two languages would make a difference in response times. The main effect for visual field was not found significant, suggesting that late bilinguals responded equally quickly to words regardless of the field, and neither was Language vs. Field interaction, suggesting participants performed similarly across languages regardless of field of presentation. This result shows that both languages of late bilinguals are represented bilaterally.

Our results regarding bilateral representation for participants' two languages do not provide full support for the existing views that explain hemispheric organization in late bilinguals, because of the unexpected lateralization pattern for the two languages of late bilinguals in our study. Although we hypothesized left-lateralized lexical processing in the participants' L1, in line with the literature (Lieberman 2002, Ries et al. 2016), we found bilateral organization for L1 as well as L2. We can explain this result in terms of the dynamic nature of bilingualism. As suggested by Grosjean (2015), many factors are at play in bilingualism, including different language modes as required by different linguistic contexts. This variability causes bilinguals to develop different language processing strategies as compared to the monolingual speakers of their two languages, which might have been the case with our participants. Although they reported being L1 dominant, the translator trainees in our study were proficient in L2. Having been exposed to an intensive L2 input since childhood, either through English-medium education or continuing language studies, it is conceivable that they have developed word processing patterns unique to bilinguals. Another explanation for this unexpected finding may be that increased proficiency may alter L1 processing. A wealth of evidence exists as regards the role of proficiency exerting influence on L1 processing patterns (Costa & Sebastian-Galles 2014, Malt et al. 2015), even in the early stages of L2 learning (Osterhout et al. 2008).

As for the lateralization of bilinguals' late learned language, current evidence is still inconclusive for a variety of reasons, notably due to the differences in language backgrounds of the participants and tasks used. Generally speaking, there is more support for greater involvement of the right hemisphere in bilinguals, which has been associated with the complementary role of the right hemisphere in language processing (Hull & Vaid 2007, Grabitz et al. 2016, Willemin et al. 2016). Depending on the circumstances, this potential of the right hemisphere can be exploited either to enable the management of two languages, as in simultaneous acquisition (Tao et al. 2011), or, as in the case of late acquisition, to compensate for the deficient pragmatic aspects of L2 (Paradis 2004). Evans, Workman, Mayer and Crowley (2002) reported rightward shift for the late learned language, and argued that the left hemisphere is inherently adapted to early acquisition of language, while the right hemisphere plays a greater role in the case of late exposure to a second language. In support for this view, for example, Shakouri and Maftoon (2016) used a lexical decision task with late bilingual participants, and reported greater reliance on the right hemisphere. Klichowski et al. (2020) reported bilateral organization for bilinguals in verbal and nonverbal tasks arguing that bilinguals display a hemispherically more balanced representation as compared to monolinguals.

Regarding emotion word processing, on the other hand, relatively fewer studies investigated the lateralization of emotion words in late bilinguals, and these show conflicting results (Jonczyk 2013, 2015, Chen et al. 2015), meaning that there is not a well-established pattern for hemispheric lateralization of emotion word processing in L2. Therefore, bilateral representation for L2 words in our study can be explained in line with lateralization of word processing literature cited above, and the finding that there is no significant interaction between valence and visual field suggests that L2 word processing is represented in both hemispheres, a finding in compliance with the literature (Hull & Vaid 2007, Klichowski et al. 2020). However, no eye tracking was used in the experiment, therefore, it remains to be seen whether future studies will report supportive evidence for the L2 lateralization pattern reported in the current study.

6. Conclusion

Extensive research has established that language functions are asymmetrical in monolinguals, and there is considerable evidence on how emotions modulate this process. For bilingual speakers, however, there is a lack of clarity over how the two languages are represented in the brain, or how they interact with emotions. First, the current study aimed to investigate the role of valence in bilingual word processing (i.e. the privilege of positive words in emotion word processing), discrepancies, if any, in emotion word processing in the L1 and L2 of late bilinguals, and hemispheric representation of word processing in both languages. To this end, Turkish-English bilinguals performed a lexical decision task with positive, negative and neutral words in both languages in a visual hemi-field design. We found supporting evidence for our first hypothesis. As established in the literature, positive words were processed faster than neutral and negative words, respectively. Contributing to the overwhelming evidence in the literature, our results further showed that L1 words had shorter latencies and emotional content of L2 words had no facilitative role in word processing. This result is in line with the psycholinguistic models of bilingual word processing and the extensive research on the emotional aspects of bilingualism. As to the hemispheric organization of word processing in L1 and L2, it was found that Turkish-English bilinguals display a more balanced representation for both languages. The current study is one of the few to investigate Turkish-English bilinguals' emotion word processing. However, it has some limitations. For example, we did no control for gender, and tachtiscopic presentation of the stimuli took place without eye tracking. Also, we currently do not have a comprehensive corpus that reveal lexical variables such as age of acquisition, familiarity, concreteness, orthographic neighborhood, valence of words in Turkish. These issues could be addressed in a follow-up study.

REFERENCES

Bradley, Margaret M. & Peter J. Lang 1999. Affective norms for English words. Instruction manual and affective ratings. http://www.uvm.edu/~pdodds/files/papers/others/1999/bradley1999a.pdf (accessed 1 February 2010)

Chen, Peiyao, Jie Lin, Bingle Chen, Chunming Lu & Taomei Guo. 2015. Processing emotional words in two languages with one brain: ERP and fMRI evidence from Chinese-English bilinguals. *Cortex* 71. 34–48. https://doi.org/10.1016/j.cortex.2015.06.002

Costa, Albert & Nuria Sebastian-Galles. 2014. How does bilingual experience sculpt the brain? *Nature Reviews Neurosci*ence 15 (5). 336–345. https://doi.org/10.1038/nrn3709

Davidson, Richard J. 2003. Affective neuroscience and psychophysiology: Toward a synthesis. *Psychophysiology* 40. 655–665. https://doi:10.1111/1469-8986.00067

De Bruin, Angela, Sergio Della Sala & Thomas H. Bak. 2016. The effects of language use on lexical processing in bilinguals. *Language, Cognition and Neuroscience* 31 (8). 967–974. https://doi.org/10.1080/23273798.2016.1190024

De Groot, Annette M. B. 1992. Bilingual lexical representation: A closer look at conceptual representations. In Ram Frost & Leonard Katz (eds.), *Orthography, phonology, morphology, and meaning*, 389–412. Amsterdam: Elsevier Science Publishers.

Dewaele, Jean M. 2004. The emotional force of swear words and taboo words in the speech of multilinguals. *Journal of Multilingualism and Multicultural Development* 25 (2–3). 204–222. https://doi.org/10.1080/01434630408666529

Dijkstra, Ton & Walter J. B. van Heuven. 2002. The architecture of the bilingual word recognition system: From identification to decision. *Bilingualism: Brain and Cognition* 5 (3). 175–197. https://doi:10.1017/S1366728902003012

El-Dakhs Dina A. S. & Jeanette Altarriba. 2019. How do emotion word type and Valence influence language processing? The case of Arabic-English bilinguals. *Journal of*

Psycholinguistic Research 48 (5). 1063–1085. https://doi.org/10.1007/s10936-019-09647-w

Estes, Zachary & James S. Adelman. 2008. Automatic vigilance for negative words in lexical decision and naming: Comment on Larsen, Mercer and Balota. *Emotion 8* (4). 441–444. https://doi.org/10.1037/1528-3542.8.4.441

Evans, Judith, Lance Workman, Peter Mayer & Kevin Crowley. 2002. Differential bilingual laterality: Mythical monster found in Wales. *Brain and Language* 83. 291–299. https://doi.org/10.1016/S0093-934X(02)00020-2

Faust, Miriam, Elisheva Ben-Artzi & Nili Vardi. 2012. Semantic processing in native and second language: Evidence from hemispheric differences in fine and coarse semantic coding. *Brain and Language* 123. 228–233. https://doi.org/10.1016/j.bandl.2012.09.007

Ferre, Pilar, Manuel Anglada-Tort & Marc Guash. 2018. Processing of emotional words in bilinguals: Testing the effects of word concreteness, task type and language status. *Second Language Research* 34 (3). 371–394. https://doi.org/10.1177/0267658317744008

Gollan, Tamar, H., Rosa I. Montoya, Cynthia Cera & Tiffany C. Sandoval. 2008. More use almost always means smaller frequency effect: Aging, bilingualism and the weaker links hypothesis. *Journal of Memory and Language* 58 (3). 787–814. https://doi.org/10.1016/j.jml.2007.07.001

Grabitz, Clara R., Kate E. Watkins & Dorothy V. M. Bishop. 2016. Cerebral lateralization of first and second languages in bilinguals assessed by functional transcranial Doppler ultrasound. *Welcome to Open Research* 1–15. https://doi.org/10.12688/wellcomeopenres.9869.1

Grosjean, François. 2015. Bicultural bilinguals. *International Journal of Bilingualism* 19 (5). 572–586. https://doi.org/10.1177/1367006914526297

Göz, İlyas. 2003. *Yazılı Türkçe'nin Kelime Sıklığı Sözlüğü*. Ankara: Türk Dil Kurumu Yayınları.

Harris, Catherine L. 2004. Bilingual speakers in the lab: Psychophysiological measures of emotional reactivity. *Journal of Multilingual and Multicultural Development* 25 (2). 223–247. https://doi.org/10.1080/01434630408666530

Hausmann, Markus, Marc Brysbaert, Lise van der Haegen, Jörg Lewald, Karsten Specht, Marco Hirnstein, Julie Willemin, Jack Barton, Delia Buchilly, Florian Chmetz, Maya Roch, Sanne Brederoo, Nele Dael & Christine Mohr. 2019. Language lateralization measured across linguistic and national boundaries. *Cortex* 111. 134–147. https://doi.org/10.1016/j.cortex.2018.10.020

Hull, Rachel & Jyotsana Vaid. 2005. Clearing cobwebs from the study of bilingual brain. In Judith F. Kroll & Annette M. B. De Groot (eds.), *Handbook of bilingualism: Psycholinguistic approaches,* 480–496. U.S.A: Oxford University Press.
http://site.ebrary.com/lib/ekonomi/Doc?id=10233717ppg=448. (accessed 20 May 2019)

Hull, Rachel & Jyotsana Vaid. 2007. Bilingual language lateralization: A meta-analytic tale of two hemispheres. *Neuropsychologia* 45 (9). 1987–2008. https://doi.org/10.1016/j.neuropsychologia.2007.03.002

Jonczyk, Rafal. 2013. *Hemispheric asymmetries for emotional verbal stimuli in Polish-English bilinguals*. http://wa.emu.edu.pl/plu/2013/files/Abstracts/Jonczyk.pdf (accessed 14 March 2018)

Jonczyk, Rafal. 2015. Hemispheric asymmetry of emotion words in a non-native mind: A divided visual field study. *Laterality* 20 (3). 326–347. https://doi.org/10.1080/1357650X.2014.966108

Jonczyk, Rafal, Bastien Boutonnet, Kamil Musial, Katie Hoemann & Thierry Guillaume. 2016. The bilingual brain turns a blind eye to negative sentences in the second language. *Cognitive Affective Behavioral Neuroscience* 16. 527–540. https://doi.org/10.3758/s13415-016-0411-x

Kazanas, Stephanie A. & Jeanette Altarriba. 2016. Emotion word processing: Effects of word type and valence in Spanish-English bilinguals. *Journal of Psycholinguistic Research* 45. 395–406. https://doi.org/10.1007/s10936-015-9357-3

Klichowski, Michal, Agnieszka Nowik, Gregory Kroliczak & James W Lewis. 2020. Functional lateralization of tool-sound and action-word processing in a bilingual brain. *Health Psychology Report* 8 (1). 10–30. https://doi.org/10.5114/hpr.2020.92718

Kousta, Stavroula T., David P. Vinson & Gabriella Vigliocco. 2009. Emotion words, regardless of polarity have a processing advantage over neutral words. *Cognition* 112 (3). 473–481. https://doi.org/10.1016/j.cognition.2009.06.007

Kroll, Judith F. & Erika Stewart. 1994. Category interference in translation and picture naming: Evidence for asymmetric connection between bilingual memory representations. *Journal* of *Memory and Language* 33. 149–174. https://doi.org/10.1006/jmla.1994.1008

Kuruoglu, Gulmira & Filiz Mergen. 2016. Hemispheric lateralization of emotion words in Turkish-English bilinguals and Turkish monolinguals. *Humanities and Social Sciences Review* 5 (3). 219–224.

Larsen, Randy J., Kimberley Mercer A. & David A. Balota. 2006. Lexical characterstics of words used in emotional stroop experiments. *Emotion* 6 (1). 62–72. https://doi.org/10.1037/1528-3542.6.1.62

Lehtonen, Minna, Annika Hulten, Antoni Rodrigez-Fornells, Toni Cunillera, Jyrki Tuomaine & Matti Laine. 2012. Differences in word recognition between early bilinguals and monolinguals: Behavioral and ERP evidence. *Neuropsychologia* 50 (7). 1362–1371. https://doi.org/10.1016/j.neuropsychologia.2012.02.021

Lieberman, Philip. 2002. On the nature and evolution of the neural bases of human language. *Yearbook of Physical Anthropology* 45. 36–62. https://doi.org/ 10.1002/ajpa.10171

Malt, Barbara C., Ping Li, Aneta Pavlenko, Huichun Zhu & Eef Ameel. 2015. Bidirectional lexical interaction in late immersed Mandarin-English bilinguals. *Journal of Memory and Language* 82. 86–104. https://doi.org/10.1016/j.jml.2015.03.001

Martin, Jennifer M. & Jeanette Altarriba. 2017. Effects of valence on hemispheric specialization for emotion word processing *Language and Speech* 60 (4). 597–613. https://doi.org/10.1177/0023830916686128

Mergen, Filiz & Gulmira Kuruoglu. 2017. A comparison of Turkish-English bilinguals' processing of emotion words in their two languages. *Eurasian Journal of Applied Linguistics* 3 (2). 89–98. https://doi.org/10.32601/ejal.460969

Mergen, Filiz & Gulmira Kuruoglu. 2021. Lateralization of lexical processing in monolinguals and bilinguals. *International Journal of Bilingualism* 25 (6). 1497–1509. https://doi.org/10.1177/13670069211018842

Meir Natalia, Marina Avramenko & Tatiana Verkhovtceva. 2021. Israeli Russian: Case morphology in a bilingual. *Russian Journal of Linguistics* 25 (4). 855–885. https://doi.org/10.22363/2687-0088-2021-25-4-886-907

Oldfield, Richard C. 1971. Oldfield Handedness Inventory. *Neuropsychologia* 9 (1). 97–113. https://doi.org/10.1016/0028-3932(71)90067-4

Ong, Elsie, Samara Hussain, Yvonne Chow & Catherine Thompson, Lipace Ouhk & Kwai Chunk. 2017. Variations in Bilingual Processing of Positive and Negative Information. In *Proceedings* of *6th annual international conference on cognitive and behavioral psychology*. 36–42. Singapore: Global Science and Technology Forum. https://doi.org/10.5176/2251-1865_CBP17.14

Opitz, Bertram & Juliane Degner. 2012. Emotionality is a second language: It's a matter of time. *Neuropsychologia* 50 (8). 1961–1967. https://doi.org/10.1016/j.neuropsychologia.2012.04.021

Osterhout, Lee, Andrew Poliakov, Kaya Inouea, Judith McLaughlin, Geoffrey Valentine, Ilona Pitkanenen, Cheryl Frenck-Mestre & Julia Hirschensohnc. 2008. Second-language learning and changes in the brain. *Journal of Neurolinguistics* 21. 509–521. https://doi.org/10.1016/j.jneuroling.2008.01.001

Paradis, Michelle. 2004. *A Neurolinguistic Theory of Bilingualism.* Holland: John Benjamins Publishing Company.

Pavlenko, Aneta. 2004. "Stop doing that, la komu skalaza!": Language choice and emotions in parent-child communication. *Journal of Multilingual and Multicultural Development* 25 (2–3). 179–203. https://doi.org/10.1080/01434630408666528

Ponari, Marta, Sara Rodríguez-Cuadrado, David Vinson, Neil Fox, Albert Costa & Gabriella Vigliocco. 2015. Processing advantage for emotional words in bilingual speakers. *Emotion* 15 (5). 644–652. https://doi.org/10.1037/emo0000061

Ries, Stephanie K., Nina F. Dronkers & Robert Knight T. 2016. Choosing words: Left hemisphere, right hemisphere, or both? Perspective on the lateralization of word retrieval. *Annals of New York Academy of Sciences* 1369 (1). 111–131. https://doi.org/10.1111/nyas.12993

Sato, Wataru & Satoshi Aoki. 2006. Right hemispheric dominance in processing of unconscious negative emotion. *Brain and Cognition* 62. 261–266. https://doi.org/10.1016/j.bandc.2006.06.006

Segalowitz, Norman, Pavel Trofimovich, Elizabeth Gatbonton & Anna Sokolovskaya. 2008. Feeling affect in a second language. The role of word recognition automaticity. *The Mental Lexicon* 3 (1). 47–71. https://doi.org/10.1075/ml.3.1.05seg

Shakouri, Nima & Parviz Maftoon. 2016. On the relationship between brain laterality and language proficiency in L2: A replication study. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience* 7 (2). 69–77.

Sianipar, Agnes, Renee Middelburg & Ton Dijkstra. 2015. When feelings arise with meanings: How emotion and meaning of a native language affect second language processing in adult learners. *PlosOne* 10 (12). 1–33. https://doi.org/10.1371/journal.pone.0144576

Tao, Lily, Anna Marzecova, Taft Marcus, Dariusz Asanowicz & Zofia Wodniecka. 2011. The efficiency of attentional networks in early and late bilinguals: The role of age of acquisition. *Frontiers in Psychology* 2 (123). 1–19. https://doi.org/10.3389/fpsyg.2011.00123

Toivo, Wilhelmiina & Christoph Scheepers. 2019. Pupillary responses to affective words in bilinguals' first versus second language. *PlosOne* 14 (4). 1–20. https://doi.org/10.1371/journal.pone.0210450

Westfall, Jacob, 2016 *PANGEA: Power ANalysis for GEneral Anova designs.* http://jakewestfall.org/pangea (accessed 24 May 2020)

Willemin, Julie, Marcus Hausmann, Marc Brysbaert, Nele Dael, Florian Chmetz, Asia Fioravera, Kamila Gieruc & Christene Mohr. 2016. Stability of right visual field advantage in an internationalized lexical decision task irrespective of participants' sex, handedness or bilingualism. *Laterality: Asymmetries of Body, Brain and Cognition* 21 (4–6). 502–524. https://doi.org/10.1080/1357650X.2015.1130716

Winskel, Heather. 2013. The emotional Stroop task and emotionality rating of negative and neutral words in late Thai-English bilinguals. *International Journal of Psychology* 48 (6). 1090–1098. https://doi.org/10.1080/00207594.2013.793800

APPENDIX. ***Stimuli used in the study***

Turkish		English	
Real Words	**Non-words**	**Real Words**	**Non-words**
Bebek	Moyur	Honest	Mowan
Barış	Fariz	Angel	Vursey
Zarif	Kalap	Beauty	Plist
Saygın	Yotnak	Charm	Rovel
Mutlu	Neyil	Humor	Volen
Öpmek	Kimek	Alive	Creal
Huzur	Azıra	Brave	Clape
Sağlık	Nalay	Glory	Dreap
Gülüş	Yenes	Heaven	Repson
Takdir	Çılaş	Trust	Droop
Mutsuz	Moplut	Abuse	Enruse
Cahil	Navşat	Insult	Nifal
Pislik	Keliç	Victim	Hunck
İflas	Töben	Agony	Searon
Şeytan	Kıtak	Hatred	Shrone
Küfür	Pekek	Corpse	Swien
Tehdit	Yukat	Grief	Macel
Vahşet	Melgü	Cruel	Dolem
Yalan	Banay	Horror	Trecen
Günah	Potrak	Misery	Prite
Bardak	Nökes	Pencil	Trang
Defter	Kedam	Ankle	Daken
Etken	Zahine	Adult	Drieve
Zeytin	Zobuk	Bottle	Paphen
Koltuk	Müden	Salad	Bause
Zaman	Matır	Chair	Cedude
Kaşık	Hiras	Avenue	Doman
Kulak	Nisek	Dinner	Lotace
Liman	Şalas	Writer	Smare
Dergi	Kapet	Truck	Strame

Article history:
Received: 13 March 2022
Accepted: 15 April 2023

Bionotes:
Filiz MERGEN is PhD, Assistant Professor at the Translation Department of Vocational School at İzmir University of Economics, Turkey. Her main fields of research include psycholinguistics, neurolinguistics, cognitive aspects of language processing and bilingualism.
e-mail: filiz.mergen@ieu.edu.tr
https://orcid.org/0000-0002-9583-9153

Gülmira KURUOGLU is PhD, Professor at the Department of Linguistics, Dokuz Eylul University, Izmir, Turkey. She is also a speech therapist (aphasiologist) at the Azerbaijan Republic Clinical Hospital and the Department of Physical Medicine and Rehabilitatio at the Dokuz Eylul University. She took part in several projects on language disorders following brain damage in Azerbaijan, Russia, Turkey, and Japan. She authord and co-authored numerous articles and two books titled “Aphasia: A Neurolinguistic Study” (Baku, 1999) and “Neurolinguistics” (Baku, 2004).
e-mail: gulmira.kuruoglu@deu.edu.tr
https://orcid.org/0000-0002-4172-0253

Сведения об авторах:
Филиз МЕРГЕН – доктор филологии, доцент кафедры перевода в Измирском университете экономики (Турция). В сферу ее научных интересов входят психолингвистика, нейролингвистика, когнитивные аспекты обработки естественного языка и билингвизм.
e-mail: filiz.mergen@ieu.edu.tr
https://orcid.org/0000-0002-9583-9153

Гюльмира САДИЕВА-КУРУОГЛУ – доктор филологии, профессор кафедры лингвистики Университета Докуз Эйлюль (Измир, Турция). Также является логопедом (афазиологом) в Азербайджанской республиканской клинической больнице и на кафедре реабилитационной медицины Университета Докуз Эйлюль. Принимала участие в ряде проектов, посвященных нарушению речи после мозговой травмы, в Азербайджане, России, Турции и Японии. Автор и соавтор многочисленных статей и двух монографий – «Афазия: нейролингвистическое исследование» (Баку, 1999) и «Нейролингвистика» (Баку, 2004).
e-mail: gulmira.kuruoglu@deu.edu.tr
https://orcid.org/0000-0002-4172-0253