

# It's All in the Eyes: How Language Dominance, Salience, and Context Affect Eye Movements During Idiomatic Language Processing

Anna B. Cieřlicka, Roberto R. Heredia and Marc Olivares

**Abstract** This paper reports an eye movement study and the effects of salience, context, and language dominance on the processing of idiomatic expressions by Spanish–English bilinguals. Salient meanings of figurative expressions are those which are processed first and accessed automatically from the mental lexicon, regardless of contextual bias (Giora 2003). The research conducted so far with second language (L2) learners and bilingual participants has shown that the literal meaning of L2 idioms might be more salient than the figurative one in the course of their processing by non-native language users (e.g. Kecskes 2000; Liontas 2002; Cieřlicka 2006; Cieřlicka and Heredia 2011). In addition, research findings suggest that the degree of language dominance, or which language is more readily accessible due to usage (Heredia 1997; Heredia and Altarriba 2001; Altarriba and Basnight-Brown 2007), might be a factor in bilingual processing. To investigate whether the degree of literal and figurative activation in bilingual idiom processing may be modulated by language dominance (i.e. dominant vs. nondominant), we recorded eye movements of Spanish–English bilinguals, dominant either in Spanish or in English, while they were reading ambiguous (literally plausible, such as ‘kick the bucket’) English idioms. Each idiom was used either in its figurative or literal meaning and embedded in a sentence with neutral preceding context, in which case its figurative (‘Within seconds she realized she was *in deep water*, and that she would very soon come to regret her words’) or literal (‘Within seconds she realized she was *in deep water*, and that she would very soon have to swim back towards the shore’) meaning became clear due to the subsequent disambiguating information, or the preceding supportive context clearly biasing one of the meanings (e.g. figurative biased: ‘Since both of us were equally guilty of causing

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A. B. Cieřlicka (✉) · R. R. Heredia · M. Olivares  
Texas A&M International University, Texas, USA  
e-mail: anna.cieslicka@tamiu.edu

R. R. Heredia  
e-mail: rheredia@tamiu.edu

the overspend, we both knew we were *in deep water*, and very likely to lose our jobs'). As predicted, the results indicated that the effects of salience and context on eye movement patterns are modulated by language dominance.

## 1 Introduction

Eye tracking methodology has been extensively employed to investigate how the language processing system copes with lexical ambiguity resolution by recording eye movements of participants engaged in reading lexically ambiguous material, such as figurative phrases having two plausible (literal and idiomatic) interpretations (e.g. 'kick the bucket' = 'die', or 'strike the pail with one's foot'). The rationale behind applying the eyetracking paradigm to studying lexical ambiguity is that the number of fixations and fixation time on the word reflects the ease or difficulty of processing that word (Cutler 1983).

Given the scarcity of eye movement studies in bilingual language processing, the goal of the present study was to record eye movements of bilinguals reading ambiguous idiomatic expressions. Briefly, idiomatic expressions have been traditionally defined as multi word phrases whose interpretation cannot be derived solely from a compositional analysis of the individual words of the phrase (Swinney and Cutler 1979). Because of their potentially ambiguous nature (i.e. literal vs. figurative senses), idioms can provide a window onto language processing by revealing mechanisms underlying lexical ambiguity resolution in bilinguals.

Previous eyetracking research in idiomatic processing has been mainly conducted with monolingual language users and has mostly focused on the role of context, salience, or different idiom characteristics in the course of on-line idiomatic processing. For example, Titone and Connine (1999) examined the effect of context on eye movement patterns in processing idioms varying along the dimension of *compositionality* (Gibbs et al. 1989; Nunberg et al. 1994). While in decomposable idioms, there is a transparent relationship between the idiom's words and components of the idiom's meaning (e.g. 'pop the question', where the noun 'question' quite clearly refers to a 'marriage proposal' and the verb 'pop' to the act of uttering it), figurative meanings of nondecomposable idioms cannot be compositionally derived from the words that comprise the string, as in 'kick the bucket' or 'chew the fat' (Gibbs and Nayak 1989; Gibbs et al. 1989). To determine whether decomposable and nondecomposable idioms are processed differently, Titone and Connine (1999) used sentence contexts biasing either figurative ('She finally *kicked the bucket* after being ill for months') or literal meanings of idiomatic phrases ('She finally *kicked the bucket*, forgetting to move it from the path') and manipulated the position of the idiom in the sentence in such a way that the biasing context either preceded the idiom (e.g. 'Forgetting to move it from the path, she finally *kicked the bucket*'), or followed it ('She finally *kicked the bucket*, forgetting to move it from the path'). The results showed no differences in processing times for decomposable

idioms, regardless of whether context preceded or followed them, and a slower reading time for nondecomposable idioms when the context preceded than when it followed the idiom. Titone and Connine concluded that compositionality significantly affects how idioms are understood. More specifically, since nondecomposable idioms have non-overlapping idiomatic and literal meanings, readers take longer to integrate the meaning compatible with the preceding context as they have to select between two different, active meanings of the phrase. In contrast, individual words of decomposable idioms directly contribute to the idiom's figurative interpretation, and so the two meanings closely overlap without slowing down the processing time, regardless of contextual bias or position in the sentence.

Another aspect of idiom processing investigated with the eyetracking methodology has been the effect of *salience*. Briefly, the *Graded Salience Hypothesis* (Giora 2002, 2003) suggests that salient meanings of figurative expressions are processed and accessed first. The salient meaning of a word or an expression is defined as its "lexicalized meaning, i.e. the meaning retrievable from the mental lexicon rather than from the context" (Giora 1999: 919). According to Giora, such salient meanings are independent of context and they are always processed initially, via direct access in the mental lexicon, immediately upon encounter of the language stimulus. In relation to idioms, the Graded Salience Hypothesis predicts that in the course of processing familiar idioms, whose highly conventionalized figurative meanings are more salient than their literal meanings, figurative meanings will be accessed faster than literal meanings. In contrast, in processing less familiar idioms their literal meaning will be more salient, since for these idioms the figurative meaning is not yet well established in the mental lexicon.

To test the effect of salience on idiomatic processing, Cieřlicka et al. (2008) recorded eye movements of native speakers of English presented with idiomatic expressions which were ambiguous with regard to their interpretation; that is, these idioms could be understood both literally or figuratively (e.g. 'a piece of cake'). These conventionalized phrases were used either figuratively (e.g. 'It's not a *piece of cake* for smaller newspapers to maintain a comprehensive Web site featuring fresh news and features') or literally (e.g. 'It's not a *piece of cake*, it's an apple tart, and I'd also appreciate it if you'd bring me the cappuccino I ordered ten minutes ago'). It was assumed, in line with Giora's model, that figurative meanings of those highly conventionalized and familiar expressions are well-established in the native speakers' lexical repertoire and hence are more salient than their alternative, literal interpretations. In addition, a context manipulation was introduced, such that the context preceding the idiomatic expression was either supportive and clearly biased its meaning as figurative (e.g. 'With foolproof instructions from "Homemaker" magazine, home decorating is a *piece of cake*, so that even beginners can produce amazing results') or literal (e.g. 'On Sunday, I went to my uncle's birthday party, but I only ate one *piece of cake* because it was vanilla with chocolate icing and it filled me up') or it was neutral, so that the meaning was disambiguated by the context following the idiomatic phrase

(e.g. ‘It’s not *a piece of cake*, it’s an apple tart, and I’d also appreciate it if you’d bring me the cappuccino I ordered ten minutes ago’).

The number and length of fixations on the idiomatic expressions were hypothesized to be a direct function of their salience in such a way that salient, highly conventionalized figurative meanings of the idiomatic phrases were predicted to elicit fewer and shorter fixations than the less salient literal readings of the phrases. Overall, the results indicated a dynamic interaction of both context and salience in affecting the eye reading data. Idiomatic phrases preceded by the supportive context elicited significantly fewer and shorter fixations than those preceded by the neutral context, but nonsalient (literal) meanings were not found any more difficult to process and integrate than salient figurative meanings, contrary to what might be expected based on the graded salience view.

While there is very limited eye tracking research addressing idiom processing in native speakers, eye tracking studies in idiomatic language processing by non-native language users are virtually nonexistent. Those few studies that have been reported so far have mainly focused on whether idiomatic, formulaic language differs from non-formulaic language. More specifically, it has been demonstrated experimental paradigms, using other that idiomatic expressions are understood more efficiently than novel non-formulaic sequences, suggesting that they are stored and processed as single memorized chunks in the mental lexicon and retrieved holistically (Altenberg 1998; Schmitt and Carter 2004; Spöttl and McCarthy 2004; Jiang and Nekrasowa 2007; Conklin and Schmitt 2008). In an eye tracking study investigating this question, Underwood et al. (2004) compared fixation count and fixation durations for native and non-native speakers of English presented with idiomatic expressions and novel non-formulaic sequences. The critical region was the last word of the idiomatic phrase (e.g. ‘honesty is the best policy’) or its control non-formulaic sentence containing the same lexical item (‘it seems that his policy of...’). If idioms are stored as whole phrases and retrieved as a single unit from the mental lexicon then fewer and shorter fixations should be expected on the last idiom word than in cases when the same word is part of a novel, non-formulaic sequence needing to be assembled through the compositional analysis. While this prediction was supported by the native-speaker data, which showed a clear processing advantage for formulaic over non-formulaic phrases, the non-native speaker results were mixed and failed to demonstrate any differences in the duration of fixations on the target words, regardless of whether the words were part of the idiom or a non-formulaic phrase.

In a similar study, Siyanova-Chanturia et al. (2011) presented idioms used figuratively (‘at the end of the *day*’—finally), literally (‘at the end of the *day*’—in the evening), and novel, non-formulaic phrases (‘at the end of the *war*’) to native and non-native speakers of English and recorded the number and length of fixations on the whole phrase as well as on the last word of the idiom (e.g. ‘day’) and its control word in a novel phrase (e.g. ‘war’). While native speakers showed a processing advantage for idioms over novel phrases, regardless of whether the idioms were used figuratively or literally, non-native speaker data showed no differences in processing times between idioms and novel phrases, as well as faster processing of

literally than figuratively used idioms, suggesting that literal meaning of idioms might be more salient than figurative ones in non-native processing.

Overall, the limited eye tracking research in the on-line processing of idiomatic expressions has demonstrated that context and salience significantly affect how idioms are understood by native speakers. The few eye movement studies conducted so far with non-native participants have additionally implied that idioms might be processed differently by native and non-native speakers and that literal meanings might be more salient than figurative meanings in non-native idiomatic language processing. This is supported by research with other behavioral paradigms that showed the role of language status (native vs. non-native) in on-line figurative language processing (see e.g. Cieśllicka 2006, 2007, 2008, 2010, 2012; Cieśllicka et al. 2009; Cieśllicka and Heredia 2011).

The present study further explores the role of context and salience in the course of processing English idiomatic expressions by Spanish–English bilinguals varying with regard to their language dominance. Language dominance has been so far largely overlooked in the bilingual idiom processing literature; yet, it might be a crucial factor likely to affect how figurative language is processed. For example, Matlock and Heredia (2002) examined the comprehension of phrasal verbs by monolingual English speakers and Spanish–English bilinguals classified as early or late. Briefly, early bilinguals are individuals learning two languages after three years old, whereas late bilinguals are those individuals who learned their second/foreign language (L2) after already having learned their native language (L1) (Heredia et al. 2007). Participants were asked to determine if a paraphrase of either a literal or figurative interpretation accurately represented the preceding phrasal verb. Early bilinguals were faster in identifying the figurative than the literal interpretation of the phrasal verbs. In contrast, late bilinguals were generally slower and revealed no differences between the literal and figurative readings of the phrasal verbs. Matlock and Heredia (2002) have therefore suggested that idiom processing by late bilinguals would involve: (1) processing the idiomatic expression literally, (2) translating idiom into L1, and (3) identifying idiomatic expression in L1 and accessing its figurative meaning. However, highly proficient L2 speakers or early bilinguals, like monolingual speakers, would have immediate access to the figurative expression.

While proficiency in L2 does not ensure dominance in that language, it is nevertheless a necessary prerequisite, with a bilingual becoming dominant in the language in which he or she is more proficient. For example, Altarriba and Basnight-Brown (2007) and Heredia (1997) have shown that Spanish–English bilinguals who use their L2 more frequently are actually faster in their L2 (see also Heredia and Altarriba 2001), and that their L2 *becomes their actual L1*. So it is possible that the bilingual's L1 can fall in strength while the L2 can become the dominant language (see Heredia and Altarriba 2001; Heredia 2008; Heredia and Brown 2013; see also Schoonbaert et al. 2009). Thus, throughout a bilingual's life, the balance of dominance between languages may shift (Hernández and Kohnert 1999; Meisel 2007). Level of L2 proficiency, in addition to age of L2 acquisition and language exposure, has been identified as one of the variables determining

language representations in the bilingual brain (Vaid and Hall 1991, 2002; Abutalebi et al. 2001, 2005; Perani et al. 2003; Indefrey 2006; Perani and Abutalebi 2005; Stowe and Sabourn 2005; Abutalebi and Green 2007).

In regards to figurative language processing, research conducted so far with late bilinguals has shown that literal meanings of L2 idioms might enjoy a particular prominence in the course of their processing by nonnative language users (e.g. Kecskes 2000; Liontas 2002; Abel 2003; Cieřlicka 2006; Cieřlicka and Heredia 2011). For example, Cieřlicka (2006) employed a cross-modal lexical priming paradigm to explore the on-line processing of English idioms by speakers of Polish who were highly fluent in their L2, English, but dominant in their native language. The study demonstrated prevalence of literal over figurative meaning activation. Faster processing for literally than figuratively used idioms by non-native speakers has also been reported in a recent eyetracking study (Siyanova-Chanturia et al. 2011).

In light of these findings regarding the differential salience status of literal and figurative meanings of L2 idioms in the course of their processing by late bilinguals, the current study looked at whether the activation of literal and figurative meanings of idioms varies as a function of language dominance. Given that figurative meanings of idioms are more salient for dominant language than their literal meanings (Giora 2002, 2003) they should be activated faster when the idiom is meant figuratively than when it is meant literally. On the other hand, if literal meanings enjoy a special salience status in the course of their processing by speakers of a non-dominant language, then bilinguals for whom English is a non-dominant language should process idioms used literally faster than when these idioms are intended figuratively. The logic behind employing the eye-tracking methodology to address questions concerning literal and figurative activation in the course of idiom processing is that the total number of fixations made on critical regions and the durations of these fixations provide an overall indication of differences in the reading dynamics depending on whether an idiomatic expression is used literally or figuratively. If literally used idioms elicit a smaller number and shorter fixations than idioms used figuratively, then it can be deduced that literal meanings of those idioms are more salient (i.e. more readily available) than their figurative meanings.

## 2 The Present Study

To explore the availability of figurative and literal meanings of idioms, we employed ambiguous idiomatic expressions that were used both figuratively (e.g. ‘Ever since one member of our research team resigned and I was asked to take over her responsibilities, I’ve been *up to my eyes* in work’) and literally (‘I enjoy the swimming lessons, even though most of the time I’m *up to my eyes* in water’). In addition, following Cieřlicka et al. (2008) experiment, a context manipulation was included, such that the context was either supportive or clearly biased the meaning

of the upcoming idiom, as in the two examples above, or it was neutral. In the neutral context condition, part of the sentence following the idiom constituted the disambiguating region, as it biased either the idiom’s figurative meaning (e.g. ‘I was starting to feel uncomfortable, as I was *up to my eyes* in overdue reports and my boss had just asked me to take over responsibilities of the absent colleague’) or its literal meaning (e.g. ‘I was starting to feel uncomfortable, as I was *up to my eyes* in unpleasantly cold, muddy water and a long distance from the safety of the shore’).

The eye measures recorded were total reading time (the sum of all fixation durations made within a region of interest), fixation count (the number of all fixations made within a region of interest), and regressions (fixations going back to the idiom region). Eye movements were recorded for both the idiom region and the post-idiom region which was the disambiguating part of the sentence when the idiom was preceded by the neutral context. For example, for the sentence ‘I was starting to feel uncomfortable, as I was *up to my eyes* in overdue reports and my boss had just asked me to take over responsibilities of the absent colleague’, the idiom region was ‘up to my eyes’ and the post idiom region was ‘in overdue reports and my boss had just asked me to take over responsibilities of the absent colleague’.

Overall, context and salience manipulation resulted in the four following conditions: (1) Neutral preceding context, figurative meaning; (2) Neutral preceding context, literal meaning; (3) Supportive preceding context, figurative meaning; (4) Supportive preceding context, literal meaning (see Table 1 for a summary of the four experimental conditions).

2.1 Hypotheses and Predictions

If, as suggested by the previous research, the figurative meaning of the idiom is more salient for the dominant language than its literal meaning, then figurative meaning should be more readily available and activated by default for participants dominant in English. Therefore, when the idiom is embedded in the neutral preceding context but intended literally (Condition 2), we might expect more regressions (re-reading of the target idiom region) and more fixations/longer total

Table 1 Sample stimuli: idiomatic expressions used in each of the four experimental conditions

Neutral preceding context	
1. Figurative meaning	‘Within seconds she realized she was <i>in deep water</i> , and that she would very soon come to regret her words’
2. Literal meaning	‘Within seconds she realized she was <i>in deep water</i> , and that she would very soon have to swim back towards the shore’
Supportive preceding context	
3. Figurative meaning	‘Since both of us were equally guilty of causing the overspend, we both knew we were <i>in deep water</i> , and very likely to lose our jobs’
4. Literal meaning	‘Extremely useful for rehabilitation from injury are water workouts, especially running <i>in deep water</i> and back floating’

reading time for the post-idiom region than when the idiom is intended in its salient figurative sense (Condition 1). This is expected because in Condition 2 the language processing mechanism will have to cope with incompatible information where the rest of the sentence biasing the literal reading of the idiom fails to match the activated salient (figurative reading).

On the other hand, for bilinguals who are not dominant in English, the literal meaning might be more salient than figurative meaning. If this is indeed the case, then the language processing mechanism is likely to activate this salient literal meaning by default in idioms preceded by the neutral context. Therefore, in contrast to predictions for the dominant language, more regressions to the idiom region and more fixations/longer total reading time for the disambiguating post-idiom region are expected for Condition 1, where the idiom is used figuratively, than for Condition 2, when it is used literally. This is so because in the neutral preceding context the salient (literal) meaning of an English idiom is activated first, so when the rest of the sentence biases its figurative (less salient) reading a conflict arises which incurs an extra processing cost. In addition, in line with the previous research reporting the role of context in idiom processing (e.g. Liontas 2002; Cieřlicka et al. 2008), idioms preceded by the supportive context (Conditions 3 and 4) should elicit fewer fixations and shorter total reading time than idioms preceded by the neutral context (Conditions 1 and 2).

Overall, these predictions can be summarized as the following research questions: (1) Will there be a significant effect of context for both figuratively and literally used idioms?; (2) Will the fixation, regression, and total reading time data differ depending on usage: whether idioms are used figuratively or literally?, and (3) Will language dominance affect which meaning (figurative or literal) will be more salient and hence processed faster?

## 2.2 Method

### 2.2.1 Participants

The participants were Spanish–English bilinguals dominant in either English or Spanish. A total of 62 fluent bilinguals participated in the study. All participants were undergraduates studying at Texas A&M International University. There were 46 English-dominant bilingual participants and 16 Spanish-dominant bilingual participants. Participants completed a language background questionnaire. Dunn and Fox Tree's (2009) *Bilingual Dominance Scale* was used to determine language dominance.

As revealed by the language questionnaire (see Table 2 for summary), 29 participants reported English as their L1 and 34 participants reported Spanish as their L1. Most of the participants claimed to have learned Spanish and English simultaneously before the age of six. Only 4 participants reported less than 6 years of schooling in English, suggesting that the majority of students have had their



**Table 2** Language background questionnaire

Variable	English	Spanish	Other
L1	N = 29	N = 34	
L2	N = 34	N = 29	
Age of acquisition	0–5; N = 46 6–10; N = 10 11–15; N = 6 16–20; N = 1	0–5; N = 57 6–10; N = 2 11–15; N = 2 16–20; N = 1	
Years of schooling in language	0–5; N = 4 6–10; N = 14 11–15; N = 25 16–23; N = 19 20–25; N = 2	0–5; N = 37 6–10; N = 9 11–15; N = 10 16–20; N = 5	
Place of residence where language is spoken	N = 43	N = 37	
Language more comfortable speaking	N = 46	N = 27	Spanglish; N = 12 Neither; N = 1
Language more comfortable reading	N = 48	N = 5	Both; N = 14

education in English speaking institutions. A comparable number of participants reported residing in an English-speaking region (N = 43) and in a Spanish-speaking region (N = 37), as might be expected given the fact that TAMIU is located in a city bordering Mexico.

## 2.2.2 Materials

Following the typology of idioms developed by Alexander (1991), a broad range of idiomatic stimuli were used in the experiment. There were 32 different idioms in total. These included phrases (e.g. ‘in deep water’, ‘cup of tea’), semi-clauses and full clauses (e.g. ‘sweep under the carpet’, ‘get off the ground’), phrasal compounds (e.g. ‘night owl’, ‘red tape’), Verb (+ Determiner) + Noun combinations (e.g. ‘draw the line’, ‘burn bridges’), and phrasal verb idioms (e.g. ‘rip off’, ‘put down’).

The stimuli were matched on a number of characteristics, such as idiom familiarity, word frequency, idiom compositionality (the degree to which the meaning of the idiom can be seen as a sum of the meanings of its component parts), transparency (the degree to which figurative meaning of the idiom can be deduced from its literal interpretation), and idiom predictability (the degree to which, given the first word or the first few words of the idiom, its idiomatic interpretation becomes immediately accessible). All of those characteristics have been shown to crucially affect the speed of idiom recognition (e.g. Titone and Connine 1994; Heredia and Cieřlicka 2008). Titone and Connine’s (1994)

published norms from English monolinguals which were first normed with Spanish–English/English–Spanish bilinguals from the Psychology subject pool at Texas A&M International University (see Heredia and Cieřlicka 2008).

Each idiom was used either in its figurative or literal meaning. In addition, when used both figuratively and literally, each idiom was either embedded in a sentence with the neutral preceding context or rich supportive context clearly biasing one of the meanings (see Table 1). Each idiom was thus used in four different conditions, for the total number of 128 idiomatic sentences. The sentences were normed in a pretest, in which 20 native speakers of English were asked to read each of them and decide if the idioms were meant literally or figuratively, as well as to evaluate whether the context in which they were embedded was indeed neutral or literal/figurative-biased. Care was taken to ensure that the neutral context preceding an idiom used figuratively and literally was identical.

Four lists were created, in which each idiom only occurred in one of the four conditions, so that the participants were not presented with the same idiom twice. Each list contained 32 idiomatic sentences and 68 filler sentences, presented in a randomized order for each participant. Also included in the lists were YES/NO comprehension questions referring to the sentence that preceded it. The questions were randomly presented to ensure that participants comprehended the sentences they were instructed to read.

### 2.2.3 Apparatus and Procedure

The data were acquired using the Eye-Link 1000 tower mounted system, with a sampling rate of 1 kHz. Eye movements were recorded from the right eye only. Based on Latin Square counterbalancing, participants were assigned to one of four lists. At the beginning of the session, the participants were asked to complete the Language Background Questionnaire. They were next directed to the Eye-Link computer, seated approximately 60 cm from the monitor and had their head supported by a chin rest to minimize head movements. The participants were instructed to read the sentences displayed on the computer screen and to answer YES/NO questions pertaining to the sentences by pressing the designated buttons on a Microsoft game controller device. Following the calibration procedure, the experimental session started, which included 12 practice trials to ensure that participants became familiar with the experimental procedure. At the beginning of each trial, participants focused on a fixation point that appeared against a white background towards the left of the screen. Once they fixated on the black dot, they were asked to press a button on a Microsoft game controller device in order to trigger sentence presentation. When they finished reading the sentence and were ready for the next trial, they had to press the same button again to trigger the display of the fixation point and the new sentence.

After the end of the experiment, all participants rated their familiarity with the idiomatic expressions used in the study. They were presented with each idiom accompanied by a 5-point Likert scale, ranging from 1—totally unfamiliar to

5—completely familiar. Only the idioms with the rating above 4.0 were included in the data analysis for a given participant. The data pertaining to idioms that were not known (overall 2 %) were removed.

## 2.3 Results

Data were first inspected for accuracy of the responses provided by the participants to the YES/NO comprehension questions. All participants met the criterion of 90% accuracy. The data were analyzed in terms of the total reading time and fixation count for the idiom region and the post-idiom region, as well as in terms of regressions to the idiom region. The design conformed to mixed factorial with language dominance (English- vs. Spanish-dominant) as a between-subject factor, and idiom usage (figurative vs. literal) and context (neutral vs. supportive) as within-subject factors, and subjects and items as random variables.

### 2.3.1 Total Reading Time

Mixed linear analysis of the total reading time on the idiom region revealed a significant main effect of language (i.e., Spanish vs. English),  $F(1, 52) = 4.68$ ;  $p < 0.05$ ; a significant main effect of context,  $F(1, 52) = 7.02$ ;  $p < 0.01$  and a significant interaction between language dominance and idiom usage,  $F(1, 52) = 3.49$ ;  $p < 0.1$  (see Table 3 and Fig. 1). No other effects were significant. As can be seen in Table 3, the total reading time for the idiom region was significantly shorter for English-dominant (549 ms for figuratively and 529 ms for literally used idioms) than for Spanish-dominant bilinguals (627 ms for figuratively and 624 ms for literally used idioms) in the neutral context condition. This suggests that bilinguals are indeed faster in recognizing idiomatic expressions in the dominant than the nondominant language. In addition, the total reading time for the idiom region was significantly shorter when idioms were preceded by the supportive than neutral context for both English- and Spanish-dominant participants, suggesting that context plays a crucial role in idiomatic language processing, regardless of language dominance.

Results for the post-idiom region showed a significant main effect of language dominance,  $F(1, 52) = 8.42$ ;  $p < 0.05$ , a significant main effect of context,  $F(1, 52) = 2.61$ ;  $p < 0.05$ , and a significant main effect of idiom usage,  $F(1, 52) = 9.69$ ;  $p < 0.001$  (see Table 3 and Fig. 1). It should be noted that total reading times on the post-idiom region were calculated as averages per character, since the region varied in length for each sentence. Overall, total reading time for the post-idiom region was significantly shorter for English- than Spanish-dominant bilinguals in all conditions. In addition, for English-dominant bilinguals there was a trend towards significance for the post-idiom region to have shorter total reading times when idioms were embedded in the supportive context and used in their figurative meaning (49 ms)

**Table 3** Mean total reading time for the idiom region and post-idiom region, averaged per character, for English-dominant and Spanish-dominant bilinguals. Standard errors are provided in parentheses

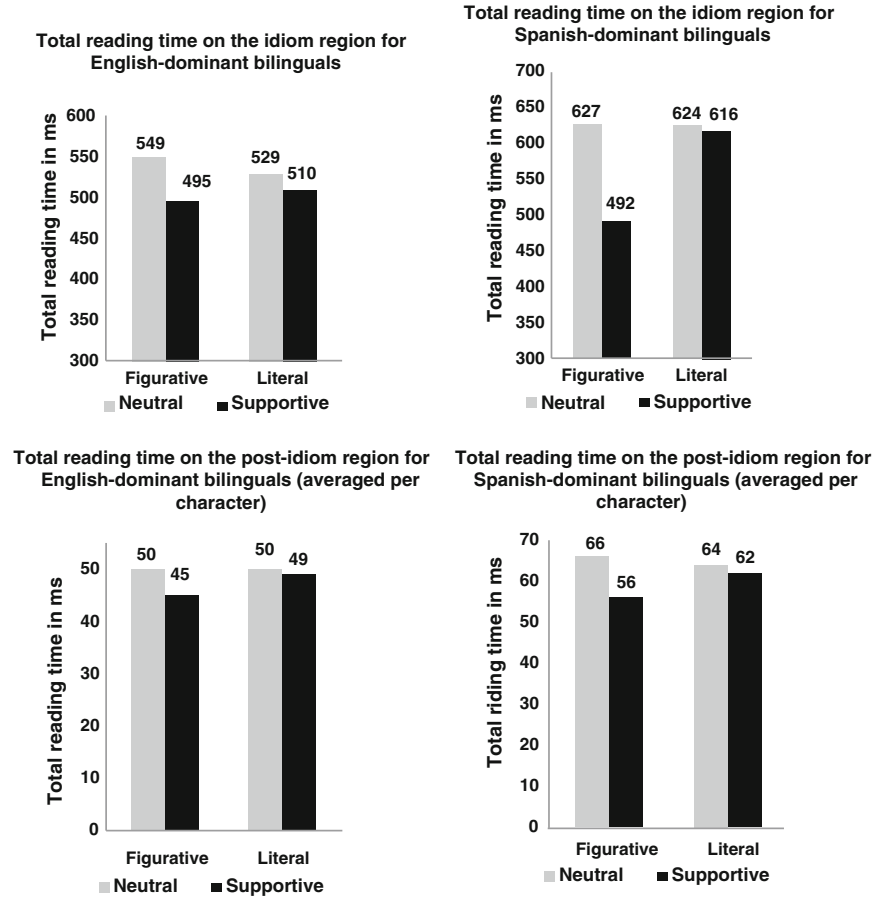
Language dominance	Area of interest	Total reading time			
		Context			
		Supportive		Neutral	
		Usage		Usage	
		Figurative	Literal	Figurative	Literal
English	Idiom region	495 (146)	510 (135)	549 (134)	529 (146)
	Post-idiom region	45 (2.53)	49(2.56)	50 (2.20)	50 (1.95)
Spanish	Idiom region	492 (83)	616 (172)	627 (248)	624 (145)
	Post-idiom region	56 (5.27)	62 (7.55)	66 (6.28)	64 (7.33)

than in their literal meaning (49 ms), suggesting that figurative meaning was more salient for English-dominant readers. On the other hand, Spanish-dominant bilinguals had shorter reading times on the post-idiom region when idioms were preceded by the neutral context and used literally (64 ms) than figuratively (66 ms), suggesting that literal meanings might be more salient and readily available when processing idioms in non-dominant language. However, this effect was not consistent for Spanish-dominant bilinguals, as in the supportive preceding context the reverse was found, with shorter reading times for the post-idiom region when idioms were used figuratively (56 ms) than literally (62 ms).

2.3.2 Fixation Count

No significant main effects or interactions were found in the fixation count data for the idiom region. However, when run for the post-idiom region, mixed linear analysis on the fixation data revealed a significant main effect of context,  $F(1, 150) = 32.05$ ;  $p < 0.0001$ , a marginally significant two-way interaction between context and language,  $F(1, 150) = 2.87$ ;  $p = 0.6$ , as well as a marginally significant three-way interaction between language, context, and usage,  $F(1, 1, 515) = 3.16$ ;  $p = 0.7$  (see Table 4 and Fig. 2 for summary).

As shown in Table 4, regardless of language dominance, there were significantly fewer fixations on the post-idiom region when the idioms were preceded by the supportive than neutral context. This effect held true for idioms used both literally and figuratively, suggesting a powerful role of context in figurative language processing and confirming the results obtained for the total reading time measure. Multiple comparisons using the Least Significant Difference (LSD) revealed that English dominant bilinguals fixated significantly less on the post-idiom region in the neutral preceding context when the idiom was used figuratively (0.33) than Spanish bilinguals (0.42), suggesting that the figurative meaning was more easily retrievable and more salient for the bilinguals dominant in English.



**Fig. 1** Mean total reading time for the idiom region (*top panel*) and post-idiom region (*bottom panel*) for English-dominant and Spanish-dominant bilinguals

2.3.3 Regressions

Regression data analysis showed a significant main effect of context,  $F(1, 398) = 8.1$ ;  $p < 0.01$  and a significant interaction between context and usage,  $F(1, 398) = 8.1$ ;  $p < 0.05$ . Mean number of regressions to the idiom region for idioms used in the four conditions is summarized in Table 5 (see also Fig. 3).

Both Spanish- and English-dominant bilinguals had significantly fewer regressions when the idioms were used in the supportive than in the neutral context, but only when they were meant figuratively. In addition, Spanish-dominant bilinguals showed significantly fewer regressions to the idiom region in the neutral preceding context when the idiom was used literally (1.12) than

**Table 4** Mean fixation count for the idiom region and post-idiom region, averaged per character, for English-dominant and Spanish-dominant bilinguals. Standard errors are provided in parentheses

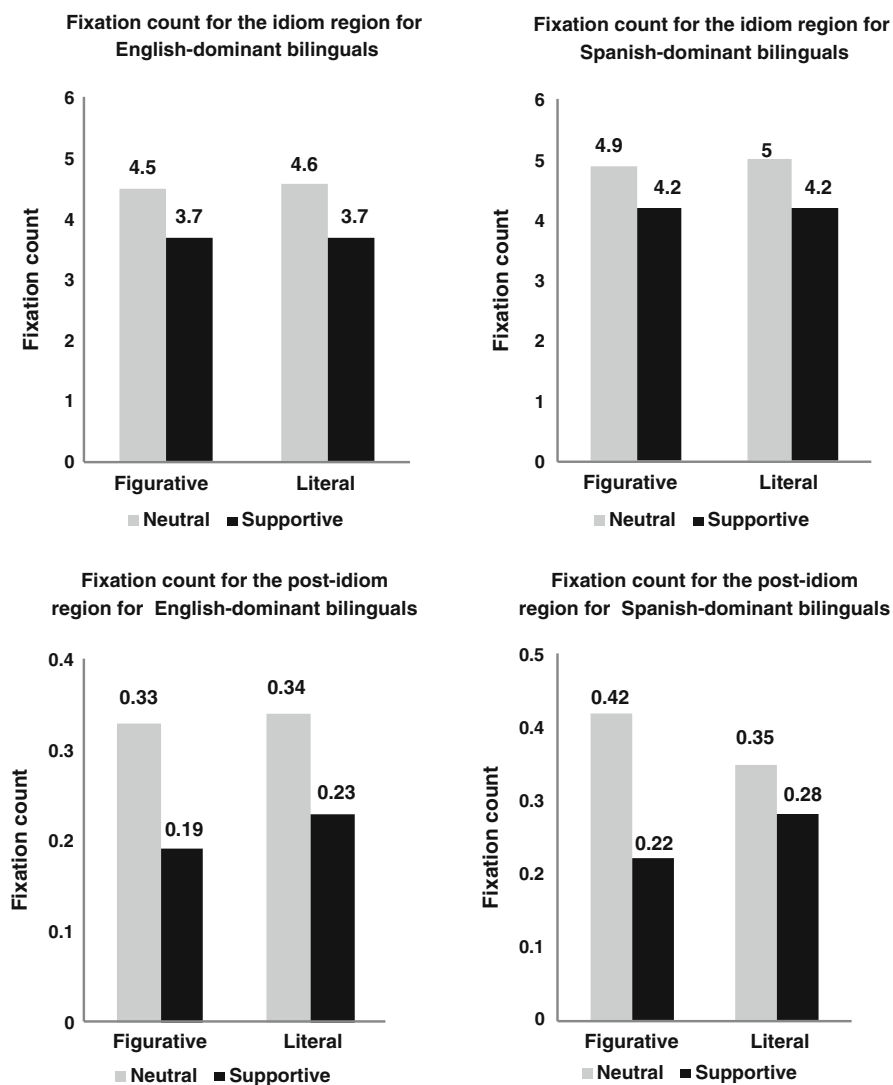
Language dominance	Area of interest	Fixation count			
		Context			
		Supportive		Neutral	
		Usage		Usage	
		Figurative	Literal	Figurative	Literal
English	Idiom region	3.7 (0.18)	3.7 (0.16)	4.5 (0.24)	4.6 (0.20)
	Post-idiom region	0.19 (0.02)	0.23 (0.02)	0.33 (0.02)	0.34 (0.02)
Spanish	Idiom region	4.2 (0.35)	4.2 (0.34)	4.9 (0.60)	5 (0.54)
	Post-idiom region	0.22 (0.03)	0.28 (0.03)	0.42 (0.03)	0.35 (0.03)

figuratively (1.47), suggesting that the literal meaning of the English idioms was easier to process and thus more salient for the bilinguals who were less proficient in English.

3 Discussion and Conclusions

In this study, we looked at the effects of context, salience, and language dominance on the on-line processing of English idiomatic expressions by Spanish-dominant and English-dominant bilinguals. To determine how these factors influence idiomatic processing, we measured eye movements of bilingual participants while they read idioms used in their literal or figurative meaning and preceded either by the rich supportive context clearly biasing their meaning or by a neutral context. The eye measures recorded were the number of fixations and total reading for both the idiom and post-idiom regions, as well as regressions (i.e. regressive fixations from the post-idiom to the idiom region). Our research questions asked whether there would be a significant effect of context for both figuratively and literally used idioms, whether eye measures would differ depending on whether the idioms are used figuratively or literally, and whether language dominance would affect which meaning (figurative or literal) is more salient and hence processed faster.

Overall, all the three factors (context, salience, and language dominance) were found to significantly affect idiom processing and our predictions were mostly supported. Context was significant in all the reading measures and strongly affected idiom processing regardless of language dominance. More specifically, total reading time for the idiom region was significantly shorter when the idioms were embedded in the supportive than in neutral context. This effect was obtained for idioms used figuratively and for both Spanish- and English-dominant participants. Similarly, fixation count data for the post-idiom region showed that there were significantly fewer fixations for the sentences where the idioms were

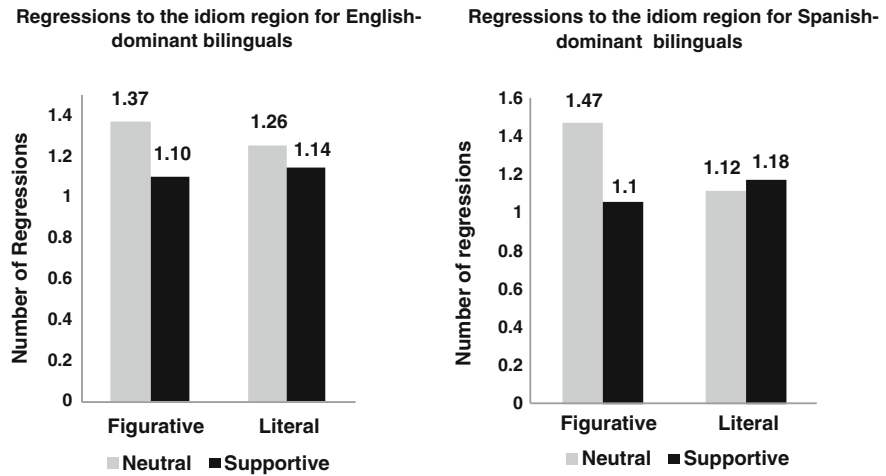


**Fig. 2** Mean fixation count on the idiom region and post-idiom region for English-dominant and Spanish-dominant bilinguals

preceded by the supportive than by neutral context. This effect held true regardless of idiom usage, suggesting that a rich supportive context biasing the less frequent, literal reading of the idiomatic expression can successfully speed up its comprehension, even if the meaning is less salient. Finally, context effects were also revealed in the regression data, as fewer regressions were made to the idiom region in the supportive than in the neutral context, for both Spanish- and English-dominant participants.

**Table 5** Mean number of regressions to the idiom region for English-dominant and Spanish-dominant bilinguals. Standard error is provided in parentheses

Language dominance	Area of interest	Regressions			
		Context			
		Supportive		Neutral	
		Usage		Usage	
		Figurative	Literal	Figurative	Literal
English	Idiom region	1.10 (0.06)	1.14 (0.06)	1.37 (0.06)	1.26 (0.05)
Spanish	Idiom region	1.06 (0.14)	1.18 (0.10)	1.47 (0.11)	1.12 (0.10)



**Fig. 3** Mean number of regressions to the idiom region for English-dominant and Spanish-dominant bilinguals

Language dominance clearly plays a significant role in figurative language processing, as suggested by Matlock and Heredia (2002). Total reading time for the idiom region and post-idiom region was significantly shorter for English- than for Spanish-dominant bilinguals. This suggests that English stimuli were easier to process as a function of participants' dominance in that language. Moreover, language dominance dynamically interacted with salience and context, affecting the speed of processing of the idiomatic expressions used literally and figuratively. In line with the previous literature suggesting that less proficient bilinguals might process literal meanings of L2 idioms faster than figurative meanings (Kecskes 2000; Liontas 2002; Abel 2003; Cieřlicka 2006; Cieřlicka and Heredia 2011), we expected to find fewer fixations and shorter readings times for literally than for figuratively used idioms in Spanish-dominant bilinguals. Conversely, English-dominant bilinguals were expected to produce data compatible with those reported for English monolingual speakers in the previous literature and show preference



for figuratively over literally used idioms, as figurative meanings are well established in their mental lexicons (Giora 1999, 2002, 2003).

Overall, we found evidence of literal salience preference for Spanish-dominant vs. English-dominant bilinguals; however, the effect was not consistent across all conditions. Similarly, the results for English-dominant bilinguals are partially compatible with the Graded Salience Hypothesis, showing that the figurative meanings of idioms were at times more easily available than literal ones, but again this effect did not hold true for all conditions and was only present in the total reading time and fixation data recorded for the post-idiom region. For example, as predicted, total reading time for the post-idiom region was shorter for English-dominant bilinguals when the idioms were used figuratively rather than literally, which implies that the figurative meanings were more salient and thus easier to process. On the other hand, for Spanish-dominant bilinguals total reading time for the post-idiom region was shorter when the idioms were used literally rather than figuratively and preceded by the neutral context. This implies that for those bilinguals it was the literal meaning of an idiomatic expression that got activated by default when no biasing context was present. When the following disambiguating context was consistent with the activated literal reading, it took shorter to process. In case when the following context biased the figurative reading of the idiom, the language processing mechanism had to suppress the literal meaning activated earlier and to resolve the inconsistency by reinterpreting the idiom figuratively. However, the results for Spanish-English bilinguals were inconsistent in the supportive context, where the reverse was found to be true, namely shorter reading times for the post-idiom region when the idioms were used figuratively rather than literally.

Differences in figurative and literal processing as a function of language dominance were also found in the fixation count data for the post-idiom region. Here, fewer fixations were recorded for figuratively used idioms in English-dominant than Spanish-dominant bilinguals, which would again imply that the figurative meanings of English idioms are more readily available (i.e. more salient) for bilinguals dominant in that language. Finally, the regression data also showed a dissociation between the salience status for the figurative and literal idiom readings as a function of language dominance. While there was no difference between regressions for figuratively and literally used idioms in English-dominant bilinguals, Spanish-dominant bilinguals had significantly fewer regressions when the idiom was used literally rather than figuratively.

The current data are broadly compatible with the limited bilingual figurative eye-processing literature. Similar to Siyanova-Chanturia et al. (2011), we found a difference in idiom processing as a function of the language status. As argued before, Siyanova-Chanturia et al. (2011) looked at the differences between idiom processing in native and non-native speakers of English. The study showed a processing advantage for idioms over novel phrases only for native speakers, suggesting that those expressions are retrieved holistically from the mental lexicon for L1 language users. For non-native speakers, there were no differences in processing times between idioms and novel phrases, which would imply that less

proficient L2 users have to process those expressions in a fashion similar to processing novel non-formulaic sequences, through the compositional analysis of each word. While we did not specifically compare idiom processing to non-idiomatic phrases, our study also showed faster and more efficient retrieval of idioms for more proficient speakers (English-dominant bilinguals) than less proficient ones (Spanish-dominant bilinguals).

Similar to Siyanova-Chanturia et al.'s (2011) results, which showed faster processing of literally than figuratively used idioms in non-native speakers, our data also revealed that the literal meanings of the idiomatic phrases were activated faster in less proficient, Spanish-dominant participants, further confirming the findings reported in the previous literature concerning literal salience preference for late bilinguals and L2 users (e.g. Kecskes 2000; Liontas 2002; Abel 2003; Cieřlicka 2006; Cieřlicka and Heredia 2011). As mentioned earlier, our eye movement data for the idiom region for English-dominant bilinguals showed no differences in the number and duration of fixations for idioms used either figuratively or literally. These results are also consistent with Siyanova-Chanturia et al.'s (2011) study where processing times for idioms did not differ significantly, regardless of whether idioms were meant figuratively or literally.

The data pertaining to the role of context obtained in the current study further extend the findings of Cieřlicka et al. (2008), where native speakers of English had significantly fewer and shorter fixations on the idioms preceded by the supportive rather than the neutral context. The current study also showed a robust effect of context, regardless of whether the idioms were used literally or figuratively and regardless of language dominance. The present findings are inconsistent with the eye tracking study conducted by Titone and Connine (1999) who found no differences in decomposable idiom processing, regardless of whether the context preceded or followed them and a slower processing times for nondecomposable idioms preceded by the supportive than by the neutral context. However, we did not look at the dimension of compositionality and our idioms were all matched along this characteristic, and therefore it is difficult to make a direct comparison.

Overall, the eye tracking study reported here confirms the findings from previous research conducted with different behavioral paradigms that have demonstrated the complexity of figurative language processing in bilingual participants. It seems that many different factors affect on-line comprehension of idiomatic phrases in bilingual language users and that additional eye tracking research is needed to fully capture the intricacies of bilingual figurative processing.

## References

- Abel, B. 2003. English idioms in the first language and second language lexicon: A dual representation approach. *Second Language Research* 19: 329–358.
- Abutalebi, J., S. F. Cappa and D. Perani. 2001. The bilingual brain as revealed by functional neuroimaging. *Bilingualism: Language and Cognition* 4: 179–190.

- Abutalebi, J., S. F. Cappa and D. Perani. 2005. What can functional neuroimaging tell us about the bilingual brain? In *Handbook of bilingualism: Psycholinguistic approaches*, eds. J. F. Kroll and A. M. B. De Groot, 497–515. Oxford: Oxford University Press.
- Abutalebi, J. and D. W. Green. 2007. Bilingual speech production: The neurocognition of language representation and control. *Journal of Neurolinguistics* 20: 242–275.
- Alexander, R. J. 1991. Hopes and fears of a corpus linguist: Or the sad, but edifying tale of a corpus search for fixed expressions. *Series A: General and Theoretical Papers* 311: 1–15.
- Altarriba, J. and D. M. Basnight-Brown. 2007. Methodological consideration in performing semantic-and translation-priming experiments across languages. *Behavior Research Methods* 39: 1–18.
- Altenberg, B. 1998. On the phraseology of spoken English: The evidence of recurrent word combinations. In *Phraseology: Theory, analysis, and applications*, ed. A. P. Cowie, 101–122. Oxford: Oxford University Press.
- Cieślicka, A. 2006. Literal salience in on-line processing of idiomatic expressions by L2 speakers. *Second Language Research* 22: 115–144.
- Cieślicka, A. 2007. Language experience and fixed expressions: Differences in the salience status of literal and figurative meanings of L1 and L2 idioms. In *Collocations and idioms 1: Papers from the First Nordic Conference on Syntactic Freezes, Joensuu, Finland*, eds. M. Nenonen and S. Niemi, 55–70. Joensuu: Joensuu University Press.
- Cieślicka, A. 2008. Hemispheric differences in processing salient and nonsalient meanings of L1 and L2 fixed expressions. In *Lenguaje figurado y motivación: Una perspectiva desde la fraseología*, ed. M. À. de la Granja, 111–127. Frankfurt am Main: Peter Lang.
- Cieślicka, A. 2010. Formulaic language in L2: Storage, retrieval and production of idioms by second language learners. In *Cognitive processing in second language acquisition: Inside the learner's mind*, eds. M. Pütz and L. Scola, 149–168. Philadelphia: John Benjamins.
- Cieślicka, A. B. 2012. Do nonnative language speakers *chew the fat* and *spill the beans* with different brain hemispheres?: Investigating idiom decomposability with the divided visual field paradigm. *Journal of Psycholinguistic Research*. DOI [10.1007/s10936-012-9232-4](https://doi.org/10.1007/s10936-012-9232-4).
- Cieślicka, A. B. and R. R. Heredia. 2011. Hemispheric asymmetries in processing L1 and L2 idioms: Effects of salience and context. *Brain and Language* 116: 136–150.
- Cieślicka, A. B., O'Rourke and D. Singleton. 2008. The processing of multi-word units: Evidence from readers' eye movements. In *Perspektywy glottodydaktyki i językoznawstwa. Tom jubileuszowy z okazji 70. urodzin Profesora Waldemara Pfeiffera*, eds. K. Myczko, B. Skowronek and W. Zabrocki, 39–55. Poznań: Wydawnictwo Naukowe UAM.
- Cieślicka, A. B., B. O'Rourke and D. Singleton. 2009. Salience or context in the processing of L1 and L2 multi-word units? In *On language structure, acquisition and teaching: Studies in honour of Janusz Arabski on the occasion of His 70th birthday*, ed. M. Wysocka 293–304. Katowice: University of Silesia Press.
- Conklin, K. and N. Schmitt. 2008. Formulaic sequences: Are they processed more quickly than nonformulaic language by native and nonnative speakers? *Applied Linguistics* 29: 72–89.
- Cutler, A. 1983. Lexical complexity and sentence processing. In *The process of language understanding*, eds. G. B. F. d'Arcais and R. J. Jarvella. New York: Wiley.
- Dunn, A. L. and J. E. Fox Tree. 2009. A quick, gradient Bilingual Dominance Scale. *Bilingualism: Language and Cognition* 12: 273–289.
- Gibbs, R. W., N. P. Nayak and C. Cutting. 1989. How to kick the bucket and not decompose: Analyzability and idiom processing. *Journal of Memory and Language* 28: 576–593.
- Gibbs, R. W. and N. P. Nayak. 1989. Psycholinguistic studies on the syntactic behavior of idioms. *Cognitive Psychology* 21: 100–138.
- Giora, R. 1999. On the priority of salient meanings: studies of literal and figurative language. *Journal of Pragmatics* 31: 919–929.
- Giora, R. 2002. Literal vs. figurative language: Different or equal? *Journal of Pragmatics* 34: 487–506.
- Giora, R. 2003. *On our mind: Salience, context, and figurative language*. Oxford: Oxford University Press.

- Heredia, R. R. 1997. Bilingual memory and hierarchical models: A case for language dominance. *Current Directions in Psychological Science* 6: 34-39.
- Heredia, R. R. 2008. Mental models of bilingual memory. In *An introduction to bilingualism: Principles and processes*, eds. J. Altarriba and R. R. Heredia, 39-67. New York, NY: Lawrence Erlbaum.
- Heredia, R. R. and J. Altarriba. 2001. Bilingual language mixing: Why do bilinguals code-switch? *Current Directions in Psychological Science* 10: 164-168.
- Heredia, R. R. and J. M. Brown. 2013. Bilingual memory. In *The handbook of bilingualism and multilingualism*, eds. T. K. Bhatia and W. C. Ritchie, 269-291. Malden, MA: Wiley-Blackwell Publishing LTD.
- Heredia, R. R. and A. B. Cieřlicka 2008. [Regression analyses on bilingual idiom norms from Titone and Connine's 1994 descriptive norms for 171 idiomatic expressions]. Unpublished data.
- Heredia, R. R., O. García and M. R. Penecale. 2007. The comprehension of idiomatic expressions by Spanish-English bilinguals. Paper presented at the 48th annual Meeting of the Psychonomic Society, Long Beach, CA.
- Hernández, A. E. and K. J. Kohnert. 1999. Aging and language switching in bilinguals. *Aging, Neuropsychology, and Cognition* 6: 69-83.
- Indefrey, P. 2006. A meta-analysis of hemodynamic studies on first and second language processing: Which differences can we trust and what do they mean? *Language Learning* 56: 279-304.
- Jiang, N. and T. M. Nekrasowa. 2007. The processing of formulaic sequences by second language speakers. *Modern Language Journal* 91: 433-445.
- Kecskes, I. 2000. A cognitive-pragmatic approach to situation-bound utterances. *Journal of Pragmatics* 32: 605-625.
- Liontas, J. 2002. Context and idiom understanding in second languages. In *EUROSLA Yearbook*, 155-185. Amsterdam: John Benjamins.
- Matlock, T. and R. R. Heredia. 2002. Understanding phrasal verbs in monolinguals and bilinguals. In *Bilingual sentence processing*, eds. R. R. Heredia and J. Altarriba, 251-274. Amsterdam: Elsevier.
- Meisel, J. M. 2007. The weaker language in early child bilingualism: Acquiring a first language as a second language? *Applied Psycholinguistics* 28: 495-514.
- Nunberg, G., I. A. Sag and T. Wasow. 1994. Idioms. *Language* 70: 491-534.
- Perani, D. and J. Abutalebi. 2005. The neural basis of first and second language processing. *Current Opinion in Neurobiology* 15: 202-206.
- Perani, D., J. Abutalebi, E. Paulesu, S. Brambati, P. Scifo and S. F. Cappa. 2003. The role of age of acquisition and language use in early, high-proficient bilinguals: An fMRI study during verbal fluency. *Human Brain Mapping* 19: 179-182.
- Schmitt, N. and R. Carter. 2004. Formulaic sequences in action: An introduction. In *Formulaic sequences: Acquisition, processing, and use*, ed. N. Schmitt, 1-22. Philadelphia: John Benjamins.
- Schoonbaert, S., W. Duyck, M. Brysbaert and R. J. Hartsuiker. 2009. Semantic and translation priming from a first language to a second language and back: Making sense of findings. *Memory and Cognition* 37: 569-586.
- Siyanova-Chanturia, A., K. Conklin and N. Schmitt. 2011 Adding more fuel to the fire: An eye-tracking study of idiom processing by native and nonnative speakers. *Second Language Research* 27: 251-272.
- Spöttl, C. and M. McCarthy. 2004. Comparing knowledge of formulaic sequences across L1, L2, L3, and L4. In *Formulaic sequences: Acquisition, processing, and use*, ed. N. Schmitt, 191-225. Philadelphia: John Benjamins.
- Stowe, L. A. and L. Sabourn. 2005. Imaging the processing of a second language: Effects of maturation and proficiency on the neural processes involved. *International Review of Applied Linguistics* 43: 327-351.

- Swinney, D. W. and A. Cutler. 1979. The access of idiomatic expressions. *Journal of Verbal Behavior and Verbal Learning* 18: 523–534.
- Titone, D. A. and C. M. Connine. 1994. Descriptive norms for 171 idiomatic expressions: familiarity, compositionality, predictability, and literality. *Metaphor and Symbolic Activity* 9: 247–270.
- Titone, D. A. and C. M. Connine. 1999. On the compositional and noncompositional nature of idiomatic expressions. *Journal of Pragmatics* 31: 1655–1674.
- Underwood, G., N. Schmitt and A. Galpin, A. 2004. The eyes have it: An eye-movement study into the processing of formulaic sequences. In *Formulaic sequences: Acquisition, processing, and use*, ed. N. Schmitt, 153–172. Philadelphia: John Benjamins.
- Vaid, J. and D. G. Hall. 1991. Neuropsychological perspectives on bilingualism: Right, left, and center. In *Bilingualism, multiculturalism, and second language learning: The McGill conference in honor of Wallace E. Lambert*, ed. A. Reynolds, 81–112. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Vaid, J. and R. Hull. 2002. Re-envisioning the bilingual brain using functional neuroimaging: Methodological and interpretive issues. In *Advances in the neurolinguistics of bilingualism: A festschrift for Michel Paradis*, ed. F. Fabbro, 315–355. Udine, Italy: Forum.

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