THE (RE)ACTIVATION OF IDIOMATIC EXPRESSIONS

A Thesis

by

ARIANA CECILIA GARCIA

Submitted to Texas A&M International University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

August 2017

Major Subject: Psychology

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Approved as to style and content by:

Chair of Committee,	Dr. Roberto R. Heredia
Committee Members,	Dr. Anna B. Cieślicka
	Dr. Monica E. Muñoz
	Dr. Daniel J. Mott
Head of Department,	Dr. Jose Carlos Lozano

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ABSTRACT

The (Re)activation of Idiomatic Expressions (August 2017)

Ariana Cecilia Garcia, Bachelor of Arts in Psychology, Texas A&M International University;

Chair of Committee: Dr. Roberto R. Heredia

These studies examine the comprehension of idiomatic expressions by bilingual speakers. The purpose of this study was to look at the (re)activation of the meaning (literal vs. figurative) of idiomatic expressions by bilinguals. Spanish-dominant, English-dominant, and balanced bilinguals listened to English sentences containing idiomatic expressions of the type, "I'm not one to make a scene, but after he yelled at me, that was impossible to avoid." Participants made lexical decisions to critical targets that were literally (e.g., "play"), figuratively (e.g., "disturbance"), and unrelated (i.e., controls) to the critical idiomatic expressions. For experiment 1, critical targets were presented immediately at idiom offset (0ms), and immediately after a pronoun anaphor (e.g., this, that, it). The purpose of experiment 2 was to further investigate idiom meaning (re)activation. In this experiment, critical targets were presented at idiom onset (before idiom) and 300ms after anaphor offset. Analyses were conducted for all independent variables (*language dominance*: Spanish vs. English vs. Balance, *cue*: 1 vs. 2 or pre-cue vs. 3, *relatedness*: related vs. unrelated, and *figurativeness*: literal vs. figurative) by the dependent variable (*reaction time*).

Results revealed that idiom meaning (re)activation was modulated by language dominance, where English-dominant bilinguals had significantly faster responses than both Spanish-dominant and balanced bilinguals. Overall, there was a general tendency for literal meanings of idioms to be

more active in all bilinguals, as revealed by faster reaction times. Results support the *Literal Salient Model* (Cieślicka, 2006a; 2006b; Heredia & Cieślicka, 2016; Heredia & Muñoz, 2015).

Keywords: idiomatic expressions, language dominance, second language (L2) idiom processing, bilingual figurative language, anaphora.

DEDICATION

In loving memory of Carlos Moreno de la Cruz and Elena María Gamiz de Moreno.

"Solamente una vez amé en la vida" - Agustín Lara

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Finally, to my two angels, thank you for never leaving my side.

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THE (RE)ACTIVATION OF IDIOMATIC EXPRESSIONS

The present study examines the (re)activation of literal and metaphoric meanings of idiomatic expressions by English-Spanish and Spanish-English bilinguals. Idiomatic phrases are typically described as linguistic expressions whose meaning is not a direct function of the meanings of their parts (Swinney & Cutler, 1979; Tabossi, Arduino, & Fanari, 2011). That is, idioms are often processed as units, rather than processed word by word. As an example, the idiomatic expression "I told Jessica not to smoke or she would kick the bucket, but she didn't care and it finally happened." The critical expression, in this case "kick the bucket" could be read in terms of its intended meaning (i.e., figurative interpretation) that Jessica's smoking might led to her death. Alternatively, the literal meaning would denote Jessica physically striking a container with her foot (Bobrow & Bell, 1973; Tabossi et al., 2011).

IDIOMATIC EXPRESSIONS

Meanings of an idiom's elements play an important role in the interpretation and use of the idiom. Although idiomatic expressions are intended for figurative use, some were not figurative in their origins (Cacciari & Glucksberg, 1991). For example, the idiomatic expression "spill the beans," which means to reveal a secret, originates from an ancient method of voting (Cacciari & Glucksberg, 1991; Gibbs, 1980). The principle of this version of democratic voting was that voters would put a bean into one of several cups – representing a candidate – in order to cast their vote in anonymity (Gibbs, 1980; Ortony, Schallert, Reynolds, & Antos, 1978). Dropping/tipping the jars, spilling the beans inside, would reveal who the winner was before counting was completed; therefor, revealing a secret. In the case of "break a leg," the idiomatic expression is used as an ironic way of wishing someone good luck (Cacciari & Glucksberg, 1991). This expression is

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This thesis follows the style of *Frontiers in Psychology*.

mainly used in the entertainment and art world (theater) since there is a belief that wishing someone "good luck" will in fact cause the opposite. It is believed that the expression may originate from Ancient Greece or Elizabethan times (Sobel, 1948). During both of these eras, instead of applause, people would resort to stopping and if they did so hard enough – meaning they liked the performance – the legs of their benches would break (Sobel, 1948). Idiomatic expressions are stored in the mental lexicon and its representations do not only include the meaning and syntactic idiosyncrasies of each word in the phrase, but also their figurative meaning (Bobrow & Bell, 1973; Sprenger, Levelt, & Kempen, 2006). However, as previously discussed, some idioms have components that refer to a literal interpretation, as well as the figurative meaning of the phrase. For instance, in the idiom "break the ice," the word "ice" refers to a *cold* social atmosphere and "break" would be the process of changing it (Sprenger et al., 2006). In contrast, "ice" literally refers to *cold* water that has been frozen to a solid state. "Thus, certain roles and relationships between the entities in the idiom can be mapped onto their figurative counterparts" (Sprenger et al., 2006, p. 162). This means that although idioms are stored as figurative language, certain idioms can have additional representations in the lexicon by the literal meaning of its components (Sprenger et al., 2006; Nunberg, Sag, & Wasow, 1994).

THEORIES OF IDIOM PROCESSING

There are four main theoretical hypotheses that account for the comprehension of idiomatic expressions, and other types of figurative language (Blasko & Connine, 1993; Cacciari & Tabossi, 1988; Camisa, 2013; Heredia & Cieślicka, 2016; Swinney & Cutler, 1979). Although these models were originally proposed for language processing in monolinguals, they have been generalized to bilingual figurative language processing. The first theoretical hypothesis of figurative language processing is the *lexical representation hypothesis*, which suggests that figurative language, such

as idiomatic expressions, are mentally represented in the same way single words are (Camisa, 2013; Swinney & Cutler, 1979; Tabossi, Fanari, & Wolf, 2005). This hypothesis assumes that idiomatic expressions are stored in the lexicon as one string, the same way a regular word would be (Tabossi et al., 2005). This would mean that the figurative and literal meanings of an idiom are accessed simultaneously. However, "the figurative interpretation would be accessed slightly faster since the phrase, or string of words, is stored as one entry (Bobrow & Bell, 1973, p. 344)." Accessing the literal interpretation would take slightly longer since each word has to be processed individually. The second hypothesis of figurative language processing is the *direct access hypothesis*, which proposes "literal interpretations are not necessarily encountered during processing (Gibbs, 1980, p. 150)." This hypothesis assumes that figurative interpretations may be accessed directly, "without first requiring an initial literal interpretation [to be rejected] (Blasko & Connine, 1993, p. 295)." In contrast, the *indirect processing hypothesis* suggests that an idiom's literal interpretation is always activated first, and it is only until the literal meaning has been rejected that a search for figurative interpretation begins (Heredia & Cieślicka, 2016; Heredia & Muñoz, 2015; Swinney & Cutler, 1979). Even though there is much evidence to support the *direct access hypothesis*, studies comparing the processing of decomposable and non-decomposable idiomatic expression supported the *indirect processing hypothesis* (see Caillies & Butcher, 2007). A fourth theoretical hypothesis of figurative language processing is the *configuration hypothesis* (Cacciari & Tabossi, 1988; Camisa, 2013). Although this hypothesis focuses on auditory processing of figurative language, its assumptions mimic those of the *indirect processing hypothesis* where idiomatic expressions are first recognized by their literal interpretation. The *configuration hypothesis* states idiomatic expressions are "assumed to activate the same lexical items that would otherwise be involved in the comprehension of literal discourse (Sprenger et al.,

2006, p. 163).” Meaning that the interpretation process will first activate the words’ literal meaning. The idiomatic expression is interpreted as literal and information begins to gather of the string, at which point the idiom is recognized as an expression (Cacciari & Tabossi, 1988; Sprenger et al., 2006; Titone & Connine, 1994a). Access to the figurative meaning of an idiomatic phrase requires it first being recognized as such. Therefore, the interpretation of an idiom will be literal until fully processed as figurative (Cacciari & Tabossi, 1988).

An additional hypothesis is the *graded salience hypothesis* (GSH). This hypothesis suggests that the comprehension of figurative language (i.e., idiomatic expressions) depends on which interpretation (i.e., literal vs. figurative) is more salient (Giora, 1997; 2003; Heredia & Cieślicka, 2016; Heredia & Muñoz, 2015; Kecskes, 2006). According to Giora (1997), “the salience of a word or an utterance is a function of its conventionality, familiarity, [and/or] frequency (p. 185).” Although this hypothesis does not predict which interpretation (literal vs. figurative) of an idiomatic expression will be activated first, it suggests that activation will depend on salience of the meanings of words in the expression (Kecskes, 2006). For instance, the literal meaning for an idiom such as “to cost an arm and a leg” would be more salient since the interpretation related to “body parts” or “limbs” is highly familiar and frequent. The figurative meaning representing “expensive” would be less salient, resulting in longer response times. In contrast, the figurative meaning of the idiom “burn the midnight oil” would be more salient since the interpretation related to “working late” is highly familiar and frequent. The literal meaning representing “candle oil” would be less salient and yield longer RTs.

In a classic cross-modal lexical priming (CMLP) study, Titone and Connine (1994a) examined the influence of predictability on idiom comprehension. Briefly, the CMLP task is a measure used to detect activation of lexical information during sentence comprehension (Swinney

& Cutler, 1979). In this task, participants listen to recorded sentences containing lexical ambiguities while, simultaneously, a string of letters is flashed on a computer screen. In Titone and Connine (1994a), participants heard sentences containing either high-predictable (e.g., "George wanted to bury the hatchet soon after Susan left") or low-predictable (e.g., "Fred wanted to hit the sack after his long day hiking") idioms and made lexical decisions to idiom-related (e.g. "forgive") or control targets (e.g., "sleep"). In this task, participants made lexical decisions in which they decided whether the target (e.g. "forgive" vs. "sleep") was a legal (real word) or illegal (nonword) word in English. Targets were presented at the idiom offset for experiment 1, and at penultimate position (second to last word of the idiom) for experiment 2. Results of these studies revealed that, at idiom offset, both high- and low-predictable idioms showed priming of the idiom-related targets (Titone & Connine, 1994a). In contrast, at penultimate position, high-predictable idioms showed more priming of the idiom-related targets than did low-predictable idioms. A third experiment examined the activation of the literal meaning of the last word of an idiom (Titone & Connine, 1994a). Participants heard sentences containing idioms from one of four categories: high-predictable literal (e.g., "The young student had cold feet about giving the presentation"), high-predictable nonliteral (e.g., "Harry had to burn the midnight oil to finish the project"), low-predictable literal (e.g., "The class was ready to paint the town after exams were over"), and low-predictable nonliteral (e.g., "Fran tried to make a clean sweep of her overdue project"). Literal (e.g. "toes" / "fuel" / "city" / "broom") and control targets were presented at idiom offset. Results from experiment 3 revealed that activation of the literal meaning of idioms was found for high-predictable literal, low-predictable literal, and low-predictable nonliteral idioms (Titone & Connine, 1994a). There was no significant meaning activation found for high-predictable nonliteral idioms. Authors concluded that these results were best characterized by the

configuration hypothesis in which idioms are represented in a distributed form (Cacciari & Tabossi, 1988).

Ortony, Schallert, Reynolds, and Antos (1978) found that the comprehension of phrases was consistently faster when such phrases were given a literal interpretation. They conducted two studies in which the targets were phrases that could be interpreted idiomatically or literally (Ortony et al., 1978). Target phrases were biased toward the literal or figurative interpretations. For instance, a sentence in the idiomatic interpretation context would read: "Mary was performing in her first play today, so I told her to break a leg to wish her good luck." Whereas a sentence in the literal interpretation context would read: "Mary was serving the turkey, so I told her to break a leg and pass it to me." Results indicated that subjects took significantly longer to understand idiomatic targets (Ortony et al., 1978). Although Ortony et al.'s (1978) findings seem to be supported empirically, other studies have suggested that stimuli presented with figurative language might have an effect on meaning activation. In two experiments, participants read a series of sentences that contained either literal or idiomatic ambiguities, and were later given a test that contained both interpretations (Bobrow & Bell, 1973). The overall results indicated that meaning activation was a function of biasing meaning exposure (Bobrow & Bell, 1973). That is, if participants were presented with idiomatic biased context, participants were most likely to trigger the idiomatic meaning of the test sentence first. In contrast, if the stimulus presented was of the literal kind, participants were more likely to read the literal meaning of the test sentence first.

The priming paradigm has been used in several studies as an index of meaning activation (see Beck & Weber, 2016; Cacciari & Tabossi, 1988; Titone & Connine, 1994a). Priming is the robust finding in which response to a target (e.g., "bread") is responded faster if the preceding stimulus (i.e., prime) is related (e.g., "butter") than unrelated (e.g., "bullet") (Matsukawa,

Snodgrass, & Doniger, 2005, p. 517). Priming, in this case, is an index of lexical activation, or how a particular concept is readily activated, in which the difference between a response to the related vs. unrelated targets are significantly different than zero. This is because, although they may not be necessarily related in semantic features, the target word would have a higher probability of appearing with the related prime, than the unrelated prime (Matsukawa et al., 2005; Perea & Rosa, 2002).

Cacciari and Tabossi (1988), who conducted three CMLP experiments to investigate the access of idioms in which subjects heard idiomatic expressions while completing a lexical decision task – target words were related to either meaning of the string (literal vs. non-literal). When critical stimuli were presented simultaneously (at idiom offset), literal related targets were activated faster, but when critical stimuli were presented 300ms after the idiom, activation was faster for non-literal or figurative targets (Cacciari & Tabossi, 1988). Cacciari and Tabossi (1988) suggested that the *configuration hypothesis* was the most adequate theoretical view to explain their findings. Specifically, this hypothesis suggests that literal interpretations are activated first, and only after the string can be identified as an idiom (i.e., 300ms after idiom offset), will the figurative interpretations become active. Beck and Weber (2016) also conducted two CMLP experiments with bilinguals, some with English as the first language (L1) and other with English as the second language (L2), following Cacciari and Tabossi's (1988) procedures. Their results showed that both types of bilinguals revealed faster activation of meanings (figurative vs. literal) when measured as a function of priming (Beck & Weber, 2016). Results also revealed that there was an overall pattern of figurative targets yielding significantly slower reaction times than literal targets. Furthermore, results from Cacciari and Tabossi (1988), as well as those from Beck and Weber (2016), suggest

that the priming effect is an accurate and reliable measurement of meaning activation for both bilingual and monolingual figurative language processing.

IDIOM PROCESING IN BILINGUALS

How do bilinguals comprehend idiomatic expressions? Past research has suggested bilinguals have difficulty comprehending idioms because of their tendency to interpret them literally rather than by their intended figurative meaning (Siyanova-Chanturia, Conklin, & Schmitt, 2011). Current research claims that idioms are not as susceptible to L1 learning, but rather to length and type of exposure to a specific language (Camisa, 2013). Since idiomatic phrases fall under the category of figurative language, they are assumed to require a different condition of encoding than literal language does (Camisa, 2013). For instance, learning to interpret common phrase such as, "See you soon," requires encoding it by its component words. Meaning, one must understand that "see" refers to the sense of vision, while "you" refers to the second person, and "soon" refers to a point in time to be encountered in the near future. In contrast, learning a common idiomatic phrase such as, "spill the beans," requires an additional step after learning to interpret the literal meaning of each word. This is why it is assumed that "bilinguals will interpret the figurative meaning of [an idiom], only if it is encountered in their most dominant language (Camisa, 2013)."

There are three main theoretical models that account for the bilinguals' processing of idiomatic expressions. The first model is the *idiom diffusion model of second languages*, which proposes that idioms comprehension in L2 consists of two stages (Cieślicka, 2006a; Liontas, 2002). The first is the prediction stage in which the individual revises hypotheses about the idiom's figurative interpretation, and the hypotheses will vary based on how transparent the idiom is, how semantically similar/different it is from its corresponding L1 idiom, and the presence of context

(Cieślicka, 2006a). Briefly, *transparent* idioms are those whose literal meaning bears a relationship to its figurative meaning (e.g., "hold your tongue"), whereas *opaque* idioms are those whose figurative interpretation has little relationship to the literal meaning, as in "shoot the breeze" (Camisa, 2013; Cieślicka, 2013; Glucksberg, 2001). If there is no context present, the individual must rely on the literal analysis of the idiom's components. As previously mentioned, the idiom will be perceived as a regular string of words in which each word is processed individually. Idioms that are identical in both languages are the easiest to understand and are referred to as *lexical-level* idioms (Cieślicka, 2006a; Liontas, 2002). This is because the individual is able to refer to lexical entries of the idiom in his/her L1 and compare them to the corresponding L2 idiom. For instance, "read between the lines" and "leer entre lineas" are lexical-level idioms in which context is not required for interpretation. Idioms that are similar, but not identical, in both languages are easy to understand but require some context; these idioms are referred to as *semi-lexical level* idioms (Cieślicka, 2006a; Liontas, 2002). For instance, "make a scene" and "hacer teatro" are semi-lexical level idioms in which one lexical item differs between languages (scene/teatro). Since these items are not identical, they require additional processing effort to infer the meaning of the item in the L2 (scene). Idioms that have no direct equivalent in the L1 rely heavily on context and are referred to as *post-lexical level* idioms (Cieślicka, 2006a; Liontas, 2002). For instance, "spill the beans" and "soltar la sopa" are post-lexical level idioms in which the meaning is the same but items in the idioms are different. Since these idioms are completely different, the individual must rely on context in order to interpret them. The individual's first attempt at interpretation will lean towards a literal analysis of its components, and will require additional processing strategies in order to analyze the figurative interpretation (Cieślicka, 2006a). The hypotheses that are generated in the first stage (i.e., prediction state) are later verified in the second stage, known as the *reconstructive*

stage (Cieślicka, 2006a; Liontas, 2002). In this stage, the individual must analyze all available information of the idiom and focus on the most relevant in order to reject/confirm possible interpretations (Cieślicka, 2006a).

Although the *idiom diffusion model of second languages* is a comprehension model, it suggests that processing is facilitated for identical or similar idioms across languages. This hypothesis is supported by Irujo (1986). Irujo investigated whether advanced Venezuelan learners of English used their L1 knowledge to comprehend idioms in the L2 (Irujo, 1986). Participants were given 4 tests (recognition, comprehension, recall, and production) to examine the comprehension of 45 English idioms: 15 lexical-level ("play with fire" vs. "jugar con fuego"), 15 semi-lexical level ("lend a hand" vs. "echar una mano"), and 15 post-lexical level ("pull his leg" vs. "tomarle el pelo"). The recognition test was a multiple-choice test, in which the choices included were: the correct paraphrase of the idiom, a sentence related to the correct paraphrase, a sentence related to the literal meaning of the idiom, and an unrelated sentence (Irujo, 1986). An example of the recognition test is presented in (1) below.

(1) *I'm fed up with him.*

a. I'm very tired of him.

b. I've been seeing him too much.

c. I'm full from eating too much.

d. I'm crazy about him.

In the comprehension test, participants were required to write a definition of the idiom in either L1 or L2. The recall test was a discourse completion task that consisted of a short paragraph containing an idiom that was missing one word, and participants had to supply the missing word (Irujo, 1986). An example of the recall test is presented in (2) below.

(2) Tim's parents were tired of hearing loud rock music all the time. "Turn that music down," his mother yelled. "I'm ____ up with your loud music!"

The production test was a translation task, in which each item consisted of a paragraph in L1 containing the idiom, and a paragraph in L2 with the idiom missing; participants were asked to supply the missing idiom. Examples of the three types of idioms (identical, similar, and different) were presented in instructions, so participants were aware that directs translations were not always possible. Results showed lexical-level (identical) idioms were the easiest to comprehend and produce, semi-lexical (similar) level were easily comprehended and produced but showed interference from L1, and post-lexical (different) idioms were the most difficult to comprehend and produced (Irujo, 1986). That is, the more lexical similarity between an idiom in L1 and its L2 counterpart, the less additional processing effort was necessary to infer the meaning of the idiom. Overall results revealed that the idioms of all categories that were comprehended and produced most successfully were those with high familiarity and transparency, as well as a simple vocabulary and structure (Irujo, 1986). The evidence from this study was taken to support the *idiom diffusion model of second languages* (Liontas, 2002).

The second model of bilinguals' processing of idiomatic expressions is the *model of dual idiom representation*, which focuses on the decomposability and familiarity of idioms (Abel, 2003; Cieślicka, 2006a). This model suggests that an idiom's representation in the lexicon is determined by its decomposability. Decomposable idioms do not require separate lexical entries because they are represented in the lexical entries of its components – known as *constituent entries* (Abel, 2003; Cieślicka, 2006a; 2013; Nunberg et al., 1994). For instance, the idiom "break the ice" can be modified in several ways, such as "I had to break the ice with a joke, or "The ice was broken with a joke." These modifications are possible because each component of the idiom is meaningful

(Cieślicka, 2013; Glucksberg, 2001). As previously mentioned, the word "ice" refers to a *cold* social atmosphere and "break" is the process of changing it (Sprenger et al., 2006). This means that the idiom "break the ice" will only require *constituent* entries in order to be processed. On the other hand, idioms that are nondecomposable require a separate lexical entry – known as *idiom entries* – because they are processed as a string, instead of individual components (Abel, 2003; Cieślicka, 2006a; 2013; Nunberg et al., 1994). For instance, in the sentence "We must get to the bottom of the problem," the idiom "get to the bottom of" does not form a constituent in the analysis of syntactic structure. This is because the phrase ("of the problem") is not a part of the idiomatic expression. The analysis is effortless because the components in the phrase ("the problem") can be changed (the situation, the story), while those in the idiom ("get to the bottom of") cannot. This means that, for the idiom "get to the bottom of," an *idiom entry* will be required in processing and activation of the expression. Nondecomposable idioms cannot be altered (Cieślicka, 2013; Glucksberg, 2001).

Evidence from previous studies has suggested that the amount of exposure to the L2 modulates the bilingual's ability to comprehend idiomatic expressions (Camisa, 2013; Cieślicka, 2006a; 2006b; 2013). A study of Spanish-English bilinguals examined the comprehension of idiomatic expressions in terms of early sequential (learned L2 between 3-12 years) vs. late sequential (learned L2 after 12 years) bilinguals, as well as transparent (decomposable) vs. opaque (nondecomposable) idioms (Camisa, 2013). Briefly, "*transparent* and *opaque* idioms are also often referred to as *decomposable* and *nondecomposable* idioms" (Camisa, 2013, p. 11; but see Cieślicka, 2013). In this study, bilinguals were required to verbally identify 20 transparent and 20 opaque idioms. Results revealed that early sequential bilinguals were able to comprehend all idioms more accurately than late sequential bilinguals (Camisa, 2013). In contrast, late sequential

bilinguals seemed to have a more accurate comprehension of transparent idioms than of opaque ones (Camisa, 2013). The evidence from this study was taken to support the *model of dual idiom representation*, which suggests that decomposable (transparent) idioms require fewer entries in the lexicon than nondecomposable (opaque) idioms in order to be activated/retrieved (Abel, 2003; Cieślicka, 2006a; 2013). This evidence also supports Cieślicka's (2006a; 2006b) view that age and length of exposure to the L2 is crucial in the processing of figurative language, such as idiomatic phrases.

Overall, some researchers (e.g. Abel, 2003; Camisa, 2013) view *transparent* and *opaque* idioms as *decomposable* and *nondecomposable* as interchangeable. However, it is important to note that the two dimensions of idiom characteristic are not completely overlapping (Cieślicka, 2006a). Some idioms can be *transparent* and *nondecomposable* (e.g., "jump the gun"), while others can be *opaque* and *decomposable* (e.g., "pop the question"). Moreover, the idiom "jump the gun" can be categorized as *transparent* because its literal meaning ("do something too soon") bears a relationship to its figurative meaning ("starting to run before the gun has fired to signal the beginning of the race"), and it can also be categorized as *nondecomposable* because the phrase cannot be altered without compromising its figurative meaning. In contrast, the idiom "pop the question" can be categorized as *opaque* because its figurative interpretation ("propose marriage") has little relationship to the literal meaning, and it can be categorized as *decomposable* because the phrase can be altered (he *popped the question* vs. *the question* was *popped*) and keep its figurative meaning intact.

The third model of bilingual figurative language processing is Cieślicka's (2006a) *literal salient model*, based on the *graded salience hypothesis* and discussed previously, accounts for acquisition and processing of idioms by L2 learners. According to this model, the literal meanings

of L2 idioms would be more salient to bilinguals than figurative meanings (Cieślicka, Heredia, & Olivares, 2014). This model suggests that literal meanings of idioms are more salient given that the L2 learner, depending on the level of L2 knowledge, is probably not familiar with the figurative meanings (Cieślicka, 2006a). That is, L2 learners are more likely to know the literal meaning of words, and have a well-established representation of them in the lexicon, before they see them used in a figurative or idiomatic context. Cieślicka's model was developed to account for the processing of idioms by L2 learners who acquire their L2 in a format setting and live in a place where L2 is not spoken outside of classroom environment (Cieślicka, 2006a). Meaning, level of saliency of idioms' interpretations might differ in L2 learners who are very familiar with figurative language in L2.

Empirical findings also suggest that nonnative speakers or L2 learners tend to process idiomatic expressions more slowly when encountered in a figurative context (Cieślicka, 2006a; 2006b; Heredia & Cieślicka, 2016; Siyanova-Chanturia et al., 2011). Siyanova-Chanturia et al. (2011) investigated idioms processing using eye-tracking. Eye-tracking examines eye-movement recordings that measure fixation duration, gaze duration, go-past duration, and total reading time (see also Heredia & Cieślicka, 2016). In their experiment, native and non-native speakers of English read various stories, which consisted of the use of idioms in literal (e.g., "at the end of the day" – in the evening) and figurative (e.g., "at the end of the day" – eventually) form; control phrases such as "at the end of war" were also used. After the stories were presented, participants were later asked comprehension questions to indicate whether or not they had understood the stories (Siyanova-Chanturia et al., 2011). Results from this study suggested there was no advantage, in terms of processing idioms, for non-natives since they appeared to have process control phrases and idioms similarly (Siyanova-Chanturia et al., 2011). That is, idioms did not

have a strong figurative representation in the lexicon in non-native speakers as they did in native speakers. In terms of eye-tracking, the results indicated that non-native speakers required additional reading when idioms where presented in their figurative form than when they were presented in literal context (Siyanova-Chanturia et al., 2011). A need for re-reading idiomatic phrases in figurative context suggested that non-native speakers required more time to process them because they lacked easy access to the figurative interpretations (i.e., representations are not as strong). The overall results of this experiment suggest that L2 learner or non-native speakers have a faster activation of the literal interpretation of idiomatic expressions than they do for figurative interpretations, as posed by the *indirect processing hypothesis* and the *literal salient model* previously described.

Cieślicka and Heredia (2013) conducted an additional eye-tracking experiment in which Spanish-English bilinguals were presented with English sentences containing idiomatic expressions (e.g., "gets cold feet"), as well as control phrases in which one component of the idiom was modified (e.g., "gets cold hands"). In this study, idioms that had direct translation to their Spanish counterparts (e.g., "point of view" vs. "punto de vista") were classified as *similar*, while idioms that lacked lexical similarity to their Spanish counterpart – but had the same meaning – (e.g., "hit the sack" vs. "planchar oreja") were classified as *different*. This experiment focused on measuring first pass reading time (i.e., the sum of all fixations made before exiting the target region), total reading time (i.e., the sum of all fixations made within the target region), and fixation count (i.e., number of all fixations made within the target region) for idioms (e.g., "gets cold feet") and their matched control phrases (e.g., "gets cold hands"); as well as for the final word of an idiom (e.g., "feet") and the final word of the matched control phrase (e.g., "hands"). Cieślicka and Heredia's results revealed that idiom similarity might have significantly affected the analysis

process of idiomatic phrases as a whole, as well as for the last word analysis (Cieślicka & Heredia, 2013). This is because idioms that were classified as similar tended to require additional processing time because there was an activation of both languages and any information from the native language needed to be suppressed (Cieślicka & Heredia, 2013). The overall results indicated that longer processing time for figurative interpretations of *similar* idioms meant that the literal interpretations were activated first. This suggests that if bilinguals encounter idioms that have a similar or identical meaning across languages, they will be more likely to activate their literal interpretations first because of the longer processing time required to activate figurative interpretations.

Similarly, Cieślicka (2006b) found that L2 learners showed a tendency to process literal idioms over figurative ones. Cieślicka's CMLP study tested the assumption that literal interpretations of idiomatic expressions are more salient than figurative interpretations. In this study, Polish-English bilinguals were presented with spoken neutral sentences containing familiar idioms that could be understood as literal or figurative. Literal idioms were those that could be understood as literal phrases in the absence of context (e.g., "kick the bucket"), whereas figurative idioms were those that were understood as such even without context (e.g., "be under the weather"). The presented sentences did not contain any contextual information related to the meanings of the idiomatic expressions. Simultaneously, as participants listened to spoken sentences, they made lexical decisions to visually presented targets that were literally (e.g., "axe") or figurative (e.g., "forgive") related to the idiom (e.g., "bury the hatchet"), as well as their respective controls. Critical targets were presented in one of two points during the sentence presentation: at the penultimate position of the idiom (second to last word), or at the idiom offset. Activation of meanings (literal vs. figurative) was measured by the participant's RT, relative to

their controls. Overall, the results by Cieślicka (2006b) revealed a predominance of activation of literal interpretations over figurative meanings. In the case of literal idioms, literal targets presented at the penultimate position were activated significantly faster than idiomatic targets. Similarly, literal targets presented at the offset position were activated significantly faster than idiomatic targets. This means that, for literal idioms, literal interpretations were being activated faster than figurative ones regardless of position. The same pattern was present in regards to figurative idioms in which literal targets presented at the penultimate position were activated significantly faster than idiomatic ones (Cieślicka, 2006b). Likewise, literal targets at the offset position were activated faster than idiomatic targets (Cieślicka, 2006b). This means that, for figurative idioms, literal interpretations were being activated faster than figurative ones, regardless of position (i.e., penultimate vs. idiom offset). The overall results suggest that, regardless of position, bilinguals tend to have faster activation of the literal meanings of idiomatic expression than figurative meanings. Results from this study were interpreted as supporting Cieślicka's (2006a) *literal salient model*.

FACTORS UNFLUENCING L2 PROCESSING

What are some specific factors that influence L2 idiom processing in bilinguals? As previously discussed, past research has suggested that bilinguals experience difficulty comprehending L2 idioms (Siyanova-Chanturia et al., 2011). Cieślicka (2006a) proposes three factors (e.g., literal plausibility, semantic decomposability, and cross-language similarity) that can potentially influence the dynamics of L2 idiom processing in bilinguals. The first factor is idiom *literal plausibility* or the extent to which an idiomatic expression can be interpreted literally (Cieślicka, 2006a). It has been suggested that literally plausible (e.g., "hold your tongue") and implausible idioms (e.g., "shoot the breeze") could be processed in different regions (i.e., left vs.

right) of the brain (left vs. right) (Cieślicka, 2006a; Jung-Beeman, 2005). According to Jung-Beeman (2005), the left hemisphere of the brain can only activate a limited set of semantic fields that are closely related to the dominant interpretation of the target word, while the right hemisphere of the brain is capable of activating large semantic fields that are secondarily related to the target. In regards to idiomatic phrases, the left hemisphere would be more efficient at processing literally implausible idioms, while the right brain would be superior at processing literally plausible idioms (Jung-Beeman, 2005). That is, since the right hemisphere can activate multiple meanings (i.e., literal and figurative) to be considered for interpretations, literally plausible idioms would be activated faster by this hemisphere. In contrast, since the left hemisphere focuses on close semantic relations, literally implausible idioms would be activated faster by this hemisphere. Cieślicka (2006b) examined the role of idiom *literal plausibility* and the degree to which literal meanings of idioms get activated. Briefly, while listening to ambiguous, or without context, idiomatic sentences, L2 subjects made a lexical decision on target words related to either the nonliteral meaning of the idiom or the literal meaning of the last word of the idiom. Surprisingly, results from this study showed no significant effect of idiom *literal plausibility* in meaning activation. While activation of literal (related) targets was not significant at the penultimate position for both literal (i.e., literally plausible) and figurative (i.e., literally implausible) idioms, there was a comparable activation for related targets at the offset of both types of idioms (Cieślicka, 2006b). Thus, deeming the study inconclusive in regards to idiom *literal plausibility*.

The second factor affecting L2 idiom processing discussed is idiom *semantic decomposability*, which is the extent to which an idiom can be modified without compromising its figurative meaning. As previously discussed, the decomposability of an idiom may be relevant for bilinguals, given their tendency to process these phrases by their components (Abel, 2003;

Cieślicka, 2006a; 2013). According to Jung-Beeman (2005), hemispheric differences in sensitivity to semantic relationships might cause differences in the processing of decomposable and nondecomposable idioms by both hemispheres. That is, similarly to literally plausible vs. literally implausible idioms, decomposable and nondecomposable idioms are likely to be processed faster by different hemispheres of the brain. Since the left hemisphere activates only related (literal) targets of an idiom, it might be more effective at processing decomposable idioms in which there are semantic connections between their figurative meaning and the literal meaning of its components. On the other hand, since the right hemisphere can activate secondarily related (figurative) targets of an idiom, it might be more efficient at processing nondecomposable idioms in which there are weak, or no connections between their figurative meaning and the literal meaning of its components. Cieślicka (2013) examined possible hemispheric asymmetries in the processing format of decomposable and nondecomposable idioms. In this study, idioms were presented in either neutral format (e.g., "I did not like the idea of *skating on thin ice*") or figurative-biasing context (e.g., "Signing a contract with him is really *skating on thin ice*"). Although results revealed that the right hemisphere had a tendency to process nondecomposable idioms faster than decomposable ones, this was only true when idioms were presented in figurative-biasing context (Cieślicka, 2013). That is, decomposability alone did not seem to affect idioms processing, but it seemed to have an effect when combined with context.

The third factor affecting L2 idiom processing discussed is *cross-language similarity*. Unlike idiom *literal plausibility* and idiom *semantic decomposability*, which are factors that have been shown to be relevant in L1 and L2 idiom processing, *cross-language similarity* is a factor unique to L2 idiom processing (Cieślicka, 2006a). As previously mentioned, bilinguals are likely to experience L1 interference when processing L2 idiomatic expressions. Nevertheless, the level

of interference is highly related to the level of *cross-language similarity* between L1 and L2 idioms (Cieślicka, 2006a). Similar idioms are those that can be directly translated from one language to the other and require little or no context to infer the meaning of the idiom in L2 (Cieślicka, 2006a; Liontas, 2002). On the other hand, different idioms, although have similar figurative interpretations, do not have a direct equivalent in L1 and rely heavily on context for processing (Cieślicka, 2006a; Liontas, 2002). Cieślicka and Heredia (2013) addressed the question of how *cross-language similarity* could affect idiomatic processing. Their eye-tracking experiment measured activation by first pass reading time, total reading time, and fixation count for the idioms as a whole (and matched control phrase) and the last word of the idiom (and matched control word). Results showed that in regards to first pass reading time, different idioms were read significantly faster than similar ones. Similarly, different idioms had significantly less fixations of the target than similar idioms. Finally, and consistent with the existing pattern, different idioms presented a significantly shorter total reading time than similar idioms. That is, *cross-language similarity* significantly affected idiom processing of bilinguals on all reading measures, for the idioms as a whole and the last word of idiom analyses.

Overall, the evidence from previous studies presents a pattern of bilinguals' predominance towards literal interpretations of idiomatic expressions (Camisa, 2013; Cieślicka, 2006b; Cieślicka & Heredia, 2013; Siyanova-Chanturia, 2011). That is, bilinguals have a tendency to activate literal meaning of idioms faster than their figurative counterparts. Evidence has also suggested that the extent of L2 knowledge (or language dominance) can modulate bilinguals' processing of idiomatic expression in L2, as well as interpretation activation (literal vs. figurative) of those idioms (Cieślicka, 2006a). Meaning that if the L2 learner is not familiar with figurative language, then idioms are more likely to be processed by their components and activate the literal interpretation

of the idiom first. Lastly, bilinguals' comprehension of idiomatic expressions in L2 can be affected by the transparency of idioms, idiom decomposability, and the semantic similarity (identical vs. similar vs. different) of idioms in L1 and L2 (see for example, Cieślicka, 2006a; 2013; Irujo, 1986; Jung-Beeman, 2005; Liontas, 2002). That is, transparent idioms are processed faster than opaque idioms, decomposable idioms are processed faster than nondecomposable idioms, and different idioms are processed faster than similar (or identical) idioms.

PRESENT STUDY

The goal of the present study is to further examine the online comprehension of idiomatic expressions by bilingual speakers. This study extends Cieślicka's (2006b) CMLP study, which examined literal and figurative activation, at penultimate (second to last word) and idiom offset positions, of literal and figurative idioms. To summarize, Cieślicka (2006b) found that regardless of target position, bilinguals tended to activate the literal interpretation of idiomatic expressions, as opposed to the figurative meanings. Similarly, the present study examines bilingual idiom interpretation (i.e., literal vs. figurative) at idiom offset (cue 1), and at a later stage (cue 2) immediately after an anaphoric referential description. Cue 2 probing further examines whether an anaphoric referential description is more likely to (re)activate its antecedent (i.e., idiom) that could be more pragmatically plausible (i.e., the figurative and intended meaning) than its literal representation. One important aspect of idiomatic expressions is that they are unique and flexible, and can serve as antecedents to pronouns and ellipsis (Gibbs, Nayak & Cutting, 1989). Meaning, that idioms can behave as antecedents and be later (re)activated by anaphoric pronouns, or ellipsis. Indeed, the use of anaphora in CMLP experiments allows for better measurement of interpretation activation because it serves as a link to the (re)activation of the antecedent (idiom).

Briefly, anaphora are linguistic devices that connect ideas by referring to a previously mentioned concept. In the sentence "John went to the store, and John bought a candy bar," the anaphor or pronoun, "he" could be used to replace the second time John is mentioned. The concept or phrase being referred to, by the anaphor, is known as the *antecedent* (Gernsbacher, 1989). Thus, the anaphor "he" refers back to the antecedent "John." For anaphora to be processed correctly, the antecedents must be the most activated concepts of the sentences. Gernsbacher (1986, 1989) proposed two mechanisms that enable this process by moderating the activation of mental representations. The first mechanism is *enhancement*, which increases activation of the components in a structure (the idiom in a sentence); the second mechanism is *suppression*, which decreases activation of components in a structure (i.e., all other words in a sentence that are not part of the idiom, in the context of the present study). These mechanisms suggest that an antecedent may become more accessible because it is being enhanced by the anaphor, or perhaps it becomes more accessible because other concepts (parts of the sentence) are being suppressed by the anaphor (Gernsbacher, 1986; 1989). In order to allow the (re)activation of idioms (i.e., antecedents) by anaphora, it is crucial that the idiomatic phrase is the most activated concept of the sentence. In relation to the present study, and given their flexibility, idioms can serve as antecedents to pronouns and ellipsis; for instance, "He <u>turned the tables</u> on me and then I turned <u>them</u> on him," or "He <u>turned the tables</u> on me and then I did <u>it</u> to him" (see Gibbs et al., 1989; Nunberg et al., 1994). In the first example, only the word "tables" is considered the *antecedent*, while "them" is the *anaphor*. For the second example, the entire idiom "turned the tables" would be considered the *antecedent*, while "it" is the *anaphor*. In this case, the anaphor establishes a link and "reactivates" the antecedent without having to reinstate the antecedent again (Heredia & Cieślicka, 2016; Heredia & Muñoz, 2015).

The CMLP paradigm has been successfully used to examine the link between an anaphor and its antecedent (see Love & Swinney, 1996; Nicol, Swinney, Love, & Hald, 2006). Love and Swinney (1996) conducted two studies in which they examined whether "[the priming paradigm] could be effective in demonstrating the (re)activation of antecedents in matched-sentences and matched-probes configuration (p. 11)." Word associates of the ambiguity (i.e., antecedent) were used as priming targets (e.g., ink = pen). This study used the priming paradigm to measure the (re)activation of an antecedent throughout various positions (cue positions 1-3) as described in (3) below.

(3) "The professor insisted that the exam be completed in ink, so Jimmy used the new pen[1] that his mother-in-law recently[2] purchased[3] because the multiple colors allowed for more creativity."

In sentence (3), the word "ink" is the antecedent that will be later (re)activated by the anaphor "pen." Probe positions in sentence (3) are marked as [1, 2, and 3] to indicate where the three probe positions would be in the experiment. Probe position [1] was placed at the antecedent offset, probe position [2] was placed 700ms before the verb offset, and probe position [3] was placed at verb offset (Love & Swinney, 1996). Overall, results from this study revealed there was an immediate (re)activation of antecedents at all probe positions (Love & Swinney, 1996). This study also revealed that there were significant priming effects for word associates of the antecedent regardless of biasing context (Love & Swinney, 1996). Based on this evidence, it can be assumed that the use of anaphora for the (re)activation of antecedents is effective regardless of anaphor position, as long as they are located after anaphor offset.

Similarly, Nicol, Swinney, and Hald (2006) conducted three CMLP studies, which followed the same procedures as Love and Swinney (1996), except for an additional probe position

in their sentences. For instance, in the sentence "The policeman saw[1] the boy[2] who the crowd at the party[3] accused[4] of the crime," the "boy" would be the antecedent which must later be (re)activated by the context of the sentence. Nicol et al., (2006) argued that there would be no priming or activation at position [1], significant priming activation at position [2] (since the position is at antecedent offset), no priming at position [3], and significant priming again at position [4] (indicating the antecedent is reactivated). Results from these experiments revealed that reaction time was faster at probe positions where the probe (priming stimulus) was congruent with the sentence than when it was incongruent (Nicol et al., 2006). This means that antecedents were (re)activated faster when presented alongside the congruent priming targets. In addition, their results revealed that activation of the antecedent was found at probe positions [2] and [4]. This means that activation of the antecedent occurs immediately after the antecedent offset and it is (re)activated when enough context about the antecedent has been processed.

Thus, the present study examines the extent to which antecedents, in this case idiomatic expressions, can be (re)activated by their anaphors, and whether the literal interpretation of the idiomatic expressions is more likely to be (re)activated as opposed to the figurative meaning. That is, what are the effects of an (idiomatic) anaphoric description and its idiomatic antecedent? Is an (idiomatic) anaphoric description capable of overriding the literal interpretation of its antecedent? If that is the case, only literal activation at cue 1 is predicted; at cue 2, only figurative meaning activation is expected. This is because the antecedent would provide the additional contextual and pragmatic information to allow for the (re)activation of the intended interpretation of the idiomatic expressions. Alternatively, based on previous findings (see Cieślicka, 2006b), regardless of probe position, the literal meaning of the idiomatic expressions will be more readily active than the figurative interpretation.

Thus, experiment 1 measures meaning activation at idiom offset (0 ms after idiom), and at anaphor offset. Experiment 2 was designed to serve as a baseline by measuring at idiom onset (immediately before the presentation of the idiomatic expression) and to further explore meaning activation at 300 ms after anaphor offset. This was done to explore late stages of idiom meaning activation and to determine the extent to which the literal or figurative interpretations remain active after well beyond anaphor offset.

Another purpose of the present study is to investigate language dominance effects and idiom comprehension. Cieślicka (2006b) used a Polish population of English learners that did not experience additional cultural, or linguistic, aspects of the language in daily living. This study extends Cieślicka's (2006b) work by using a more homogeneous population of bilinguals. Instead of focusing in the differences between L1 and L2, this study focuses on language dominance as a moderator using the Bilingual Dominance Scale (BDS; Bunn & Fox Tree, 2009). Bilinguals are classified in terms of dominance (i.e., English-dominant vs. Spanish-dominant vs. balanced). Dunn and Fox Tree (2009) have argued that an individual's dominant language is not necessarily the L1. They further argued that there are several factors that can contribute to the loss or gain in language dominance, such as if the L1 ceases to be used. The BDS used here targets three main criteria deemed necessary in evaluating dominance: "percent of language use for both languages, age of acquisition and comfort for both languages, and restructuring language fluency due to changes in linguistic environment (Dunn & Fox Tree, 2009)."

To summarize, the present set of experiments examines the extent to which bilingual idiom comprehension, and meaning (re)activation (i.e., literal vs. figurative), might be modulated by language dominance. Not surprisingly, a number of previous studies (e.g., Heredia & Cieślicka, 2016) have revealed that bilinguals tend to show a predisposition towards literal or figurative

meanings depending on their dominant language. Based on the previously discussed evidence (see Cieślicka, 2006b; Heredia & Cieślicka, 2016), it is hypothesized that literal interpretations will be more active in Spanish-dominant bilinguals, whereas English-dominant and balanced bilinguals may have equal access to both meanings.

EXPERIMENT 1

Experiment 1 investigates the (re)activation of idiomatic expressions by bilinguals (English-Spanish and Spanish-English). Specifically, it examines if language dominance (English-dominant vs. Spanish-dominant vs. balanced) can modulate which meaning of an idiom (literal vs. figurative) is activated first. Interpretation activation is measured at idiom offset (0 ms after idiom; cue 1) and at anaphor offset (cue 2).

METHODS

Participants

A total of 125 bilinguals (Female = 81, Male = 44) from Texas A&M International University (TAMIU) psychology subject pool participated in the study. Participants were English-Spanish or Spanish-English. Detailed data were obtained regarding the participants' language dominance in both English and Spanish using the BDS language survey. Nine participants were excluded from the analysis due to low accuracy performance scores of less than 80%.

Table 1 summarizes the percentage of bilinguals that fall into each category of age of acquisition of the L2.

TABLE 1 | Age of Acquisition of the L2 (Experiment 1).

	0-5 years	6-9 years	10-15 years	+16 years
Spanish-English	69.7% (N = 23)	18.2% (N = 6)	9.1% (N = 3)	3.0% (N = 1)
English-Spanish	53% (N = 35)	33.3% (N = 22)	9.1% (N = 6)	4.5% (N = 3)
Balanced	97.05% (N = 16)	2.95% (N = 1)		

As can be seen from **Table 1**, the large majority of bilinguals learned the L2 between the ages of 0-5. The second most important learning age of the L2 was at 6-9 years of age. Few

English-Spanish and Spanish-English bilinguals (no balanced) indicated learning the L2 between ages 10-15. In addition, one Spanish-English bilingual, and three English-Spanish bilinguals reported learning the L2 after the age of sixteen.

As revealed by the BDS, there were 24 Spanish-dominant (*M* = -14.2, *SD* = 8.2), 65 English-dominant (*M* = 13.4, *SD* = 6.5), and 27 balanced bilinguals (*M* = 0.07, *SD* = 2.9). In relation to the place of learning of the L2, 36.2% of participants reported having learned it both at school and at home; compared to 38.8% who reported learning it only at school, and 25% only at home. The participants' dominance score from the BDS determined language dominance, where individuals scoring above 5 were considered English-dominant, those scoring below -5 were considered Spanish-dominant, and those scoring between 5 and -5 were considered balanced.

Table 2 summarizes participants' responses to language performance measures – broken down into language dominance. Subjects completing the BDS reported their age and how often they mixed their Spanish and English languages. Subjects also completed a series of self-rating scales regarding language use, speaking ability, reading ability, understanding ability, and writing ability within each language (i.e., English and Spanish).

TABLE 2 | Language Background Information for the Bilingual Sample (Experiment 1).

	ENGLISH (N =33)	**SPANISH (N =66)**	**BOTH (N =17)**
Age	21.51 (0.90)	20.76 (0.44)	19.59 (1.19)
Mean language mixing Ratings	4.39 (0.29)	4.59 (0.24)	5.35 (0.36)
MEAN SELF-RATINGS	**ENGLISH**	**SPANISH**	
Language use	6.12 (0.10)	4.80 (0.16)**	
Speaking	6.53 (0.08)	5.61 (0.12)**	
Reading	6.67 (0.06)	5.41 (0.14)**	
Understanding	6.72 (0.05)	6.06 (0.11)**	
Writing	6.53 (0.08)	4.77 (0.16)**	

Note: Values in parentheses represent Standard Error of the Mean; **p < 0.01; Self-ratings (1 = Very little knowledge, 7 = Very Fluent); Language mixing (1 = I never mix languages, 7 = I mix languages all the time).

As can be seen from **Table 2**, all bilingual groups (English-Spanish, Spanish-English, and balanced) showed comparable patterns in regards to language mixing or code-switching. Bilinguals rated English as the most frequently used language and reported having a slightly, but significant, higher language proficiency in English for speaking, reading, understanding, and writing than Spanish. So, it appears that our bilingual groups are very similar.

Table 3 summarizes the correlations (*r*) between variables typically used to measure language proficiency and dominance in bilinguals. The variables were: age in which an individual learned English/Spanish, years of schooling in English/Spanish an individual experienced, an individual's tendency to code-switch, an individual's use of English/Spanish in a typical day, an individual's proficiency in English/Spanish, and an individual's dominance of the English/Spanish language.

TABLE 3 | Summary of Correlations for Scores on Language Variables (Experiment 1).

Variables	1	2	3	4	5	6	7	8	9	10
2	-0.026									
3	0.312*	-0.035								
4	-0.177	-0.054	-0.0.042							
5	0.165	0.001	-0.008	0.005						
6	0.096	-0.009	0.304**	-0.103	0.111					
7	0.064	-0.090	-0.219*	0.114	0.349**	-0.248**				
8	0.143	-0.047	0.408**	-0.341**	0.123	0.792**	-0.253**			
9	-0.017	-0.080	-0.178	0.195*	0.194*	-0.244**	0.769**	-0.213*		
10	0.092	0.021	0.296**	-0.309**	-0.008	0.501**	-0.621**	0.622**	-0.606**	
11	-0.160	-0.056	-0.256**	0.267**	0.085	-0.470**	0.603**-	-0.505**	0.636**	-0.788**

Note: 1 = Age learned English; 2 = age learned Spanish; 3 = years of schooling in English; 4 = years of schooling in Spanish; 5 = code-switching; 6 = English use in a typical day; 7 = Spanish use in a typical day; 8 = English proficiency; 9 = Spanish proficiency; 10 = English dominance; 11 = Spanish dominance. *$p < 0.05$. **$p < 0.01$.

It is important to note that language use and an individual's proficiency in that language were positively correlated. It is also important to note that language proficiency was positively correlated with language dominance. In addition, language proficiency and language use presented a moderate positive correlation with years of schooling in a language. Interestingly, an individual's tendency to code-switch revealed a weak positive correlation with proficiency in Spanish. The overall pattern of results suggests that, as language use, language proficiency and language dominance increase for one language, they decrease for the other language. More importantly, however, was the negative correlation between dominance of the English language and dominance of the Spanish language, which suggests that if an individual is dominant in one language, he/she is less likely to be dominant in the other language.

Materials

Idiomatic Sentences

The data selection process regarding the idiomatic phrases consisted of several steps. First, 90 idiomatic phrases were selected from Titone and Connine's (1994a; 1994b) idiom norms. Four phrases were removed from the original list because they lacked an equivalent idiom in Spanish, and 77 phrases were removed based on low frequency. After the idioms were selected, they were sorted into three categories regarding similarity in their Spanish counterpart. Eighteen idioms were considered to be *identical* to their Spanish-idiom counterpart (e.g., "play with fire" vs. "jugar con fuego"), 29 idioms were considered to be *similar* to their Spanish-idiom counterpart (e.g., "make a scene" vs. "hacer teatro"), and 43 idioms were considered to be *different* from their Spanish-idiom counterpart (e.g., "pull the plug" vs. "tirar la toalla"). Identical idioms were those in which both versions (English vs. Spanish) were direct translations of each other. Similar idioms were those in which one or more components (words) were different between languages. Lastly,

different idioms were those in which, although the meaning is the same, the components are completely different. It is important to note that although idioms were classified according to semantic similarity, the analyses reported in this study do not consider this variable.

After the phrases were selected, sentences were created for each idiom so that a pronoun (e.g., it, that, etc.) served as an anaphor linking the antecedent or idiomatic expression (see Appendix A). For instance, "I'm not one to make a scene$_1$, but after he yelled at me, that$_2$ was impossible to avoid." In this case, "make a scene" is the idiomatic phrase and "that" is the anaphor that links the pronoun (that) to the antecedent (idiom). Filler sentences were created in order to prevent the participant from generating hypotheses about the purpose of the experiment. These filler sentences followed the same procedures as the experimental stimuli. Meaning, they were compound sentences of similar length and condition (e.g., "Her conversations skills are very poor, and that is why I rarely spend time with her alone"). There was a total of 120 filler sentences.

To assure that participants were paying attention to the sentences presented via spoken language, comprehension questions were implemented. At random, participants were presented with a simple yes/no type question regarding the previous sentence. For example, the sentence "I wondered where Jenny was during the assembly, and she was next to me the entire time" was followed by the comprehension question "Jenny was at her house," to which the response would be NO.

Visual Targets for Lexical Decision Task

Every idiomatic phrase was paired with an experimental literal and figurative related, and their respective controls (unrelated) targets. Literal and figurative targets were matched for word length (+/-1) and word frequency (+/-3) to their control targets. The average word length for literal targets (M = 4.8, SD = 1.49) was the same as the average word length for literal control targets (M

= 4.8, *SD* = 1.49), *t*(89) = 1.0, *p* = 0.96. Likewise, the average word length for figurative targets (*M* = 6.6, *SD* = 2.2) was the same as the average word length for figurative control targets (*M* = 6.6, *SD* = 2.2), *t*(89) = 1.4, *p* = 0.92. In regards to frequency, the average for literal targets (*M* = 401.7, *SD* = 1301.8) was slightly lower than the average frequency for literal control targets (*M* = 528.9, *SD* = 1790.5), but this difference was not statistically reliable, *t*(89) = -2.1, *p* = 0.59. Similarly, the average frequency for figurative targets (*M* = 92.9, *SD* = 232.6) was slightly lower than the average frequency for figurative control targets (*M* = 109.9, *SD* = 299.3), but this difference was not statistically significant, *t*(89) = -2.3, *p* = 0.67

All control words were from the same word class (noun, verb, adjective, adverb, interjection) and same morphology (gerund, participial, past/present tense) as their literal or figurative term counterpart. The majority of the literal related terms (81 of 90) were found in Oxford Dictionaries' online database (www.oxforddictionaries.com), while the rest (9 out of 90) were found in University of South Florida free association norms database (Nelson, McEvoy, Schreiber, 1998). The word length and word frequency of all literal related terms, and their control counterparts, were collected from $SUBTLEX_{US}$ (Brysbaert, New, & Keuleers, 2012). The same procedure was followed for the word length and frequency of figurative related targets and their corresponding control targets. About half of the figurative related terms (49 out of 90) were found in Longman's Dictionary of English Idioms (Long & Summers, 1979), while the other half (41 of 90) was found in Cambridge Dictionary and Thesaurus (www.dictionary.cambridge.org).

The overall design required a total of eight experimental lists to counterbalance the critical targets (literal vs. control, figurative vs. control) so that each critical idiomatic expression was presented only once in each sentence position (cue 1 vs. cue 2). This means that there were two lists for the literal (and control) and two lists for the figurative (and control) in each sentence

position (cue 1 vs. cue 2), for a total of eight lists. Item assignment to each list and list presentation was partially counterbalanced using a Latin square design (see Appendix B).

The next step was to create, for 106 of the filler sentences, a non-word to be presented on screen. The reason it was only necessary to do so for 106 of the 120 sentences was because the other 14 sentences were presented with comprehension questions. The non-words were created using Wuggy Word Generator, a pseudoword generator geared towards making nonwords for psycholinguistic experiments (www.crr.ugent.be/programs-data/wuggy). All nonwords were generated by inputting 106 (out of the 180) unrelated targets (literal and figurative controls) into the generator, which then converted them into nonwords that were comparable in word length to the original legal words (unrelated targets).

Audio Recordings and Cue Positions

All critical and filler sentences, as well as comprehension questions, were recorded by a male native speaker of American English. He had no knowledge of what the intent of the study was. Before the recordings, he was instructed to read the sentences with neutral intonation and to not show any emotion throughout the utterances. All audios were recorded using an Audio-Technica ATR25 stereo microphone and a Sony TCD-D8 digital audio tape recorder. The digitation and editing of audios was performed using the open source sound editing Audacity (www.sourceforge.net/projects/audacity). Audios were cropped at 100 ms before starting point and at 100 ms after ending point – this avoids excess of white noise for participants.

After the recording, cues were placed throughout each sentence. Cue 1 was placed at idiom offset (immediately after the antecedent) and Cue 2 was placed at anaphor offset. For instance, in the sentence "I'm not one to make a scene$_1$, but after he yelled at me, that$_2$ was impossible to avoid," Cue 1 was included immediately after the offset of the idiomatic expression "*make a scene*"

and Cue 2 after the anaphor "*that.*" To determine the appropriate cue positions, it was necessary to listen to each audio and visually examine the sound waves created by the sound editing software. Examining sound waves visually helped determine where the offset of idiomatic expressions was located, as well as offset of the anaphor. Cues were placed at random for filler sentences since responses to these were not included in analysis for accuracy.

The experiment was run using PsyScope, an experiment builder application (Cohen, MacWhinney, Flatt, & Provost, 1993). Upon presentation of critical target in the middle of a computer screen, participants answered by pressing a button labeled "WORD," or "NONWORD." A serial ioLab Systems USBB Button Box (www.psy.ck.sissa.it/bbox/bbox.html) recorded participants' responses (WORD/NONWORD) to the visually presented targets. Sentences were played at a medium volume setting through a set of Genius HS-04A headphones that were connected to external computer speakers.

Procedure

The study was conducted at the Cognitive Neuroscience Laboratory (Canseco Hall 205) at TAMIU. All university professors were notified of the study via email and were asked to inform their students of its existence. Participants were able to sign up for the study via the Sona Systems' website (www.tamiu.sona-systems.com), where they chose their date and time of participation from the provided time slots. The present study's experimental methods and procedure were approved by TAMIU's Institutional Review Board.

Upon arrival, participants were instructed to take a seat at a large table where they were informed of the procedures that were to wait for the rest of the participants that were scheduled for that time. Each session consisted of a maximum of five participants. Participants were given only five minutes for late arrivals in order to allow all participants in the session to begin the study at

the same time. If a participant arrived later than 5 minutes after their appointment, they were asked to reschedule. As soon as all participants were present, or the allotted 5 minutes had passed, subjects were instructed to sit on a computer cubicle and position themselves 12 inches from an iMac Apple Macintosh. Before the experiment commenced, participants were given a pair of headphones. Before the study begun, subjects were presented with written instructions that appeared on the computer screen and were asked to raise their hand whenever they finished reading them. The instructions stated the study was designated to find out how sentences were understood, and specified that it was in no way testing intelligence. Instructions asked participants to not attempt changing responses in the case of a mistake or missed word. Lastly, instructions specified that comprehension questions were to be answered via the USBB button box where the button for *words* would be use for a *yes* response and the button for *nonwords* would be used for a *no* response. If there were no questions, the study began.

For the lexical decision task, participants were required to listen to audios over headphones while simultaneously deciding whether strings of English letters (i.e., words) presented on the computer screen were legal words or illegal words (non-words). In order for participants to become familiar and comfortable with the experiment's procedure, they were presented with a brief practice trial before they began the actual experiment. The practice trial consisted of eight audio sets (sentence and target/question). Four practice trials consisted of a filler sentence followed by a target stimulus requiring lexical decision, and the other four trials consisted of audio sentences followed by comprehension questions.

After the completion of the practice trials, spoken sentences were presented via headphones, and critical targets (literal, figurative, or control) were presented at the designated positions within the sentence (cue 1 and cue 2). At cue offset, the critical target appeared in the

middle of the computer screen (with a white background), designated by an elongated rectangle, in Arial font size 20. Targets were presented for 300 ms and there was a response window of 2300 ms, as well as an inter-trial interval of 1000 ms. Participants' task was simply to determine if the visually presented target was a legal (WORD) or illegal (NONWORD) letter string in English. In order to make sure participants were paying attention to the audio recordings, they were also required to answer 14 (of which 4 were merely for practice) simple yes/no type questions regarding the audio that was previously heard. These comprehension questions were presented at random.

After the experiment was completed, subjects were moved to a different computer and were instructed to complete the BDS via Google forms. Once participants finished all parts of the study, they were given a participation proof ballot signed by the researcher (see Appendix C). The full study took approximately 45 minutes to complete.

RESULTS

A linear mixed model effects (LME) analysis was conducted with items and subjects as random factors and Language Dominance (English vs. Spanish vs. balanced), Cue (cue 1 vs. cue 2), Relatedness (related vs. unrelated), and Figurativeness (literal vs. figurative) as fixed factors. Thus, the overall design conformed to a 3 X 2 X 2 X 2. Reaction time (RT) was taken as a measurement of activation. Participants' responses were scored in terms of accuracy (in percentages). Data from nine participants was removed from analysis given that their accuracy scores were less than 80%. RTs with Z scores of ± 3 were considered outliers and removed from the data analysis. The overall data analyses include only cases in which participants' responses were correct. The data was analyzed using IBM SPSS V. 20.

As can be seen in **Table 4**, there was a main effect of Figurativeness (literal vs figurative). Literal targets (M = 647 ms, SE = 2.6) were responded 44 ms faster than figurative targets (M =

691 ms, *SE* = 3.0).Indeed, as expected, overall results suggest that bilinguals were able to respond faster to the literal interpretations of idiomatic expressions than their figurative counterparts.

TABLE 4 | Summary of Main Effects and Interactions (Experiment 1).

Source	Numerator df	Denominator df	F	*p*
Intercept	1	144.119	4307.901	.000
CUE	1	9116.568	.606	.436
FIG	1	389.221	42.858	.000**
REL	1	491.634	1.058	.304
DOM	2	112.985	2.529	.084
CUE * FIG	1	9110.391	.014	.907
CUE * REL	1	9108.847	.004	.951
CUE * DOM	2	9158.432	.914	.401
FIG * EXP	1	477.102	.202	.653
FIG * DOM	2	9114.685	3.106	.045*
REL * DOM	2	9116.039	.868	.420
CUE * FIG * REL	1	9109.614	6.463	.011*
CUE * FIG * DOM	2	9145.429	.250	.778
CUE * REL * DOM	2	9145.824	.524	.592
FIG * REL * DOM	2	9115.331	3.830	.022*
CUE * FIG * REL * DOM	2	9145.732	5.192	.006**

Note: Numerator df = degrees of freedom between; Denominator df = degrees of freedom within; *p < 0.05. **p < 0.01.
FIG = Figurativeness; REL = Relatedness; DOM = Language Dominance.

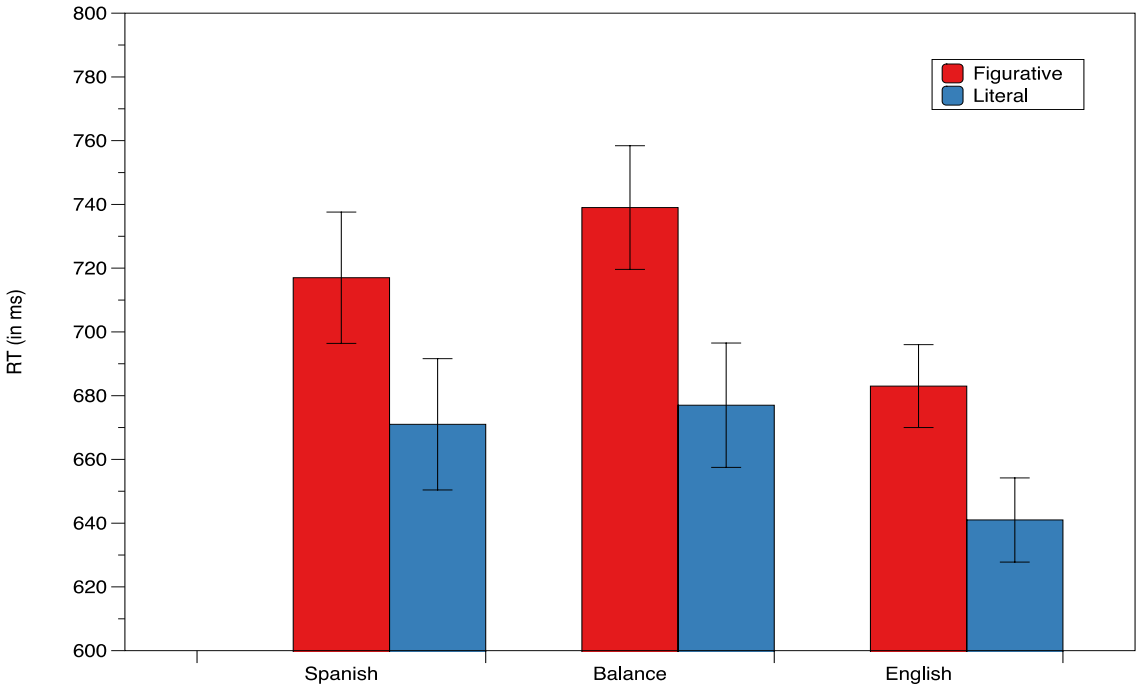
The main effect for Language Dominance (English vs. Spanish vs. balanced) was marginally significant, showing that English-dominant bilinguals (*M* = 653 ms) were faster than Spanish-dominant bilinguals (*M* = 679 ms) and balanced bilinguals (*M* = 70 0ms).

Figurativeness vs. Dominance

The interaction between Figurativeness and Language Dominance (English vs. Spanish vs. balanced) was statistically reliable. **Figure 1** summarizes the statistical interaction. Follow up multiple comparisons using Fisher's Least Significant Difference (LSD) revealed that regardless of language dominance, literal targets were significantly faster than figurative ones, suggesting

that the literal meaning was more active for bilinguals. The only reliable difference found, in the case of figurative targets, was between English-dominant (*M* = 683 ms, SE = 13.0) and balanced bilinguals, (*M* = 739 ms, SE = 19.4) where English-dominant bilinguals had faster responses. No other effects reached significance.

FIGURE 1 | Mean RTs and Two-Way Interaction as a Function of Figurativeness and Language Dominance (Experiment 1).



Cue vs. Figurativeness vs. Relatedness

As summarized in **Table 4**, the 3-way interaction between Cue (1 vs. 2), Figurativeness (literal vs. figurative) and Relatedness (unrelated vs. unrelated target) was statistically reliable. **Table 5** summarizes the 3-way interaction. Thus, regardless of Cue position, the overall pattern suggests that literal targets were responded to faster than their figurative counterparts. This is true both for the related and unrelated targets. So, regardless of cue position, the literal interpretation of the idiomatic expressions appears to be more active.

TABLE 5 | Mean and Standard Error (SE) and 3-Way Interaction as a function of Cue, Figurativeness, and Relatedness.

Probe Position	*M*	*SE*	*DIFF*
Cue 1			
Figurative Related	717	12.7	63.4*
Literal Related	654	13.0	
Figurative Unrelated	713	12.7	38.3*
Literal Unrelated	674	12.9	
Cue 2			
Figurative Related	705	12.6	44.1*
Literal Related	661	13.0	
Figurative Unrelated	718	12.7	55.9*
Literal Unrelated	662	13.0	

Note: DIFF = Difference between figurative and literal targets; *p < 0.05

Figurativeness vs. Relatedness vs. Dominance

There was an additional statistically reliable 3-way interaction between Figurativeness (literal vs. figurative), Relatedness (related vs. unrelated) and Language Dominance (English vs. Spanish vs. balanced) (see **Table 4**). **Table 6** below, summarizes the 3-way interaction. Notice the propensity of the literal meaning of the idiomatic expression to be faster regardless of Language Dominance. Additional LSD analyses revealed significant priming, for balanced bilinguals in the literal condition. That is, balanced bilinguals revealed a 31 ms priming effect (Literal related: *M* = 661 ms – Literal unrelated: *M* = 692 ms) whereby literal targets were responded to faster than their respective unrelated controls, suggesting lexical activation for the literal interpretation of the idiomatic expression for balanced bilinguals. No other effects reached significance.

TABLE 6 | Mean and Standard Error (SE) and 3-Way interaction as a Function of Figurativeness, Relatedness, and Language Dominance.

Language Dominance	*M*	*SE*	*DIFF*
Spanish			
Figurative Related	717	21.6	47.0*
Literal Related	670	21.8	
Figurative Unrelated	718	21.7	46.1*
Literal Unrelated	672	21.7	
Balance			
Figurative Related	740	20.5	78.2*
Literal Related	661	20.6	
Figurative Unrelated	738	20.5	46.4*
Literal Unrelated	692	20.6	
English			
Figurative Related	676	14.0	35.9*
Literal Related	640	14.4	
Figurative Unrelated	690	14.1	48.7*
Literal Unrelated	641	14.3	

Note: DIFF = Difference between figurative and literal targets; *p < 0.05.

Cue vs. Figurativeness vs. Relatedness vs. Dominance

The 4-way interaction between Cue (1 vs. 2), Figurativeness (literal vs. figurative), Relatedness (related vs. unrelated) and Language Dominance (English, Spanish, balanced) was statistically reliable (see **Table 4**). Additional simple effects, as described in **Table 7**, show that regardless of Language Dominance and Cue, a general pattern emerges in which literal targets were responded to faster than figurative ones.

Further pairwise comparisons demonstrate a reliable difference between Cue 1 (*M* = 732 ms) and Cue 2 (*M* = 702 ms) for Figurative Related targets and Spanish dominant bilinguals. In this case, RTs for the Figurative related targets were 30 ms faster in Cue 2 than Cue 1. English

dominant bilinguals showed a similar pattern for Cue 1 (*M* = 685 ms) vs. Cue 2 (*M* = 668 ms), however, the 17 ms difference was marginally significant (p = .053).

TABLE 7 | Mean and Standard Error (SE) and 4-Way Interaction as a Function of Cue, Figurativeness, Relatedness, and Language Dominance.

	Cue 1					Cue 2				
	Figurative		Literal		***DIFF***	Figurative		Literal		***DIFF***
Dominance Relatedness	*M*	*SE*	*M*	*SE*		*M*	*SE*	*M*	*SE*	
Span Rel	732	22.9	656	23.0	**75.8***	702	22.8	684	22.9	**18.3**
Span Unrel	701	23.1	679	22.9	**21.8**	734	22.9	664	23.0	**70.5***
Bal Rel	734	21.8	666	21.7	**68.9***	745	21.5	657	21.7	**87.6***
Bal Unrel	744	21.6	695	21.7	**49.2***	732	21.6	688	21.8	**43.6***
Eng Rel	685	14.7	639	15.1	**45.4***	668	14.7	641	15.0	**26.3***
Eng Unrel	692	14.7	648	14.9	**43.8***	688	14.7	634	14.9	**53.6***

Note: DIFF = Difference between figurative and literal targets; *p < 0.05.
Span = Spanish; Eng = English; Bal = balanced; Rel = related; Unrel = unrelated.

There was a general pattern for Cue 2 to exhibit facilitation effects for literal meaning (30 ms) for balanced, and figurative meaning activation (32 ms) for Spanish and English dominant bilinguals; however, the analyses were marginally significant (*Ps* = .062, .057, and .094, respectively).

In relation to differences between bilinguals and language dominance, for Cue 1, English dominant bilinguals (M = 685 ms) were 49 ms faster than balanced bilinguals (M = 734 ms) in responding to Figurative related targets (p < .05), and 47 ms faster than Spanish dominant bilinguals (M = 732 ms). However, the differences were marginally significant (p = .07). For Cue 2, the only meaningful RT differences were between responses to Figurative Related targets. In

this case, English dominant (*M* = 688 ms) were 77 ms faster to respond to figurative related targets than balanced bilinguals (M = 744 ms).

DISCUSSION

In this experiment, we ask whether the figurative interpretation of an idiomatic expression is more likely to be triggered by the inclusion of an anaphoric expression (Cue 2) that might serve as a contextual and pragmatic cue to automatically link its referent or antecedent. In other words, we investigate whether the figurative interpretation of an idiom (antecedent) can be (re)activated by an anaphoric referential description. Another purpose of the present study was to further examine idiom meaning activation (literal vs. figurative) as a function of language dominance. To do that, Spanish-dominant, English-dominant, and balanced bilinguals heard sentences containing idiomatic expressions (e.g., "I'm not one to make a scene, but after he yelled at me, that was impossible to avoid"). In addition to the sentences, participants made lexical decisions of visual targets that were literally related and unrelated (control), and figurative related and unrelated (control). Visual targets were presented immediately after idiom offset (Cue 1) and at anaphor offset (Cue 2).

First, in relation to Cue, the results from LME analyses revealed no reliable effects in relation to Cue (1 vs. 2) position. There was a significant the 3-way interaction between Cue (cue 1 vs cue 2), Figurativeness (literal vs. figurative), and Relatedness (related vs. unrelated). This interaction revealed that participants' response times were faster during Cue 2 than at Cue 1. However, there was a general trend for the literal meaning of the idiomatic expression to be faster than the figurative interpretation. That is, bilinguals were faster in responding to the literal interpretation, suggesting that regardless of Cue position, the literal interpretation appeared to be more active than the figurative meaning. This general pattern was further supported by the 4-way

interaction between Cue (cue 1 vs. cue 2), Figurativeness (literal vs. figurative), Relatedness (related vs. unrelated), and Language Dominance (English vs. Spanish vs. balanced). Where the literal interpretation of the idiomatic expression was responded to faster than the figurative meaning regardless of Language Dominance and Cue position. There was a general pattern in which figurative related meanings were faster in Cue 2, than in Cue 1 for Spanish-dominant and English-dominant bilinguals. The only hints of facilitation (as measured by priming effects) suggesting "true" meaning activation was between balanced bilinguals for literal meaning at Cue 2, and Spanish and English-dominant bilinguals exhibiting figurative meaning activation at Cue 2. These priming effects were marginally significant. Thus, the data does not provide strong evidence for the (re)activation of the figurative meaning of idioms. In contrast, the present results provide strong evidence for the (re) activation of the literal interpretation of idiomatic expressions. Overall results reflect a pattern in which a faster (re)activation of an idiomatic expression was achieved after the presentation of an anaphor linking back to the antecedent (i.e., idiom). Thus, supporting the view that idioms are flexible and can serve as antecedents to be later (re)activated by an anaphoric pronoun, but only to their literal interpretation.

In relation to Language Dominance, there was a marginal main effect revealing a general trend in which English-dominant bilinguals were faster than Spanish-dominant and balanced bilinguals. The 2-way interaction between Figurativeness (literal vs. figurative) and Language Dominance (English vs. Spanish vs. balanced) revealed that in general, the literal meaning was faster than the figurative regardless of Language Dominance. More important, however, was the finding that English-dominant bilinguals were faster to respond to the figurative related targets than Spanish-dominant and balanced bilinguals. The 3-way interaction further showed the propensity of the literal meaning to be responded to faster. In addition, it further showed a priming

effect for the literal interpretation, but only for balanced bilinguals. The 4-way interaction, as discussed before, further revealed Language Dominance effects whereby Spanish-dominant bilinguals were faster to name figurative targets in Cue 2 than Cue 1. English-dominant bilinguals revealed similar patterns. In relation to Cue 1, English-dominant bilinguals were faster than Spanish-dominant bilinguals in responding to figurative related targets. For Cue 2, English-dominant bilinguals were faster than balanced bilinguals in responding to figurative targets. Overall results, however, revealed a general pattern showing language processing differences in which English-dominant bilinguals are more likely to access the literal interpretation of the idiomatic expression.

Overall results from Experiment 1 revealed faster meaning activation at anaphor offset (Cue 2). This is because the antecedent (i.e., idiom) provided the additional contextual and pragmatic information that allowed for the (re)activation of the intended interpretation of idiomatic expressions by the anaphor, but the literal interpretation of the idiom. However, there was an observable pattern of reaction time between bilinguals suggesting that English-dominant bilinguals may have faster activation than Spanish-dominant and Balanced bilinguals. More importantly, the tendency for the literal to be more active in bilinguals was supported by faster responses to literal targets than to figurative ones. This pattern was generalized throughout all interactions between fixed effects – Cue (cue 1 vs. cue 2), Relatedness (related vs. unrelated), and Language Dominance (English vs. Spanish vs. balanced). In terms of Language dominance as a moderator, results from LME analyses showed that English-dominant bilinguals yielded faster reaction times when presented with literal meanings, as did Balanced bilinguals. Spanish-dominant bilinguals showed the same pattern, however the results were not deemed statistically significant.

EXPERIMENT 2

Experiment 2 further investigated idiom meaning activation (i.e., literal vs. figurative) by bilinguals (English-Spanish and Spanish-English), as well as examining if language dominance (English-dominant vs. Spanish-dominant vs. Balanced) can modulate which meaning of an idiom (literal vs. figurative) is activated first. In this experiment, a baseline cue (pre-cue) was used for comparison, and was placed at antecedent onset (before the idiom). It is assumed that there will be no significant meaning activation (neither literal nor figurative) at this cue. An additional Cue (3) was used to further investigate meaning activation after anaphor offset. Cue 3 was placed 300 ms after the anaphor offset (~1000 ms after idiom offset). It is expected that by about 1000 ms after idiom offset, a clearer picture of the nonliteral interpretation might emerge, since by then, any possible ambiguity is resolved (e.g., indirect processing hypothesis).

METHODS

Participants

A total of 111 bilinguals (Female = 85, Male = 26) from TAMIU psychology subject pool participated in the study. Participants were English-Spanish or Spanish-English bilinguals. Detailed data were obtained regarding the participants' language dominance in both English and Spanish using the BDS language survey. Ten participants were excluded from the analysis due to low accuracy performance scores of less than 80%.

Table 8 summarizes the percentage of bilinguals falling into each category of L2 age of acquisition. As can be seen from **Table 8**, the large majority of Spanish-English and Balanced bilinguals learned the L2 between the ages of 0-5. On the other hand, the large majority of English-Spanish bilinguals reported learning the L2 at 6-9 years of age. Fewer English-Spanish and Spanish-English bilinguals (no balanced) indicated learning the L2 between ages 10-15. In

addition, two Spanish-English bilinguals, and four English-Spanish bilinguals reported learning the L2 after the age of sixteen.

TABLE 8 | Age of Acquisition of the L2 (Experiment 2).

	0-5 years	**6-9 years**	**10-15 years**	**+16 years**
Spanish-English	63% (N = 19)	22.6% (N = 7)	9.7% (N = 3)	6.5% (N = 2)
English-Spanish	37.3% (N = 19)	43.1% (N = 22)	11.8% (N = 6)	7.8% (N = 4)
Balanced	100% (N = 19)			

As revealed by the BDS, there were 18 Spanish-dominant (*M* = -11.5, *SD* = 4.4), 43 English-dominant (*M* = 10.9, *SD* = 64.1), and 40 balanced bilinguals (*M* = 0.6, *SD* = 3.3). In relation to the place of learning of the L2, 21.8% of participants reported having learned it both at school and at home. Compared to 43.6% who reported learning the L2 only at school, and 32.7% who reported learning it only at home. Two individuals (2%) reported learning the L2 with friends. The participants' dominance score from the BDS determined language dominance, where individuals scoring above 5 were considered English-dominant, those scoring below -5 were considered Spanish-dominant, and those scoring between 5 and -5 were considered balanced.

Table 9 summarizes participants' responses to language performance measures – broken down into language dominance. As in experiment 1, subjects completing the BDS reported their age and how often they mixed their Spanish and English languages. They also completed a series of self-rating scales regarding language use, and speaking, reading, understanding, and writing ability within each language. As can be seen from **Table 9**, all bilingual groups (English-Spanish, Spanish-English, and Balanced) showed comparable patterns in regards to code-switching. Bilinguals rated English as the most frequently used language and reported having a significantly

higher language proficiency in English for speaking, reading, understanding, and writing than Spanish. So, it appears that our bilingual groups are very similar.

TABLE 9 | Language Background Information for the Bilingual Sample (Experiment 2).

	ENGLISH (N =31)	**SPANISH (N =51)**	**BOTH (N =19)**
Age	21.90 (0.82)	23.04 (0.91)	22.53 (1.17)
Mean language mixing Ratings	4.25 (0.32)	5.06 (0.26)	4.68 (0.44)
MEAN SELF-RATINGS	**ENGLISH**	**SPANISH**	
Language use	6.02 (0.12)	4.82 (0.17)**	
Speaking	6.48 (0.10)	5.55 (0.13)**	
Reading	6.65 (0.07)	5.30 (0.16)**	
Understanding	6.72 (0.07)	5.93 (0.12)**	
Writing	6.55 (0.08)	4.79 (0.17)**	

Note: Values in parentheses represent Standard Error of the Mean; **p < 0.01; Self-ratings (1 = Very little knowledge, 7 = Very Fluent); Language mixing (1 = I never mix languages, 7 = I mix languages all the time).

Table 10 summarizes correlations (*r*) between variables used to measure bilinguals' language proficiency and dominance: age in which an individual learned English/Spanish, years of schooling in English/Spanish an individual experienced, an individual's tendency to code-switch, an individual's use of English/Spanish in a typical day, an individual's proficiency in English/Spanish, and an individual's dominance of the English/Spanish language. It is important to note, that there was a moderate negative correlation between an individual's proficiency in English and an individual's proficiency in Spanish, which suggests that as an individual's language proficiency increases for one language, it decreases for the other. It is also important to note that years of schooling experienced in one language were negatively correlated to years of schooling experienced in the other language. On the other hand, there was a positive relationship between the years of schooling experienced in one language and the use of that language in a typical day. In addition, there was a positive correlation between the age in which an individual learned a language (reverse scored) and dominance in said language. However, unlike in experiment 1, there

was a positive relationship between language dominance in English and Spanish. This might be attributed to the unique sample population of bilinguals that took part in this study, who appear to be equally dominant in English and Spanish.

TABLE 10 | Summary of Correlations for Scores on Language Variables (Example 2).

Variables	1	2	3	4	5	6	7	8	9	10
2	0.040									
3	0.199*	0.082								
4	-0.079	0.006	-0.130*							
5	0.084	-0.070	0.026	0.123						
6	0.039	0.023	0.070	-0.112	-0.100					
7	0.019	-0.047	-0.134	0.272**	0.275**	-0.201*				
8	-0.051	-0.002	-0.103	-0.021	-0.114	0.060	-0.174*			
9	0.043	-0.062	-0.092	-0.023	0.053	0.003	0.051	-0.339**		
10	0.037	-0.105	0.135*	0.097	-0.050	-0.092	0.084	0.048	0.233*	
11	0.112	-0.109	0.086	0.107	-0.106	-0.020	0.043	0.420**	-0.381**	0.481**

Note: 1 = Age learned English; 2 = age learned Spanish; 3 = years of schooling in English; 4 = years of schooling in Spanish; 5 = code-switching; 6 = English use in a typical day; 7 = Spanish use in a typical day; 8 = English proficiency; 9 = Spanish proficiency; 10 = English dominance; 11 = Spanish dominance. *$p < 0.05$. **$p < 0.01$.

Materials

The same materials from Experiment 1 were used in Experiment 2 (i.e., target sentences and visual targets for the lexical decision task, and audio recordings of the previously mentioned sentences). As in experiment 1, this experiment required two cues to be placed in the sentences/recordings in order to measure participants' RTs. In this study, a Pre-cue was placed immediately at idiom onset and it served as baseline for comparison, while Cue 3 was placed 300 ms after anaphor offset (~1000 ms after idiom offset). For example, in the sentence "I'm not one

to $_{pre}$make a scene, but after he yelled at me, that was impossible$_{3}$ to avoid," Pre-cue would be set immediately before *make* and Cue 3 would be set 300 ms after *that* (~1000 ms after *scene*). This was done in order to better examine what occurs, in terms of activation, before idiom onset and after anaphor offset, since experiment 1 revealed no significant differences, in terms of RT, between cues.

Procedure

Experiment 2 followed the same procedure described in experiment 1: sign-up and debriefing, Cross-modal Lexical Decision task (screen and audios), and completing the BDS.

RESULTS

As in experiment 1, a linear mixed model effects (LME) analysis was conducted with items and subjects as random factors and Language Dominance (English vs. Spanish vs. balanced), Cue (pre-cue vs. cue 3), Relatedness (related vs. unrelated), and Figurativeness (literal vs. figurative) as fixed factors. Thus, the overall design conformed to a 3 X 2 X 2 X 2. Reaction time (RT) was taken as a measurement of activation. Participants' responses were scored in terms of accuracy (in percentages). Data from ten participants was removed from analysis given that their accuracy scores were less than 80%. RTs with Z scores of ± 3 were considered outliers and removed from the data analysis. The overall data analyses include only cases in which participants' responses were correct. The data was analyzed using IBM SPSS V. 20.

As can be seen in **Table 11** below, the main effect of Cue (pre-cue vs. cue 3) was statistically reliable. Participants responded to targets 17 ms faster during Cue 3 (M = 662 ms, SE = 3.3) than during Pre-cue (M = 679 ms, SE = 3.4). LME also revealed a significant main effect of Figurativeness (literal vs. figurative). That is, literal targets (M = 661 ms, SE = 2.6) were responded 42 ms faster than figurative targets (M = 703 ms, SE = 3.0).

TABLE 11 | Summary of Main Effects and Interactions (Experiment 2).

Source	Numerator df	Denominator df	F	*p*
Intercept	1	113.912	2521.137	.000
CUE	1	7937.691	12.358	.000**
FIG	1	366.262	26.763	.000**
REL	1	448.290	.451	.502
DOM	2	97.764	1.363	.261
CUE * FIG	1	7935.261	.952	.329
CUE * REL	1	7934.066	5.437	.020*
CUE * DOM	2	7920.331	2.052	.128
FIG * REL	1	435.173	3.906	.049*
FIG * DOM	2	7895.504	4.187	.015*
REL * DOM	2	7895.368	.018	.982
CUE * FIG * REL	1	7934.126	1.242	.265
CUE * FIG * DOM	2	7913.126	1.236	.291
CUE * REL * DOM	2	7913.183	3.784	.023*
FIG * REL * DOM	2	7894.979	.576	.562
CUE * FIG * REL * DOM	2	7913.480	.153	.858

Note: Numerator df = degrees of freedom between; Denominator df = degrees of freedom within; *p < 0.05. **p < 0.01.
FIG = Figurativeness; REL = Relatedness; DOM = Language Dominance.

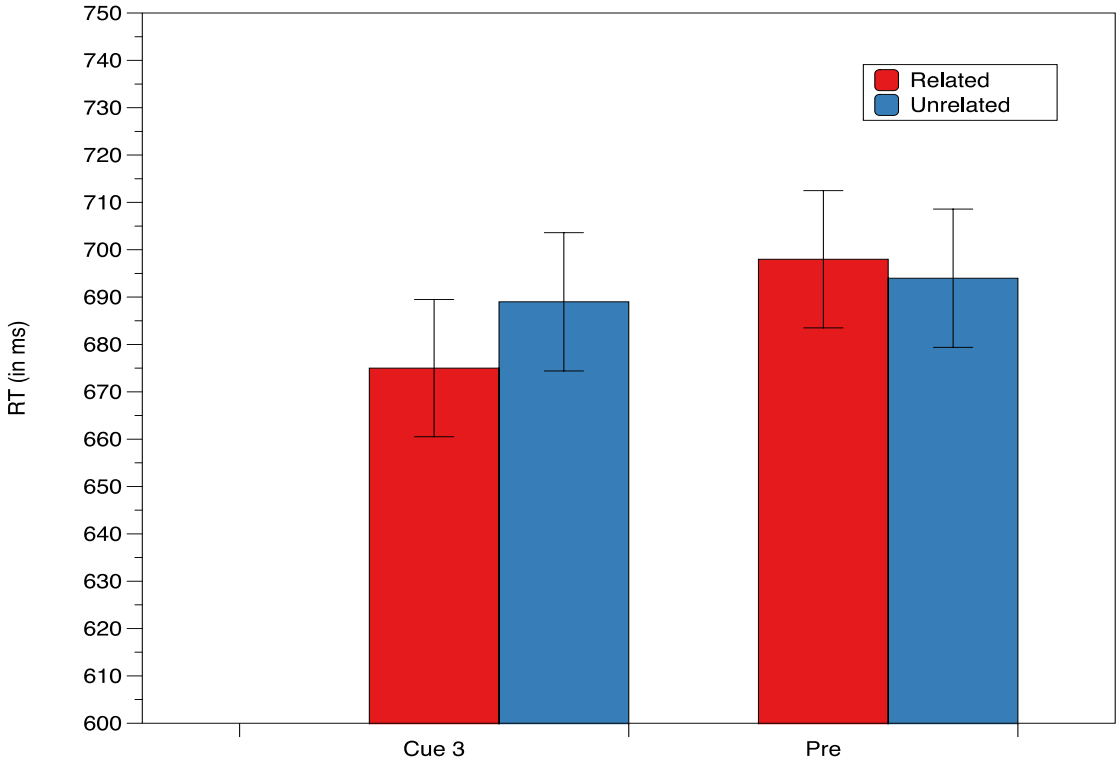
As expected, the results suggest that there was no statistically significant meaning activation (literal and figurative) before the idiom was presented (i.e., pre-cue). Interestingly, overall results revealed that literal interpretations remained active after well beyond anaphor offset.

Cue vs. Relatedness

The interaction between Cue (pre-cue vs. cue 3) and Relatedness (related vs. unrelated) was statistically reliable (see **Table 11**). **Figure 2** summarizes the two-way statistical interaction. Follow up LSDs revealed that related targets where activated 24 ms faster during Cue 3 (*M* = 658 ms) than during Pre-cue (*M* = 682 ms). No other effects reached significance. As expected, results suggest that bilinguals were unable to active either meaning (literal or figurative) before the

idiomatic phrase was presented, but were able to maintain activation well beyond anaphor offset (cue 3).

FIGURE 2 | Mean RTs and Two-Way Interaction as a Function of Cue and Relatedness.

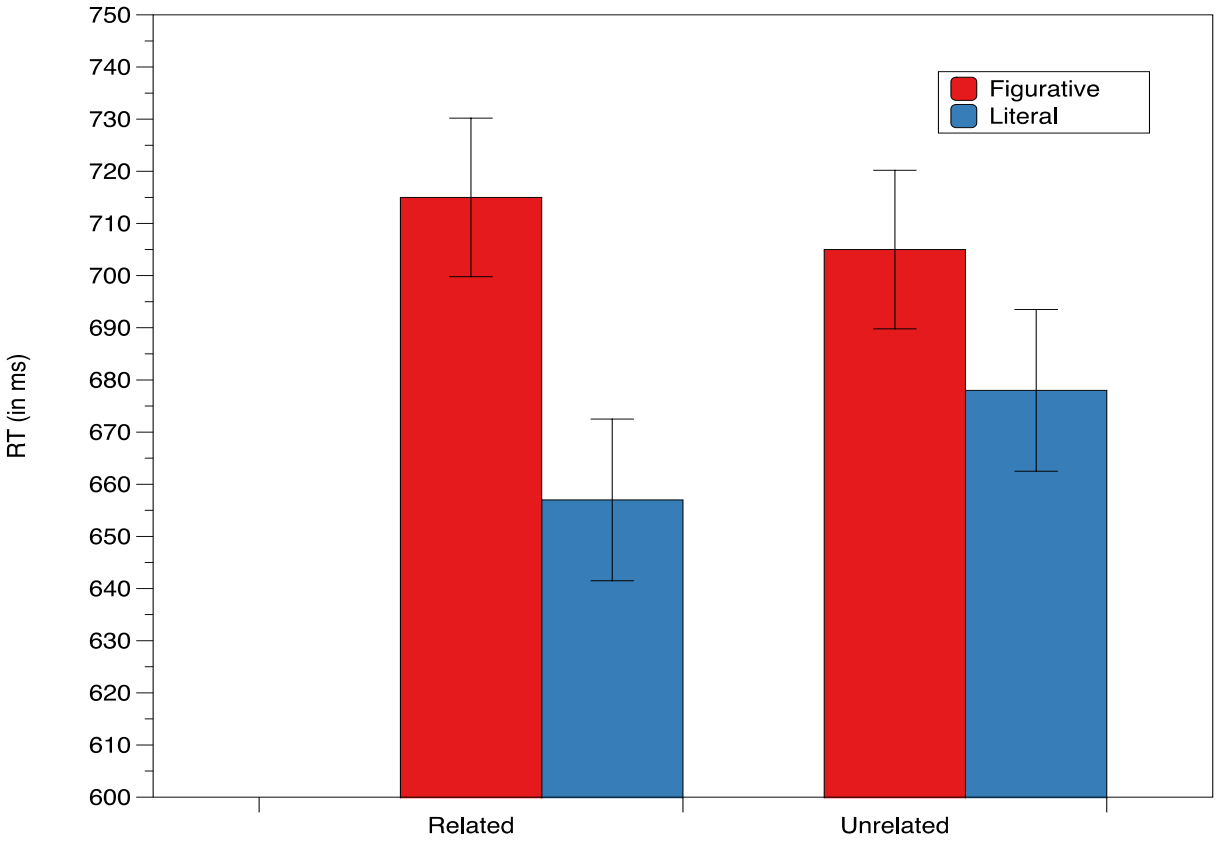


Figurativeness vs. Relatedness

As can be seen in **Table 11**, the interaction between Figurativeness (literal vs. figurative) and Relatedness (related vs. unrelated) was statistically reliable. Follow up LSDs analyses, as described in **Figure 3**, revealed significant priming effect where literal related targets (*M* = 657 ms, *SE* = 16) were 21 ms faster than literal controls (*M* = 678 ms, *SE* = 15). However, this difference was marginally significant (*p* = .07). Figurative related vs. figurative controls showed no reliable differences. On other comparisons of interest, literal related targets (*M* = 657 ms, *SE* = 16) were responded 58 ms faster than figurative targets (*M* = 715 ms, *SE* = 15.2). Likewise, participants with the unrelated targets responded 27 ms faster when exposed to literal targets (*M* = 678 ms, *SE* = 15.5) than when exposed to targets of the figurative kind (*M* = 705 ms, *SE* = 15.2).

Relatedness (related vs unrelated) effects did not reach significance. Thus, regardless of Relatedness, the overall pattern suggests that literal targets were responded to faster than figurative ones.

FIGURE 3 | Mean RTs and Two-Way Interaction as a Function of Figurativeness and Relatedness.

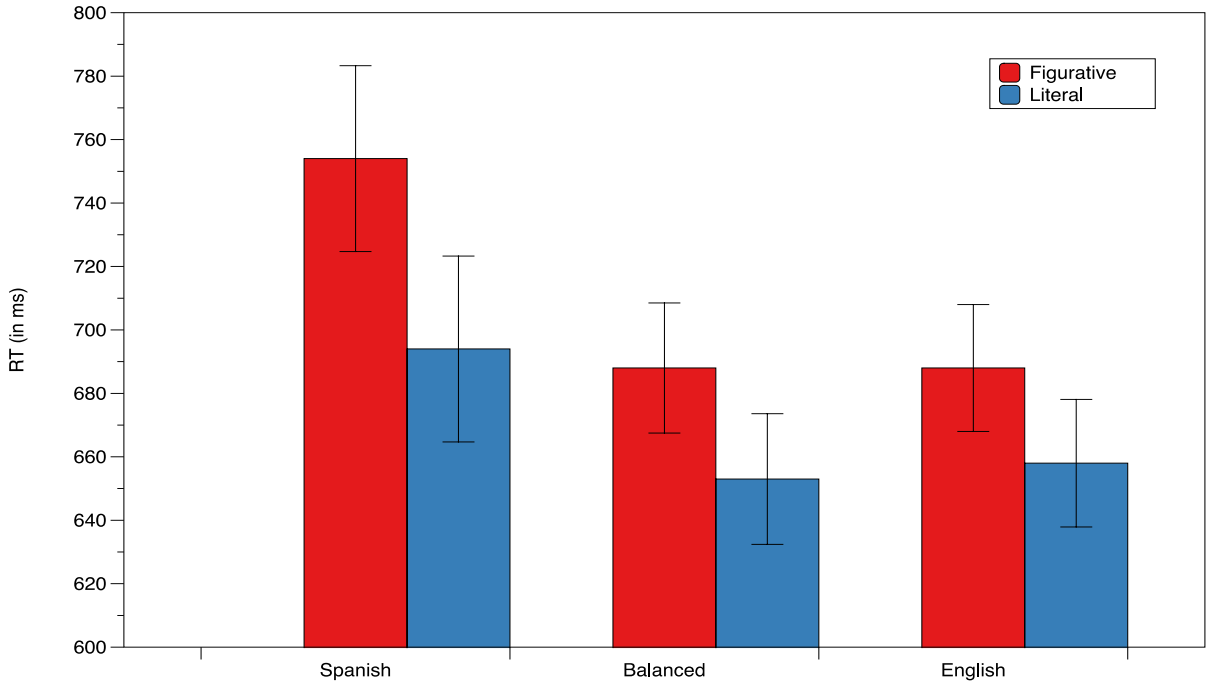


Figurativeness vs. Dominance

The two-way interaction between Figurativeness (literal vs. figurative) and Language Dominance (English vs. Spanish vs. balanced) was statistically significant (see **Table 11**). As can be seen in **Figure 4**, LSDs revealed that all bilinguals had quicker access to literal meanings than to figurative ones. That is Spanish-dominant bilinguals revealed a 62 ms difference (literal targets: *M* = 692 ms – figurative targets: *M* = 754 ms), balanced bilinguals revealed a 35 ms difference

(literal targets: *M* = 653 ms – figurative targets: *M* = 688 ms), and English-dominant bilinguals revealed a 30 ms difference (literal targets: *M* = 658 m – figurative targets: *M* = 688 ms). Overall, English-dominant bilinguals were 66 ms faster to respond to figurative targets than Spanish-dominant bilinguals; however, this difference was marginally significant (*p* = .06). No other effects reached significance.

FIGURE 4 | Mean RTs and Two-Way Interaction as a Function of Figurativeness and Language Dominance (Experiment 2).



Cue vs. Relatedness vs. Dominance

As summarized in **Table 11,** the 3-way interaction between Cue (3 vs. pre), Relatedness (related vs. unrelated), and Language Dominance (English vs. Spanish vs. balance) was statistically reliable. As expected, there was no statistically significant activation of meaning at idiom onset (pre-cue). LSDs revealed an overall pattern, as seen in **Table 12**, that suggests all bilinguals responded faster to related targets during Cue 3 than during pre-cue. More interestingly,

however, was the 30 ms finding effect for Spanish-dominant bilinguals in responding to related targets (*M* = 708 ms, *SE* = 30) than unrelated targets (*M* = 738 ms, *SE* = 30; p = .03), for cue 3 only.

TABLE 12 | Mean and Standard Error (SE) and Three-Way Interaction as a Function Cue, Relatedness, and Language Dominance.

Probe Position	*M*	*SE*	*DIFF*
Related			
Spanish Cue 3	708	29.9	25.0*
Spanish Pre	733	29.9	
Balance Cue 3	659	20.9	17.0*
Balance Pre	676	20.9	
English Cue 3	656	20.4	28.5*
English Pre	685	20.4	
Unrelated			
Spanish Cue 3	738	30.0	22.6**
Spanish Pre	716	29.9	
Balance Cue 3	659	20.9	26.3
Balance Pre	686	20.9	
English Cue 3	670	20.5	10.7
English Pre	680	20.5	

Note: DIFF = Difference between Cue 3 and Pre targets; *p < 0.05. **Borderline significance.

DISCUSSION

Experiment 2 served two purposes. First, it provided a baseline at the Pre-cue (idiom onset) to assess the effects of the preceding context (up to idiom onset) in meaning activation. Second, to further explore the (re)activation of meanings of idiomatic expressions at 300 ms after anaphor offset.

In relation to Cue position, there was a reliable effect showing that participants were faster in Cue 3 than Pre-cue; the main effect for Figurativeness (literal vs. figurative) revealed that literal targets were significantly faster than nonliteral, suggesting a literal salience effect, where literal meanings, in general, are more readily available than nonliteral ones.

The interaction between Cue (pre-cue vs. cue 3) and Relatedness (related vs. unrelated) further shows that most meaning activation occurred at Cue 3, and only for related targets. The 3-way interaction between Cue (pre-cue vs. cue 3), Relatedness (related vs. unrelated), and Language Dominance (English vs. Spanish vs. balanced) revealed a pattern in which all bilinguals were faster in responding to literal targets than figurative targets. Further supporting the view that for bilingual, the literal interpretations is more accessible than the nonliteral one.

In relation to accessibility of the literal vs. figurative interpretation, the interaction between Figurativeness and Relatedness, again, showed a priming effect for the literal interpretation. As discussed before, the priming effect has been taken as a direct measurement of meaning activation.

As far as Language Dominance is concerned, our results found language dominance effects. First, there was a general pattern in which regardless of language dominance, bilinguals were quicker in responding to literal targets. More important, however, was the statistical pattern in which English-dominant bilinguals were faster in responding to figurative targets than Spanish-dominant bilinguals, and no difference between balanced bilinguals. This result, as in Experiment 1, suggests that English-dominant bilinguals are more likely to have access than Spanish dominant bilinguals.

Overall, as in Experiment 1, these results reveal a propensity of the literal meaning of the idiomatic expression to be faster regardless of language dominance or Cue position (1, 2, 3). This means there was a significant effect for bilinguals in the literal condition, suggesting a faster lexical

activation for this interpretation of idiomatic expressions. However, the results also hint to the possibility that figurative meaning activation is a function of language dominance, where English-dominant, and balanced bilinguals are more likely to have more access to the figurative meaning of the idiomatic interpretation than Spanish-dominant bilinguals.

As expected, the overall results from Experiment 2 revealed no significant activation at pre-cue (i.e., idiom onset). This is because meaning activation is not possible before the idiomatic expression is presented. However, results revealed that the literal interpretation of idiomatic expressions remained active well beyond anaphor offset (i.e., cue 3). There was an observable pattern suggesting that English-dominant bilinguals may have faster activation than Spanish-dominant and balanced bilinguals. Results from Experiment 2 mimicked those from Experiment 1 where evidence suggests related targets might be more efficient priming stimuli than unrelated targets. More importantly, the tendency for the literal to be more active in bilinguals was present throughout all interactions between fixed effects – Cue (Experiment 1: cue 1 vs. cue 2 & Experiment 2: Cue 3), Relatedness (related vs. unrelated), and Language Dominance (English vs. Spanish vs. balanced).

GENERAL DISCUSSION

Since the study's subjects consisted English-Spanish and Spanish-English bilinguals, it was important to find what their dominant language was. This was done using the BDS. A correlational analysis was conducted to test the relationships between several language variables of the BDS, which were: age in which an individual learned English/ Spanish, years of schooling in English/Spanish an individual experienced, an individual's tendency to code-switch, an individual's use of English/Spanish in a typical day, an individual's proficiency in English/ Spanish, and an individual's dominance of the English/ Spanish language.

The overall results of Experiment 1 suggest that, as language use, language proficiency and language dominance increase for one language, they decrease for the other language. More importantly, however, was the negative correlation between dominance of the English language and dominance of the Spanish language, which suggests that if an individual is dominant in one language, he/she is less likely to be dominant in the other language. Experiment 2 revealed the same general pattern suggesting that, as language use, proficiency, and dominance increase for one language, they decrease for the other language. However, unlike Experiment 1, Experiment 2 found a positive correlation between dominance of the English language and dominance of the Spanish language, which suggests that if an individual is an English-dominant bilingual, he/she is also likely to be a Spanish-dominant bilingual. These contradicting findings could explain the high percentage of participants in the study (i.e., 23% in Experiment 1 and 39% in Experiment 2) that were balanced bilinguals.

Although there seem to be some contradictions between the results of Experiment 1 and Experiment 2, in regards to correlation for scores of language variables, it is important to note that these correlations were conducted on answers to the BDS, and it followed the scoring procedures

provided by the authors. Since Dunn and Fox Tree (2009) did not report reliability scores of the BDS, we went ahead and computed reliability scores on our data using the nine items, as well as participants' responses to those items, for each language independently (English and Spanish). Results for this analysis revealed that Cronbach's Alpha for English was slightly higher (.514) than for Spanish (.507). According to the rules dictated by SPSS, scores revealed the scale may have poor internal consistency in both languages.

Two experiments were conducted in order to examine processing differences between figurative and literal meanings in the (re)activation of idiomatic expressions by bilinguals. In these studies, bilingual (i.e., English-Spanish and Spanish-English) participants listened to sentences containing idiomatic expressions, and made lexical decisions of visual targets presented in either literally or figuratively relation to the idioms' interpretations (control stimuli had no relation). It is important to note that these studies focused on language dominance and not on L1 vs. L2. Meaning activation of idiomatic expressions was predicted to increase by using an anaphoric expression to establish links and (re)activate the antecedent (i.e., idiom) to its anaphor. In the sentence "I'm not one to make a scene, but after he yelled at me, that was impossible to avoid," the idiomatic expression (i.e., make a scene) was the antecedent and "that" was the anaphor. Interpretation activation was tested with cues placed at idiom offset and at anaphor offset, or at idiom onset and 300 ms after anaphor offset. Activation was measured by reaction time.

In experiment 1, cue 2 (anaphor offset) yielded faster reaction times than cue 1 (idiom offset). However, results exhibited a pattern in which literal meanings were activated faster than figurative at both cues. Experiment 2 followed the same procedures as experiment 1, except for cue placement. In this experiment, cues were placed at idiom onset (pre-cue) and 300 ms after anaphor offset (cue 3). Results revealed a general faster reaction time at cue 3 than at pre-cue for

all bilinguals. As in experiment 1, results from Experiment 2 suggested an overall pattern of predominant activation of literal interpretations regardless of cue placement. However, as expected, there was no significant activation before idiom onset (i.e., pre-cue). In contrast, results revealed that literal interpretations of idiomatic expressions remained active well beyond anaphor offset (i.e., cue 3).

Overall results from both experiments revealed a strong tendency for bilinguals to respond to literal targets faster than to figurative targets. That is, bilinguals were faster in responding to the literal interpretation, suggesting that regardless of Cue position or Language Dominance, the literal interpretation of idiomatic expressions appeared to be more active than the figurative interpretations. This means there was a significant effect for bilinguals in the literal condition, suggesting a faster lexical activation for this interpretation of idiomatic expressions. However, results also hint to the possibility that figurative meaning activation is a function of language dominance, where English-dominant, and balanced bilinguals are more likely to have more access to the figurative meaning of the idiomatic interpretation than Spanish-dominant bilinguals.

It was expected that the overall results would reflect both the *indirect processing hypothesis* and the *configurational hypothesis*, which suggest that the literal meaning of idiomatic phrases tends to be activated before the figurative meaning. However, results showed that, regardless of Cue, Relatedness, and/or Language Dominance, only the literal meaning of idiomatic expressions was being activated. Overall results reflect Cieślicka's (2006a) *literal salience model*, which assumes that literal meanings of idiom components are more salient than the idiom's figurative meaning. Although salience of words is not permanent – since it is defined by frequency and familiarity – it is believed that for some idiomatic expressions, literal meanings may be more salient than figurative ones because of their commonality in daily interactions (Giora, 1997; 2003;

Kecskes, 2006; Cieślicka, 2006a; 2006b). Since L2 learners are already familiar with the meaning of words before they see them in a figurative format (idiom), those literal interpretations are likely to have stronger encoding in the lexicon. Thus, literal meanings are more salient than figurative ones. The overall results from these experiments were consistent with those by Heredia and Cieślicka (2016), since literal references ("disturbance") to the idiomatic expressions ("make a scene") were activated faster than figurative references ("play") – as revealed by faster reaction times (see also Cieślicka, 2006b; Siyanova-Chanturia et al., 2011).

This study also examined bilingual idiom interpretation at different probe positions (Experiment 1: idiom offset and anaphor offset, Experiment 2: idiom onset and 300 ms after anaphor offset). It was expected that the overall results would reflect the idea that an anaphoric referential description would more likely (re)activate its antecedent that could be more pragmatically plausible (i.e., figurative meaning) than its literal interpretation. Interestingly, results from this study did not yield sufficient evidence to support this claim. As previously discussed, overall results revealed a general pattern for literal targets to be responded to faster than literal targets regardless of cue position. That is, the literal interpretation of idiomatic expressions was activated faster than the figurative meaning even after the presence of anaphoric referential descriptions (i.e., Cue 2 and Cue 3). Although anaphora did elicit faster responses from Cue 2 and Cue 3 than from Cue 1, there was essentially no figurative meaning activation.

Unlike evidence from Heredia and Cieślicka (2016) study, which showed that predominance towards literal meaning activations occurs only for Spanish-dominant bilinguals, this study's results reflect that all bilinguals (i.e., English-dominant, Spanish-dominant, and balanced) tend to activate literal interpretations of idiomatic expressions faster than figurative meanings. That is, this study suggests that bilinguals have a more direct access to the literal

meaning of idiomatic expressions than they do to the figurative interpretation. However, as in Heredia and Cieślicka (2016), English-dominant and balanced bilinguals were more likely to have access to the figurative meaning of the idiomatic expression than Spanish-dominant bilinguals. That is, although all bilinguals had faster activation of literal interpretations, English-dominant and balanced bilinguals seem to also activate figurative meanings of idiomatic expressions; while Spanish-dominant bilinguals do not.

Based on the *idiom diffusion model of second languages* (Liontas, 2002; Cieślicka, 2006a), further analyses are suggested to examine differences in reaction times of different types of idioms. This model proposes that idiom comprehension in L2 depends on the similarity of the English idiom to its Spanish counterpart (Liontas, 2002; Cieślicka, 2006a). In this study, idioms were separated into the three categories mentioned in the model: lexical-level or identical, semi-lexical level or similar, and post-lexical level or different. Therefore, further analysis is possible. Additional analyses are also suggested in order to further examine differences in reaction times between cue 2 and cue 3 (i.e., anaphor offset and 300 ms after anaphor offset). This would allow for a better understanding of what occurs, in terms of meaning activation, during that in-between period.

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APPENDIX A

Idiomatic Phrases in Sentence Format

1. I'm not one to make a scene$_1$, but after he yelled at me, that$_2$ was impossible to avoid.
2. It's essential to keep an ace up your sleeve$_1$, because if something goes wrong, it$_2$ can be of help.
3. I like people who dance to another tune$_1$ and my friend doesn't agree, but that$_2$ is what makes people unique.
4. The movie gave me the willies$_1$, and everyone agreed, but Mary didn't think it did so$_2$.
5. Sometimes it is more important to save your skin$_1$ than another's, because it$_2$ can prevent problems from escalating.
6. One must be careful not to seal one's fate$_1$, because if that$_2$ happens, the consequences are irreversible.
7. It's better to take the back seat$_1$ on certain situations, as this$_2$ can allow professionals to deal with the issue.
8. I guess I'll have to climb on the bandwagon$_1$ of new trends, for only then$_2$ will I stay in style.
9. It is not easy to ride the storm$_1$, but you must do so$_2$ if you want to accomplish your goals.
10. Theon's fall from grace$_1$ was no surprise to anyone, because that$_2$ is what happens when you betray your family.
11. In order to be a great king, one must rule with an iron fist$_1$ and there is no other way but this$_2$.
12. Keyla decided to add fuel to the fire$_1$ during their fight, and that$_2$ led him to punch a hole in the wall and break his hand.
13. She loves to throw the book at$_1$ everyone, and I guess that$_2$ shows she really does want to become a successful individual.
14. There were mistakes on the data and now I'm back to square one$_1$, and having to be so$_2$ is a drag.
15. Charles is fit as a fiddle$_1$, and the doctor stated he was so$_2$ after his last check-up.
16. You can't bet your bottom dollar$_1$ on her, because you might regret it$_2$ later.
17. One must bite the bullet$_1$ at hard times, and doing so$_2$ can make you emotionally stronger.
18. You should take the bull by the horns$_1$ at the meeting because it$_2$ is the only way he will take you seriously.
19. Tim Burton's movies take the cake$_1$, and because they do that$_2$, they receive so many award nominations.
20. My cousin and I are two peas in a pod$_1$ and I think being one$_2$ is why we feel so comfortable around each other.
21. Marcus says he must bring home the bacon$_1$ everyday since it$_2$ is part of his job as a parent.
22. I am a fish out of water$_1$ when I'm with strangers, and being one$_2$ makes it hard for me to make new friends.
23. In order to end a problem one must nip it in the bud$_1$, even though some people will say that$_2$ might not be easy.

24. In order for a man to wear the pants$_1$, his wife must allow him to do so$_2$.
25. I'm walking on egg shells$_1$ whenever I am around her and it$_2$ makes things frustrating between us.
26. His comments were below the belt$_1$ and Karen did not appreciate them being so$_2$.
27. Maria had her final presentation today but she had a frog in her throat$_1$, and because she had that$_2$, she failed the class.
28. I always miss the boat$_1$ when it comes to jokes, and that$_2$ makes it nearly impossible for me to attend comedy shows.
29. You sure do drive a hard bargain$_1$ and the sales woman was impressed by how you did that$_2$!
30. You have to lay down the law$_1$ on them without hesitating, and only by then$_2$ will the kids listen.
31. Sarah says she wants to pull the plug$_1$ on her relationship since it$_2$ seems to be the only way to move on.
32. You should really shut your trap$_1$ because not doing it$_2$ will get you in trouble some day.
33. Michael was born with a silver spoon in his mouth$_1$ and his cousins get jealous of him being so$_2$ because they were not.
34. I just can't believe my ears$_1$, even if her story seems possible, that$_2$ happens when people lie a lot.
35. A known rule of thumb$_1$ is "don't wear white after Labor Day," and most women cherish this one$_2$ since childhood.
36. We only have the tip of the iceberg$_1$ and Monica said that this$_2$ is not enough to make a decision.
37. You're going to bite the dust$_1$ when I'm done and you doing that$_2$ will make me very happy.
38. One must learn the ropes$_1$ before becoming an expert even if it$_2$ entails simple tasks.
39. Jessica Lang steals the show$_1$ on every season, and her doing so$_2$ is the main reason I watch American Horror Story.
40. I told her to keep a level head$_1$ during the argument, but she didn't do so$_2$ and now she is single.
41. Seems impossible to lose one's touch$_1$ on certain skills, but it$_2$ can be caused by lack of practice.
42. I've been under the weather$_1$, but I hope I'm not so$_2$ by Christmas.
43. Greg finally decided to pop the question$_1$ and his girlfriend was surprised by him doing it$_2$, but said yes with a big smile on her face.
44. Think about what you are doing before you bite someone's head off$_1$ and later regret it$_2$.
45. Let's just bury the hatchet$_1$ already, because doing so$_2$ will make us feel better.

46. I just gave you some food for thought$_1$ and didn't mean for this$_2$ to be taken the wrong way.
47. Calm down before you lose your cool$_1$, because I can see that it$_2$ will only satisfy her more.
48. Jesse wants to blow someone's mind$_1$ with his new illusions and says it$_2$ would be his biggest accomplishment.
49. Paul discovered he got the job by word of mouth$_1$, but was upset that such great news would come in this$_2$ fashion.
50. I told her they should clear the air$_1$ between them and that$_2$ would repair their friendship.
51. We all told him to drive safely or he would kick the bucket$_1$ but he ignored us and he did it$_2$ as we predicted.
52. It is never easy to pour one's heart out$_1$ since there is always the risk of doing it$_2$ at the wrong time.
53. My dad loves to crack a joke$_1$ or two, but he is not good at doing so$_2$ and he ends up being the only one laughing.
54. Summer is the perfect season to have a fling$_1$ since you can be sure doing it$_2$ will not cause problems.
55. Whenever a friend is in need, lend an ear$_1$ and they will appreciate you doing so$_2$ even if you have no advice to give them after.
56. One may choose to lie through one's teeth$_1$ about a situation because it$_2$ is the only solution seen at the time.
57. Some students can play by ear$_1$, while others have to learn to read notes, and it$_2$ is a gift few people have.
58. Try to read between the lines$_1$ whenever you speak to a woman, and that$_2$ could help you understand better.
59. You will be on cloud nine$_1$ the day of your wedding, and that$_2$ will show in every picture.
60. It is normal for the groom to have cold feet$_1$ and he may feel anxious when this$_2$ happens, but all soon passes.
61. Mark is already in hot water$_1$ with his mom and being so$_2$ makes him nervous to speak to her.
62. The bartender tried to make a pass$_1$ at Carol, but she has a boyfriend so it$_2$ did not work.
63. The presentation went by with flying colors$_1$, but achieving it so$_2$ was not an easy task.
64. Vanessa could very well be the spitting image$_1$ of her mother, and that$_2$ bothers her a lot.
65. Haunted houses only succeed if they give the creeps$_1$ to most people, and if this$_2$ doesn't happen, the house will probably not re-open.
66. I never imagined I would hit the jackpot$_1$ when I went to Las Vegas, but it$_2$ changed my life forever.
67. Past experiences will always be in back of one's mind$_1$, and them being so$_2$ might be why it is hard to trust someone after they have lied to you.
68. If you want Carl to eat his words$_1$, the best way to make him to do it$_2$ would be proving him wrong.

69. You are down by a point but hold your horses$_1$, Sarah, because if you don't do it$_2$ you could lose the game!
70. It is very easy to pull someone's leg$_1$ since all you must do is keep a straight face for that$_2$ to happen.
71. People won't listen unless you speak your mind$_1$, because doing so$_2$ demonstrates you're passionate about the subject.
72. When I was younger I would accidentally spill the beans$_1$, and get in trouble for it$_2$ all the time.
73. You will waste your breath$_1$ with her for hours, and that$_2$ is not a pleasant experience.
74. Next time you feel nervous, try to break the ice$_1$ with simple conversation, even if it$_2$ seems hard to do at first.
75. This old video game costs an arm and a leg$_1$, and this new one will do$_2$ too.
76. Please don't lose your grip$_1$ of the situation because that$_2$ will spiral you into complete chaos.
77. You shouldn't play with fire$_1$, because your mother told you it$_2$ was wrong a long time ago.
78. Jeff finally decided to tie the knot$_1$ with the woman he loves and it$_2$ is the biggest step he has had to make so far.
79. Life is not a piece of cake$_1$ and I would never want people to assume my achievements were so$_2$ either.
80. I told him not to jump the gun$_1$ when he saw that picture because doing so$_2$ could potentially ruin his relationship.
81. I don't know the National Anthem and I have to learn it by heart$_1$ for my citizenship test, but I find that$_2$ unnecessary.
82. Sometimes I twist someone's arm$_1$ to get answers since it$_2$ is a technique that never fails.
83. Carla always wanted to call the shots$_1$, but Jason was not ok with her doing so$_2$.
84. What I wanted to do was hit the sack$_1$, but my friends made it$_2$ impossible with all their noise.
85. Sometimes it is necessary to swallow one's pride$_1$ in a relationship, and that$_2$ entails apologizing when you are wrong.
86. You need to get the picture$_1$ that she is gone even if it$_2$ is not easy to do.
87. You shouldn't give the cold shoulder$_1$ to your mom because that$_2$ is very immature and proves she was right.
88. Appointments are easy to slip one's mind$_1$, but don't be ashamed because them doing so$_2$ is normal.
89. The politicians said money appeared out of thin air$_1$, and I also suspect the money disappeared in that$_2$ form.
90. She shouted the answer out of the blue$_1$, and he responded equally in that$_2$ manner.

APPENDIX B

Example of First Latin Square

FIG	LIST_1	FIG	LIST_2	FCONT	LIST_3	FCONT	LIST_4	LIT	LIST_5	LIT	LIST_6	LCONT	LIST_7	LCONT	LIST_8
disturbance	AC1	disturbance	BC2	convenience	CC1	convenience	DC2	play	EC1	play	FC2	head	GC1	head	HC2
advantage	BC1	advantage	CC2	direction	DC1	direction	EC2	shirt	FC1	shirt	GC2	cross	HC1	cross	AC2
change	CC1	change	DC2	forget	EC1	forget	FC2	music	GC1	music	HC2	power	AC1	power	BC2
frighten	DC1	frighten	EC2	threaten	FC1	threaten	GC2	nerves	HC1	nerves	AC2	nights	BC1	nights	CC2
protect	EC1	protect	FC2	forgive	GC1	forgive	HC2	soft	AC1	soft	BC2	tiny	CC1	tiny	DC2
decide	FC1	decide	GC2	attack	HC1	attack	AC2	destiny	BC1	destiny	CC2	secrets	DC1	secrets	EC2
observe	GC1	observe	HC2	impress	AC1	impress	BC2	chair	CC1	chair	DC2	extra	EC1	extra	FC2
join	HC1	join	AC2	rock	BC1	rock	CC2	wheel	DC1	wheel	EC2	block	FC1	block	GC2

APPENDIX C

Participation Proof Ballot

The purpose of this study, conducted by Ariana C. Garcia (graduate student), was to better understand bilinguals' comprehension of idiomatic expressions. You were asked to listen to audios, some of which containing idiomatic phrases; as well as participate in a lexical decision task. In addition, you were asked to complete a dominance questionnaire in order to have the appropriate data of your bilingualism.

As previously mentioned, the records of this study will be kept private. In any sort of report we make public we will not include any information that will make it possible to identify you. Research records will be kept in a locked file; only the researchers and the supervising professor will have access to the records.

Taking part is voluntary: You are free to withdraw from this study and/or refuse to have your results be a part of the data to be analyzed.

I have completed the study and have been debriefed as to what the study is about. I have read the above information, and have received answers to any questions I asked. I give consent to have my results be a part of the data for this study.

Your Name (printed) _____

Signature of experimenter _____ Date _____

VITA

Name: Ariana Cecilia Garcia

Address: 1715 Cortez Street, Laredo, TX, 78043

Email Address: ariana_ceciliag@hotmail.com

Education: B.A., Psychology, Texas A&M International University, 2014