Sentence Processing in Late Bilinguals: Comprehension of Form and Meaning*

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Research in sentence comprehension has shown that monolingual speakers are able to accurately detect meaning changes but less able to detect structural changes in sentences. In this study we ask whether this monolingual pattern holds for bilingual speakers in reading comprehension in a second language. English-Spanish bilinguals at different proficiency levels participated in a task in which sentences from native and second languages were presented. Recognition was tested on sentences that were either identical to the original sentences, or were changed in meaning or form from the originals. Results confirm a significant main effect of change type and the effects of interaction between language, change type, and proficiency. The results are discussed in light of models of bilingual lexical processing and sentence comprehension.

Keywords: Sentence processing; English-Spanish bilingualism; Second language acquisition; Form-meaning relationship; Bilingual proficiency; Lexical and sentence representation

A sentence is a composite linguistic unit made of words and phrases according to the formal structures and the semantic specifications of the language. While many studies have examined bilingual lexical processing, the

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way in which bilingual learners process forms and meanings in sentence comprehension is less well understood. Obviously, any learner has to identify the meaning of a sentence through its form, but it is yet unclear to what extent bilinguals attend to linguistic form versus sentence meaning during comprehension, and whether and how they shift attention from form to meaning as proficiency in L2 increases.

Let us start by taking the following example as an illustration.

> *I have two passions in life — monkeys and wrestling. Wrestling is a fun sport. Monkeys are a fun animal. You know what's great? … combining the two! Wrestling monkeys is entertaining. Usually I wrestle only one at a time. Every now and then I like a challenge though. On those occasions I compete against two or three. Some people call me creepy because I like to wrestle monkeys.? Is it really that weird?*

In a test of comprehension, we can ask the reader or listener which of the following sentences he or she read or heard:

1. Wrestling monkeys are entertaining.
2. Wrestling monkeys is entertaining.
3. It is entertaining to wrestle monkeys.

Chances are that he or she would have chosen Sentence 2 or 3 as the answer, as both sentences communicate the same idea (the correct answer is 2). Sentence 1 differs from 2 and 3 grossly in meaning, but it differs from Sentence 2 by only one word in form. Yet, this one-word difference is significant: in Sentence 1 *wrestling* serves as an adjectival modifier to the subject of the sentence *monkeys*; in Sentence 2 *wrestling monkeys* is a Verb-Object (VO) structure which serves the subject role of the sentence.

This example provides the opportunity to lay out some key terminology. Sentence 1 is what will be referred to as a *meaning change* sentence in our study. A meaning change sentence may look similar to the original sentence in form, but the alteration causes a different interpretation in meaning from the original sentence. In contrast, Sentence 3 will be referred to as a *form change* sentence (see our operational definition of meaning change and form change

under *Materials*). Form change sentences do not resemble the original sentence in structure, but they preserve the meaning of the original sentence. Finally, Sentence 2 will be referred to as the *identical* sentence, as both the form and the meaning of the original sentence are preserved.

In a classic study of sentence comprehension, Sachs (1967) presented form change and meaning change sentences to native speakers (L1) of English at varying points of delay after the participant heard the target sentence. Her results showed that as time elapsed between the initial listening phase and the testing phase, participants became less accurate in detecting form changes but remained accurate at detecting meaning changes. Sachs concluded that her findings suggest that listeners retain the general meaning of sentences but not the specific linguistic or grammatical details once sentence comprehension is completed. Such conclusions make perfect sense with regard to language comprehension or information processing in general — the goal of comprehension is to extract meaning from the signal and to retain the meaning in memory. Lower levels of processing must yield to semantically rich levels of elaboration that could be more easily retrieved from memory (Craik & Lockhart, 1972). Thus, form, or the exact wording, of a sentence is less relevant once meaning comprehension is achieved.

Although Sachs's study looked at monolingual comprehension in an auditory context, it raised the question about what bilinguals do during sentence comprehension. Most bilinguals, unlike native speakers, may not be able to efficiently and effectively extract meaning during the comprehension of speech or text. When they are less familiar with the L2 compared to the L1, do they attend more to the formal features of L2 sentences during sentence comprehension?[1] Previous research has provided few answers to this question, although the study of form-meaning relations is an active field in second language acquisition (see VanPatten, Williams, Rott, & Overstreet, 2004). Our study takes this question as the starting point for a new line of investigation

[1] An anecdotal note seems to suggest that they do. A native speaker and a bilingual speaker proofread their co-authored paper, written in the bilingual speaker's L2. The bilingual speaker found a dozen typographic or grammatical errors, while the native speaker found only one. The native speaker told the bilingual speaker that such formal errors do not catch his attention, even if he wanted to pay attention to them.

into sentence recognition in L1 and L2 that incorporates theories of L2 learning, discourse comprehension, and bilingual memory. Of central interest to us is whether the level of proficiency in a second language affects the manner with which learners read for comprehension.

The issue of how L2 proficiency affects linguistic comprehension has been extensively examined in the bilingual lexical memory literature. In particular, the revised hierarchical model has been proposed and tested in this regard (Kroll & Curley, 1988; Kroll & Stewart, 1994; Sholl, Sankaranarayanan, & Kroll, 1995; Talamas, Kroll, & Dufour, 1999; see Kroll & Tokowicz, 2005 for a recent synthesis). Briefly, the model argues that the strength of the links between the lexicons and concepts in L1 and L2 differs as a function of fluency in L2 and the relative dominance of L1 to L2: initially, words in L1 are strongly and directly linked to concepts while words in L2 are linked to concepts only weakly or indirectly via L1. As proficiency increases, the strength between words and concepts in L2 is increased. To verify this idea, Talamas, Kroll, and Dufour presented participants with a word translation task. English-Spanish bilinguals of various proficiency were asked to decide if a pair of words were translation equivalents, with the pair being correct translations (garlic/ajo), form-related words (garlic/ojo (eye)), or semantically-related words (garlic/cebolla (onion)). Less proficient bilinguals showed impaired performance on form-related but not semantically-related words, while the reverse was true for the more proficient bilinguals. These data suggest that L2 proficiency modulates learners' attention to form versus meaning differentially.

If the bilingual lexical memory literature supports the idea that form and meaning hold different status to L2 learners during word-level processing, a natural question to ask is whether this picture is also true of sentence-level processing for bilinguals. To answer this question, our study attempts to examine sentence comprehension in a second language. We consider two possible hypotheses here. (1) Because less proficient bilinguals may not have direct access to meaning in their second language (Sholl et al., 1995), and because they demonstrate greater interference effects from form than from meaning (Silverberg & Samuel, 2004; Talamas et al., 1999), they may pay more attention than proficient bilinguals or native speakers to structural components during the processing of L2 sentences. This differs from the strong attention paid to semantic processing in native languages. Thus, it is possible

that the form versus meaning patterns observed in bilingual word processing could apply to sentence processing as well. (2) An alternative hypothesis is that reading single words differs from reading sentences in connected discourse, and therefore, top-down perceptual processes involved in reading could override bilinguals' focus on form, as they would have more opportunities for abstracting meaning from context in connected speech or discourse. If this is the case, then regardless of proficiency level and language, participants should be better at detecting meaning changes than detecting form changes during the processing of L2 sentences.

To test these hypotheses, we examined English-Spanish bilinguals at different proficiency levels in both their native and second languages to determine if there are differences in sentence processing and in subsequent sentence recognition between L1 and L2. The bilingual participants in our study were college students who acquired Spanish mostly through classroom learning, and were all considered late learners. If patterns of bilingual lexical processing extend to sentence processing, we expect to see that proficiency modulates bilingual learners' performance in L1 and L2 differentially. However, if comprehension in a second language relies on contextual and perceptual processes, as does comprehension in the native language, then proficiency should not have an impact on sentence recognition across language (L1 vs. L2) or sentence change type (form change vs. meaning change).

Method

Participants

Forty undergraduate students (17 men and 23 women) from the University of Richmond took part in this experiment. Students ranged in age from 18 to 22 years. All students were native speakers of English and learned Spanish at various ages, largely in classroom settings. The mean age at which the participants started to learn Spanish was 11.7 (range = 5 to 20, s.d. = 3.9). They were recruited through the Department of Modern Languages and Literatures at the university. The participants each received $10 for their participation. They all had normal hearing and vision (or corrected-to-normal vision).

Each participant was asked to complete a Language History Questionnaire (Li, Sepanski, & Zhao, 2006; an online version of the questionnaire is available

at http://cogsci.richmond.edu/LHQ.php). The questionnaire required participants to list all languages they had studied, age of exposure to each language, length of learning, and the environment/context of L2 learning. Self-perceived competence in reading, writing, speaking, and understanding for each language was evaluated on a 7-point Likert scale. In addition, questions regarding verbal SAT scores, current or most recent Spanish courses taken, and grades received in the courses were also asked of the participants. Questionnaires of this type have been found to correlate with objective measures such as the Boston Naming Test (Kohnert, Hernandez, & Bates, 1998), Woodcock-Johnson and Woodcock-Muñoz reading fluency, passage comprehension, oral comprehension, and productive vocabulary tests (Marian, Blumenfeld, & Kaushanskaya, 2007), and grammaticality judgment tests (Flege, MacKay, & Piske, 2002).

Analyses of the questionnaire results allowed us to divide the 40 participants into three groups according to their level of proficiency: high proficiency (6), intermediate proficiency (20), and low proficiency (14).

Materials

Text passages and questions in English were either published short stories that we adapted to fit the experiment's requirements (Ragland, 2004; Sorrentino, 2004), or were created by native speakers who were members of the Cognitive Science Laboratory at the University of Richmond at the time of study. There were five passages altogether, each 12 sentences long with an average sentence length of 10 words. All passages used a concrete story line rather than scene descriptions or other abstract scenarios. Four sentences from each of the five passages were chosen, resulting in 20 test sentences. A meaning change sentence and a form change sentence were created for each of the four test sentences, resulting in 40 possible sentences in the change condition. The meaning change sentence involved replacing a word or a phrase with different meanings that looked similar to the original. It could also involve the change of an affirmative statement into a negative one.[2] The form change

[2] In Sachs's (1967) study meaning change also involved the change of sentence subjects into sentence objects and vice versa.

sentence involved reversing the order of the same phrases or clauses. The no-change condition contained the 20 unaltered original sentences. Length of the test sentences was controlled so that for each question the form-change, meaning-change, and identical sentences were nearly identical in length. The mean difference in number of words between the test sentences was .46 words in Spanish and .27 words in English. Test sentences overall tended to be longer than the average sentence read in the passage (M_{Spanish} = 12.2, SD = 3.6; M_{English} = 13.4, SD = 2.9). See Appendix A for an example of English testing materials.

The corresponding Spanish text passages were created by one Spanish instructor and two undergraduate teaching fellows in the Department of Modern Languages and Literatures at the University of Richmond. They were given the English materials and asked to mimic the style, creating Spanish passages of similar sentences with similar length. The Spanish passages were considered to be at an intermediate level and all had concrete plot lines similar to the English passages. Creators of the passages were instructed to use a variety of well-known, beginner-level vocabulary words and vocabulary to which low proficiency Spanish had likely not yet been exposed. The purpose of using this intermediate technique was to increase the likelihood that low proficiency Spanish learners would read words out of their grasp. The goal was not to ensure equal understanding across high and low proficiency Spanish learners; this would not be ecologically valid. Rather, the goal was to understand how individuals who are less adept at a language encode and remember contextual material compared to individuals who are more adept at that language. Thus, intermittent challenging vocabulary words were necessary to assess the possible influence of top-down processes. Unlike bilingual word processing, if bilingual sentencing processing is facilitated by context, then we would not expect to find differences across proficiency levels for detecting form and meaning changes.

The types of meaning and form changes were held constant across language. See Appendix B for an example of Spanish testing materials.

Procedure

Participants were tested individually in an experimental room at the Cognitive Science Laboratory, University of Richmond. They were seated in

front of a Gateway VX720 computer with a flat-screen monitor. After completing the Language History Questionnaire and the consent form, they were given a brief overview of the experiment. Written instructions were provided to participants on the computer screen, indicating that they should read the passages and answer questions about the passages as accurately and as quickly as possible. The E-Prime software (Psychological Software Tools, 2001) was used to control the presentation of experimental materials. Participants read each passage on the computer screen and responded immediately afterward to the test sentences one by one. They pressed the Y key to indicate that the test sentence appeared in the original text they read, and the N key to indicate that it did not appear. Passage reading was self-paced so that the participants pressed the spacebar when they were ready to proceed to the test phase. Once a Y or N response was made to a test sentence, the next test sentence immediately appeared on the screen.

The experimental session lasted for about 20 minutes. The order of presentation in language was randomized across participants so that half of the participants was exposed to the Spanish text first and the other half to the English text first. Within each language the order of passages remained the same. Results from a multivariate analysis of variance indicated that order effects were not significant, except in the English form-change condition: participants who were exposed to the English text first made more mistakes on English form-change questions and responded more slowly to these questions than the group exposed to Spanish first.

Each participant received ten text passages, five in English and five in Spanish. The test sentences were presented individually on the computer and followed by a series of Y/N sentence identification questions. All questions were similar in format (e.g., *did you read this sentence?*) For each text passage, three test sentences were altered in meaning from the original (meaning change), three were altered in form (form change), and one remained identical (see Appendix A for examples). This resulted in a total of 70 Y/N responses, 35 for each language (English or Spanish). The order of presentation of the test sentences for each passage was randomized. The dependent measures were the number and type of sentences correctly identified in each language (accuracy) and the reaction time (RT) for each test sentence. RT was measured from the onset of the test sentence on the computer screen to the onset of the

participant's key pressing.

Results

In this section we present two kinds of results to show bilingual speakers' sentence recognition abilities in reading comprehension: the accuracy data and the reaction time data.

Sentence Recognition Accuracy

Table 1 presents the accuracy data as a function of type of change, language, and proficiency. A 2 (type of change: form, meaning) x2 (language: English, Spanish) x3 (proficiency: low, intermediate, high) mixed ANOVA (with proficiency as a between-subject variable) was conducted to analyze the first dependent variable, sentence recognition accuracy scores. Data were coded on the number of inaccurate responses that participants made in recognizing the test sentences (a maximum number of inaccurate responses for each subject is 15 per condition). From the data we can observe the following effects.

First, there was a significant main effect of type of change, F (1, 37) = 126.52, $p < .01$. Participants made more form change mistakes ($M = 7.1$) than meaning change mistakes ($M = 2.2$). Second, there was a significant interaction between sentence change type and proficiency level, F (2, 37) = 5.16, $p < .05$. Paired samples t tests (corrected for Type I error using the Bonferroni procedure) confirmed that the low proficiency group did significantly worse at detecting meaning changes than the intermediate and the high proficiency

Table 1. Mean Number of Inaccurate Responses for Type of Change Across Language and Proficiency Level*

Type of Change	Language	Proficiency			Mean
		High	Mid	Low	
Meaning	English	0.83	1.8	2.07	1.57
	Spanish	1.67	2.25	4.36	2.76
Form	English	6.83	7.7	7.14	7.22
	Spanish	7.17	8.05	5.71	6.98

Note: *Maximum number of inaccurate responses is 15 per cell

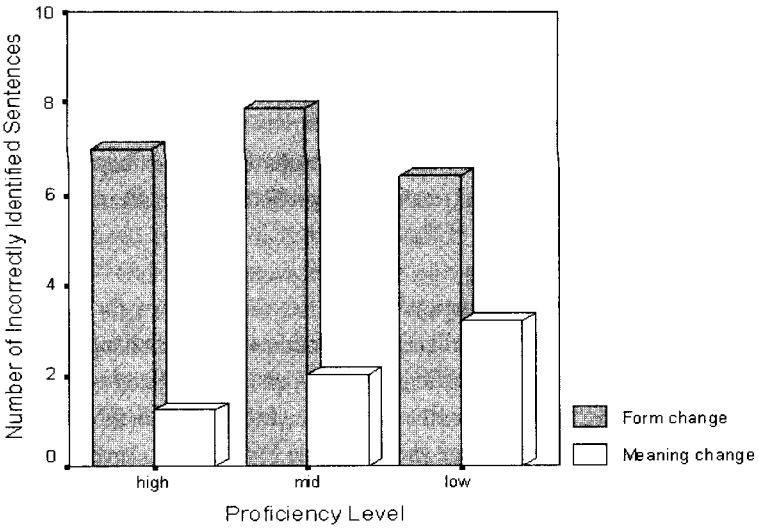

Fig. 1. Number of incorrectly identified sentences based on L2 proficiency level and sentence change type

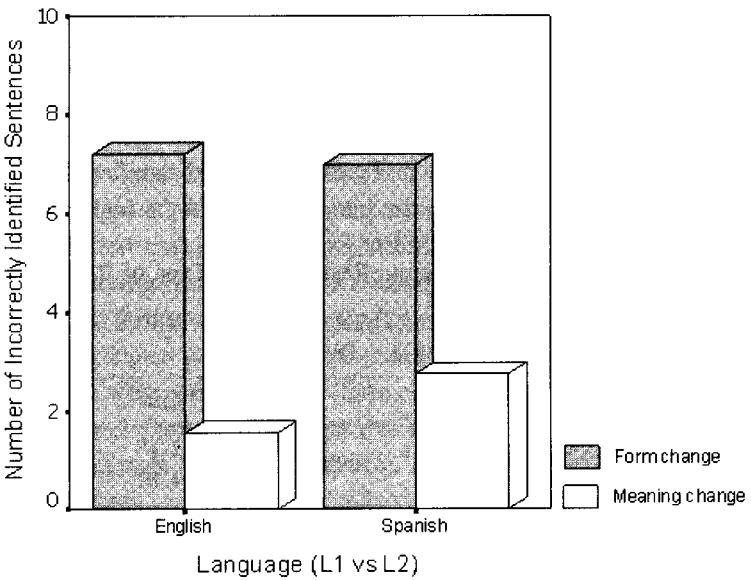

Fig. 2. Number of incorrectly identified sentences based on language and sentence change type

group, t (27) = -2.17, $p < .05$, and t (11) = -4.58, $p < .01$ respectively. Figure 1 illustrates this interaction. Third, the interaction between sentence change type and language was marginally significant, F (1, 37) = 4.08, $p = .051$. Collapsed across proficiency levels there was a significant difference between English meaning change accuracy and Spanish meaning change accuracy, t (39) = -.58, $p < .01$. Participants were more accurate at detecting English meaning changes than Spanish meaning changes, whereas they showed no difference for the form change sentences. Figure 2 illustrates this interaction. No other main effects or two-way interaction effects were significant.

The three-way interaction between language, type of change, and proficiency also reached statistical significance, F (2, 37) = 3.59, $p < .05$. One-way ANOVAs were used to further test for specific group differences. There was a marginally significant effect for Spanish form change accuracy, F (2, 37) = 3.19, $p = .053$. T-tests showed that the low proficiency and intermediate proficiency groups performed significantly differently. Low proficiency participants were more accurate at detecting Spanish form changes (M = 5.71) than intermediate proficiency participants (M = 8.05). There was also a significant difference in accuracy for detecting Spanish meaning changes depending on proficiency levels, F (2, 37) = 6.15, $p < .01$. T-tests showed that the low proficiency participants (M = 4.36) were significantly worse at detecting meaning changes in Spanish than participants at the intermediate (M = 2.25) and the high (M = 1.67) level of proficiency. These effects indicate that sentence recognition accuracy in L2 is sensitive to form versus meaning differences, and that the less proficient the bilingual is, the more likely the bilingual will pay attention to the sentence form.

Reaction Time (RT) Data

Table 2 presents the RT data as a function of type of change, language, and proficiency. A 2 (type of change) x2 (language) x3 (proficiency) mixed ANOVA (with proficiency as the between-subject variable) was conducted on the reaction times as the dependent measure. Box's M test highlighted significant differences in the variance between groups, F (20, 882.5) = 2.04, $p < .01$. Because homogeneity of variance is an underlying assumption of ANOVA (Howell, 2004), data transformations were performed by taking the square root of the RTs to correct this problem. No significant differences

Table 2. Mean Reaction Times (ms) for Type of Change Across Language and Proficiency Level

Type of Change	Language	Proficiency			Mean
		High	Mid	Low	
Meaning	English	3269	4144	4689	4034
	Spanish	5015	5806	6612	5811
Form	English	4711	5037	5718	5155
	Spanish	6485	6378	6387	6417

between group variances were detected by the Box's M test (F (20, 882.5) = 1.51, $p > .05$) after the transformation. ANOVAs run on the properly transformed data revealed the following effects.

First, there was a significant main effect of type of change, F (1, 37) = 55.97, $p < .01$. Participants were faster at responding to meaning change sentences (M = 4923 ms) than to form change sentences (M = 5786 ms). Note that RT was calculated from the beginning of the subject's reading of the test sentence to the beginning of his or her key pressing response. Second, there was a significant main effect of language (L1 vs. L2), F (1, 37) = 52.35, $p < .01$. Not surprisingly, participants were in general faster at responding to L1 (English) sentences (M = 4595 ms) than they were at responding to L2 (Spanish) sentences (M = 6114 ms). Interestingly, the main effect of language was not significant in the accuracy data, suggesting that reaction times may be more sensitive to processing differences in L1 versus L2.

The interaction between sentence change type and proficiency level reached significance, F (2, 37) = 5.35 $p < .01$. Paired samples t tests (corrected for Type I error using the Bonferroni procedure; Howell, 2004) confirmed that both the high proficiency and intermediate proficiency groups showed significant differences in their RTs to form versus meaning change sentences, t (5) = -5.73, $p < .01$, and t (19) = -4.62, $p < .01$ respectively. Both bilingual groups responded significantly faster to meaning change sentences than to form change sentences. Although the low proficiency group showed the same trend (M = 5651 ms for meaning change sentences, and M = 6052 ms for form change sentences), the difference was not significant for this group. Figure 3 illustrates this interaction.

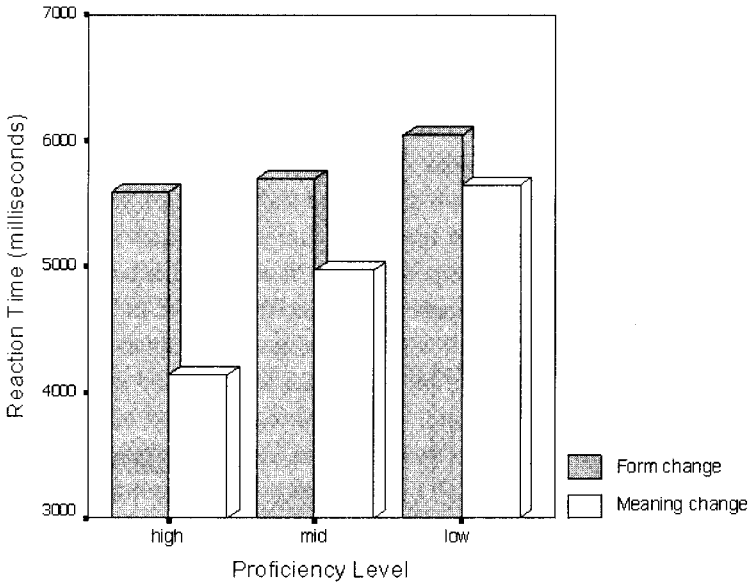

Fig. 3. Reaction times (in milliseconds) assessed across L2 proficiency level and sentence change type

The interaction between sentence change type and language also reached significance, F (1, 37) = 5.88, $p < .05$. Although participants were in general faster in responding to English (L1) sentences than to Spanish (L2) sentences, paired samples t tests indicated that RTs to English form and English meaning change sentences were also significantly different, t (39) = 7.39, $p < .01$: participants were faster at responding to English meaning changes (M = 4034 ms) than to English form changes (M = 5155 ms). By contrast, their RTs to Spanish form (M = 5811 ms) and Spanish meaning change sentences (M = 6417 ms) were not as different, t (39) = 2.34, $p > .05$ (with Bonferroni correction). This interaction is illustrated in Figure 4. This interaction worked slightly differently than the same interaction for accuracy scores. For the accuracy data, the interaction between sentence change type and language was mainly due to the significant difference in meaning detection across L1 and L2 and no difference in form detection accuracy (although noting its interaction with proficiency: low proficiency participants were better at detecting L2 form

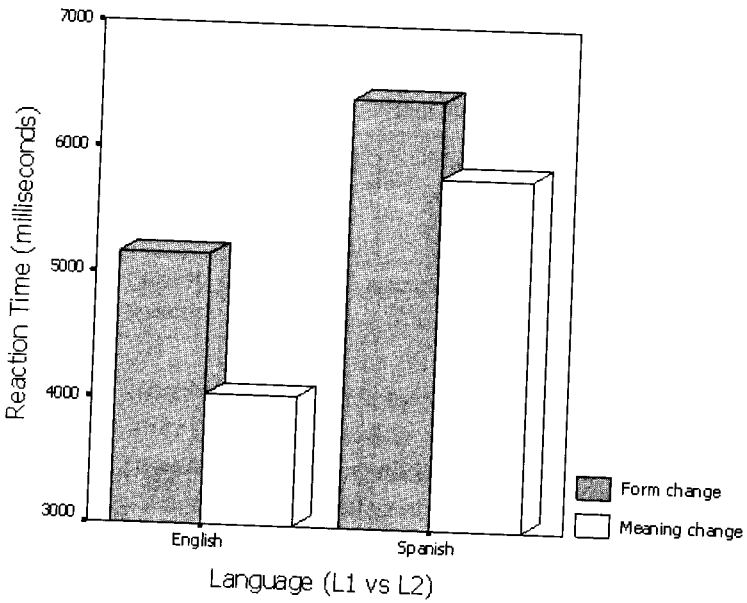

Fig. 4. Reaction times (in milliseconds) assessed across language and sentence change type

changes than intermediate proficiency participants, whereas the reverse was true for detecting L2 meaning changes). For the RT data, the interaction was mainly due to the significant difference in form-vs.-meaning detection in L1 and the relatively small difference in L2. However, both kinds of data speak to the fact that sentence recognition in L2 may differ from L1 with respect to the role that form versus meaning plays.

Finally, although the three-way interaction in the RT data did not reach statistical significance, we can observe a clear trend in that direction. For example, the low proficiency group was distinctly different from the intermediate and high proficiency groups in reaction time to L2 form and meaning change sentences (consistent with the accuracy data), but the RT differences between L1 form and meaning change sentences were not statistically significant across the proficiency levels.

Discussion

A major goal of this research is to determine if bilingual learners differ from native speakers in their attention to form versus to meaning during sentence comprehension. Modeled after the classic study of Sachs (1967) with native speakers, our experiment indicates that bilingual speakers show both similarities and differences from native speakers. Consistent with the L1 patterns found in Sachs (1967), bilingual learners are generally more accurate and faster at detecting meaning changes than form changes in sentence recognition, in both L1 and L2, as shown by the main effects of sentence change type in both the accuracy data and the RT data. This similarity, however, is significantly weakened when we consider other variables relevant to bilingual processing, for example, the different levels of proficiency in L2 examined in this study. More specifically, both the accuracy and the RT data indicate that sentence change type interacts with proficiency level (high, intermediate, or low) and with language (L1 or L2). Low proficiency bilinguals are less accurate and slower at recognizing meaning changes in the L2 than the moderately and highly proficient bilinguals. Conversely, moderately and highly proficient bilinguals are less accurate at recognizing form changes in L2 than the low proficiency bilinguals, but proficiency plays no significant role in modulating response times for form changes.

An astute observer may question why bilingual learners appear to show different accuracy rates and reaction times on native language sentences across L2 proficiency levels (see Tables 1 and 2). Though these variations may be theoretically appealing, the differences are not statistically significant. Only the reaction time for English meaning change sentences demonstrated a marginally significant difference across high and low proficiency groups ($p = .057$).

An important finding is that while the detection of meaning changes and that of form changes are significantly different in the bilingual's L1 (in both accuracy and RT), the difference is somewhat reduced in the bilingual's L2, especially for the low proficiency bilinguals. For the highly and moderately proficient bilinguals, detection of meaning changes in L2 shows an overwhelming advantage over the detection of form changes (difference accuracy scores are 5.5 and 5.8 for high and low proficiency groups

respectively, and difference RT scores are1470 ms and 572 ms, respectively; see Table 1); for the low proficiency bilinguals, this advantage is small (difference accuracy score = 1.35) or non-existent (difference RT score =-226 ms). Such discrepancies between meaning and form in L1 versus L2 indicate that novice learners may be more attuned to formal properties of the sentence before they can efficiently extract meaning from the sentence during comprehension.

Whether efficiency in meaning extraction determines bilinguals' stronger attention to form requires further research. An examination of the three-way interaction in accuracy and near interaction in the RT data shows that our low proficiency bilinguals seem to show a general disadvantage in detecting meaning changes, thus giving some support to the idea that there may be a trade-off between attention to meaning and attention to form during sentence comprehension. Of course, many other factors could be at work in affecting bilingual readers' meaning comprehension ability. For example, in the case of first language, research has shown that reading comprehension can be predicted by vocabulary size and speed of lexical access (Dixon, LeFevre, & Twilley, 1988; Hannon & Daneman, 2001). Whether vocabulary size and lexical access similarly underlie second language reading comprehension, and whether they play a causal role in directing bilingual learner's attention to form versus meaning, remains to be investigated. Another issue that requires further study is whether bilingual speakers of structurally different languages would show the same patterns as bilinguals whose L1 and L2 are structurally similar (such as English and Spanish examined here). For example, semantic versus syntactic cues have different prominence (weights, or cue validity) in English and Chinese (Li, Bates, & MacWhinney, 1993; Liu, Bates, & Li, 1992). The way in which bilingual Chinese-English learners attend to form versus meaning in the two different languages would be important to study.

It should be noted that we have consistently contrasted the low proficiency bilinguals with the moderate and the high proficiency bilinguals, partly due to the distinct patterns associated with these two types of learners, and partly due to the relatively small number of participants in the high proficiency group. Had there been more highly proficient participants, we would have been able to look at proficiency on a more fine-grained level. An increased number of participants in the high proficiency group may also sharpen the contrast

between bilinguals at different proficiency levels with respect to their attention to form versus meaning in the second language. What we have shown here, however, is that even with a moderate proficiency, bilingual speakers are already able to move to a processing strategy closer to that of native speakers in sentence comprehension.

Finally, it is essential to differentiate between form as discussed in this paper, and form as more generally understood among linguists and language researchers. As conceptualized in this paper, form is a general surface structure rather than a syntactic marker (see examples in Appendix A). This distinction is important, as it separates our work from that of other researchers such as VanPatten's (2002) hypothesis (*Primacy of Meaning Principle*) that second language learners process input for meaning before processing it for form. According to this account, due to limited capacities, learners rely on content words for meaning, which effectively decreases reliance on grammatical markers that may impart similar information. VanPatten's hypothesis need not conflict with our findings since we do not assume that similar information is being conveyed through a focus on form and a focus on meaning. Individuals who focus on the form of a sentence are essentially processing its surface features, i.e. what order words come in and what they look like. Individuals who focus on the meaning of a sentence are processing the sentence at a deeper level of understanding.

In conclusion, bilingualism offers us a unique window to study mechanisms of processing in sentence comprehension. The current study shows that while the communicative aspect of the sentence (meaning) is the goal of comprehension, and hence more important for both bilinguals and monolinguals relative to structural properties (form), bilingual learners display significant differences in L1 versus L2 in their attention to form versus meaning. Such differences may be modulated by the bilingual's level of proficiency in L2. This conclusion supports one of the two hypotheses that we discussed earlier, namely that meaning-form relations in L2 word processing and sentence processing may be served by the same processing principles, both of which are constrained by L2 proficiency. According to the revised hierarchical model (Kroll & Stewart, 1994), the L2 lexicon-to-concept connection is initially weak and lexical processing is form-driven in L2 early on. As the bilingual gains proficiency in L2, form-meaning connections in the

bilingual's lexicon become stronger and more direct, and consequently lexical processing comes to be driven by meaning as in L1. Although our data indicate an overall advantage of meaning over form in bilingual sentence comprehension, the trade-off between paying attention to form versus paying attention to meaning is clearly reflected as a function of the bilingual's proficiency, suggesting common processing mechanisms underlying both the word level and the sentence level in second language acquisition.

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Appendix A: Sample English Testing Material

PASSAGE:

I have a friend who must be the sweetest, shyest person in the world. His name is brittle and ancient, Luke. His age is modestly intermediate, forty. He is rather short and skinny, has a thin moustache and even thinner hair on his head. Since his vision is not perfect, he wears glasses. They are small, round, and frameless.

In order not to inconvenience anyone, he always walks sideways. Instead of saying 'Excuse me', he prefers to slide by a person. If the gap is so narrow that it will not allow him to pass, Luke waits patiently until the obstruction moves by itself. Stray dogs and cats panic him and in order to avoid them Luke constantly crosses from one side of the road to the other. If you saw Luke on the street you might think he is a bit bizarre. Maybe he is, but I feel proud to call Luke a friend.

TEST SENTENCES:

1. In order not to inconvenience anyone, he always walks sideways. (*identical*)
2. He always walks sideways in order not to inconvenience anyone. (*form change*)
3. He wears glasses since his vision is not perfect. (*form change*)
4. He prefers to slide by a person instead of saying 'Excuse me'. (*form change*)
5. In order not to incapacitate anyone, he always walks sideways. (*meaning change*)
6. Since his vision is perfect, he does not wear glasses. (*meaning change*)
7. Instead of saying 'Excuse me', he prefers to slam into a person. (*meaning change*)

TEST SENTENCES:

1. Cuando estoy bailando, se me olvida casi todo! (*identical*)
2. Se me olvida casi todo! cuando estoy bailando. (*form change*)
3. La sensualidad de mi baile le impresiona a todo el que me ve bailar. (*form*

change)

4. El baile me permite una libertad física de la que falto en mi vida diaria y por eso me alegra. (*form change*)
5. Cuando estoy bailando, muevo casi todo mi cuerpo! (*meaning change*)
6. A todo el que me ve besar le impresiona la sencillez de mi beso. (*meaning change*)
7. El viaje me alegra porque me da la oportunidad de vivir en una manera diferente que mi vida diaria. (*meaning change*)

Appendix B: Sample Spanish Testing Material

PASSAGE:

Me llamo Ilia Rolón y tengo 25 años. Nací en Nueva York, de padres puertorriqueños. Mi pasatiempo favorito es bailar.

Cuando estoy bailando, se me olvida casi todo! No me gusta bailar en pareja porque me es difícil coordinar mis pasos con los pasos de mi pareja. Tengo mi propio estilo de baile con influencia latina y africana. A todo el que me ve bailar le impresiona la sensualidad de mi baile.

Como puede imaginar, esto a veces causa malentendidos. Pero yo no bailo para impresionar a nadie. El baile me alegra porque me permite una libertad física que falto en mi vida diaria.

TEST SENTENCES:

1. Cuando estoy bailando, se me olvida casi todo! (*identical*)
2. Se me olvida casi todo! cuando estoy bailando. (*form change*)
3. La sensualidad de mi baile le impresiona a todo el que me ve bailar. (*form change*)
4. El baile me permite una libertad física de la que falto en mi vida diaria y por eso me alegra. (*form change*)
5. Cuando estoy bailando, muevo casi todo mi cuerpo! (*meaning change*)
6. A todo el que me ve besar le impresiona la sencillez de mi beso. (*meaning change*)
7. El viaje me alegra porque me da la oportunidad de vivir en una manera diferente que mi vida diaria. (*meaning change*)