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Missing verbal inflections as a representational problem

Evidence from self-paced reading

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A continuing concern in second language acquisition (SLA) research is whether problems with inflectional morphology are representational or related somehow to performance. In this study, we examine 25 non-advanced learners of L2 Spanish and compare them with 18 native Spanish speakers on three grammatical structures: subject-verb inversion, adverb placement and person-number inflections on verbs. We use self-paced reading as a measure of underlying sensitivity to grammatical violations. Our results clearly show that the L2 learners pattern like the native speakers on the two syntactic structures; both groups demonstrate sensitivity to grammatical violations while reading sentences for meaning. For person-number on verbs, L2 learners did not show sensitivity to grammatical violations whereas the native speakers did. We argue that these results suggest a representational problem for morphology in our L2 population.

Keywords: second language inflectional morphology, representation, self-paced reading, sensitivity to grammatical violations

1. Background and motivation

1.1 Morphological deficiencies in Second Language Acquisition (SLA)

In a number of second language (L2) studies, it has been observed that syntactic operations are often fully acquired while related verbal inflections may not be. For example, Lardiere (2000, 2007) showed that her subject — a Chinese L1 speaker of English L2 — had fully represented TP with 100% appropriate use of pronominal case while having variable and non-native-like production of regular past tense endings (anywhere from 30% in oral production to over 60% in written

spontaneous production in emails). Similar findings were reported by Haznedar and Schwartz (1997) for a Turkish L1 learner of English L2 (see also Haznedar, 2001). In the realm of verb movement, similar findings have been found for verb placement and verbal inflections (e.g. Bruhn de Garavito, 2003; Clahsen, 1988; Prévost & White, 2000), and other studies report different “missing inflections” (e.g. Herschensohn, 2001) while others discuss missing inflections from an epistemological viewpoint (e.g. Rothman, 2007).

The conclusion of such studies is that abstract features such as Agreement and Tense, which in turn trigger syntactic operations when those features are strong, are fully represented in the syntax. As such, these accounts have argued against earlier “impairment” accounts that claimed either new features or novel parametric variations were not acquirable (e.g. Beck, 1998; Hawkins, 2001; Hawkins & Chan, 1997). However, because of the relationship between morphological inflections and underlying features posited in at least some accounts of parametric variation, scholars were left to explain how it is that the syntax could be there but the morphology not. This problem led Prévost and White (2000) to argue for what they termed the Missing Surface Inflection Hypothesis (MSIH). The central idea of the MSIH is that while syntactic features such as Agreement and Tense may be fully represented in the grammar, the learner may encounter mapping problems when attempting to use associated verbal inflections. White (2003) states the following: “a learner may fail to link an abstract [+past] feature to the particular form /-ed/ in English, for example. Although the form has been learned, the learner may be unable to retrieve it on a consistent basis” (p. 194). The idea behind this claim is that there is an access or retrieval problem during production, not that there is a representational problem.

This mapping account may certainly be true for long-term learners of an L2, such as Lardiere’s Patty — who had been living in the United States for some 20 years at the time of Lardiere’s study — but it is not clear that such is the case for beginning or even intermediate learners of a language. McCarthy (2008) explores this issue in her study of the acquisition of gender and number agreement with nouns and adjectives in Spanish as L2. In her study, she administered both comprehension (interpretation) tasks and production tasks in which learners had to show knowledge of number and gender. For production, she asked her participants to describe various color photographs. For comprehension, she used a picture identification task in which learners read a short narrative and then selected from among three pictures. For example, learners would read the following short narrative (from McCarthy, 2008, p. 472):

- (1) Paco quiere llevar algunas cosas que acaba de comprar pero no encuentra nada. Paco dice: “Acabo de comprarlo. ¿Dónde está?”

‘Paco wants to bring some things that he just bought, but he can’t find anything. Paco says, “I just bought it-_{MASC}. Where is it?”’

After reading each item, learners had to select from among three drawings; in the case of the example above, a shirt (FEM), a belt (MASC) and two ties (FEM-PL). Because the object clitic *lo* in the example is masculine and singular, the correct answer could only be the picture of the belt. What McCarthy found was that intermediate learners were inconsistent and variable on both the comprehension and the production measures. Because the learners’ performance was variable on the comprehension task, McCarthy concluded that the problems observed in previous research regarding morphology might not just be performance issues in production. Her interpretation task did not involve production, and, as she argued, what may lie at the heart of the syntax-morphology problem may be that morphological representation is weak. She says, “Morphological variability is, at least in part, a representational issue, and does not derive strictly from production-based limitations” (p. 483). As gleaned from this quote, McCarthy does not discount a production/performance issue in SLA when it comes to morphological inflections; what she does do is question the extent to which previous research can discount a representational problem with morphology. In addition, her research focused on features within the DP and not the IP as in the research cited above. Given the debate on whether gender is an acquirable feature or not for those whose L1 does not have gender (e.g. Carroll, 2001; Franceschina, 2005; Keating, 2009; Rothman, Judy, Guijarro-Fuentes, & Pires, 2010; Sabourin, Stowe, & de Haan, 2006), it is not clear to what extent her research can speak to research related to morphological inflections on verbs.

Bruhn de Garavito (2003) also looked at what she called “recognition” as opposed to production. In line with a focus on the IP, her study examined verb movement and verbal inflections (person-number) in Spanish. Her production test involved a story-retelling task in which learners read a story in the L1 (English) and then retold it in the L2 (Spanish). Recognition involved two different tests. For verbal inflections, participants had to read a sentence and then select among various options for subjects of the second verb. An example appears here:

- (2) Ernesto, Pablo y yo nadamos todos los días, pero solamente _____
 juega al tenis.
 a. Pablo b. Pablo y Ernesto c. yo d. Pablo y yo e. NA
 ‘Ernesto, Pablo and I swim every day, but only _____ plays tennis.’
 ‘a. Pablo b. Pablo and Ernesto c. I d. Pablo and I e. NA’

The focus of this test is the second verb, *juega* (3rd-_{SING}), for which only ‘a. Pablo’ is the correct answer. For verb movement, Bruhn de Garavito used a sentence

preference test in which participants had to indicate which of two pairs of sentences they preferred. At the same time, they had to judge each sentence on a scale of 1–5 in terms of its grammaticality. Examples appear below, one with subject-verb inversion in *wh*-questions and one with adverbs:

- (3) a. ¿Qué lee Gustavo por la tarde?
 *¿Qué Gustavo lee por la tarde?
 ‘What does Gustavo read in the afternoon?’
 b. Ernesto prepara rápido la sopa.
 *Ernesto rápido prepara la sopa.
 ‘Ernesto rapidly prepares the soup.’

In each example, the first sentence is grammatical and the second is not. What Bruhn de Garavito found was that participants were better on recognition tasks compared to production tasks, making twice the number of errors on the production tasks. She suggested that recognition tasks might be a better method of determining underlying learner knowledge compared with production tasks.

We are sympathetic to both McCarthy’s and Bruhn de Garavito’s concern for production tests as measures of underlying representation; however, we are not convinced that paper-and-pencil comprehension or recognition tests are the best means for tapping mental representation. In the case of Bruhn de Garavito’s tasks, an easily made criticism is that the tests invited the use of conscious knowledge and/or reflection, something Bruhn de Garavito discusses as a possible limitation of her design. That her recognition test could have tapped conscious knowledge of verb morphology receives some support given that a major focus of formal study in Spanish is verbal morphology. It is less likely that conscious knowledge could have been involved in the word order issues she examined (inversion, adverb placement), given that these are not routinely taught, and acceptable adverb placement in particular is not readily determined by input data in Spanish (a point we return to later).

At the same time, we note that in McCarthy’s study, it is not clear why one would use clitic object pronouns as indicators of underlying knowledge of the gender of adjectives. Given that clitic object pronouns are notoriously difficult for L2 learners of Spanish with English L1 from both comprehension and production perspectives (e.g. Malovrh & Lee, 2011; VanPatten, 1984), it could be that variable performance in her study was related to problems with clitic object pronouns as much as it was to underlying knowledge of gender (cf. Keating, 2009; White, Valenzuela, Kozłowska-Mcgregor, & Leung, 2004).

In the present study, we explore the issue of underlying representation of morphological inflections. We begin with the idea that McCarthy is correct (i.e. that part of the problem with variable L2 performance with morphological inflections lies in representation). We believe this is particularly true of non-advanced learners

of a language, especially those with limited exposure to naturalistic input (i.e. learners who have largely classroom experience only). To address the issue of task, we explore the use of on-line techniques (self-paced reading) for testing grammatical sensitivity that are traditionally used for testing processing and parsing.

1.2 Verbal inflections in Spanish

Spanish is a morphologically rich language in that verbs are inflected for person-number, tense, mood, and aspect (in the past). Of concern here are person-number inflections. Spanish has distinctive inflections for person-number on all verbs (1st singular *-o*, 2nd singular *-s*, 3rd singular *-?*, 1st plural *-mos*, 2nd plural *-is*, and 3rd plural *-n*). For example, see the paradigm in (4) below.

- (4) *hablo* ‘I speak’
hablas ‘you speak’
habla ‘he/she speaks’
hablamos ‘we speak’
habláis ‘you all speak’
hablan ‘they speak’

The use of distinctive person-number inflections occurs in all tenses, moods, and aspects, with only slight variations on 1st singular in some tenses (as well as subjunctive mood) and one variation on 2nd singular in the simple preterit form (although some socio-dialects add the *-s* due to regularization; for example, *fuiste* ‘you went’ → *fuistes*).

English, on the other hand, is morphologically poor. Only 3rd singular in the present tense carries a distinctive inflection: *he walks* but *I/you/we/they/you all walk* and *I/you/he/we/they/you all walked*. Thus, English speakers learning Spanish would not begin the acquisition of Spanish with either a parsing system that expects surface agreement or with a hypothesis space in the grammar that expects rich morphology on verbs. Similar to lexical items, morphological inflections must be built up in the grammar over time, with their relative strength dependent upon robustness in the input (see, for example, Truscott & Sharwood Smith, 2004). However, it is not clear that classroom learners of Spanish L2 receive enough (and varied) input containing verbal inflections that would lead them to a robust representation for these forms in their grammars. A cursory examination of typical Spanish textbooks reveals an overwhelming use of 3rd-person singular verb forms, which we venture to guess also forms the bulk of classroom aural input — a suspicion corroborated by research on the overuse of 3rd-person singular as the default (underspecified) verb form in the production of non-advanced learners of Spanish (McCarthy, 2006). Since robustness of input is implicated in a

number of models and theories when it comes to such inflections (e.g. Ellis, 2003; Rothman & Guijarro-Fuentes, 2010; Sorace, 2003), we believe that learners who are largely classroom-bound in their learning will not get the same kind of input that, say, children learning Spanish as an L1 might get in their first three years of life. Thus, the first question our study addresses is whether or not the L2 learners in our study show evidence of underlying representation for person-number inflections in Spanish. Because we are focusing on L2 learners with English as L1 with limited exposure to Spanish outside of class, our prediction is that these learners will not have strong representations for the various person-number inflections required in Spanish.

To be sure, previous research on verb agreement using self-paced reading such as this one has been conducted in English, notably by Jiang (2004). In that study, Jiang examined what is traditionally called “broken agreement”, when two NPs appear before a verb and one is the controlling NP for the verb: *the keys* to the cabinet *are* in the drawer vs. *the key* to the cabinets *is* in the drawer. Research on native speakers in English shows a slow down effect in reading in the area after *cabinets* presumably because the verb immediately following is singular. Jiang showed that L2 learners of English (Chinese L1 speakers) do not demonstrate this same slow down in reading, which is suggestive of an inability to use agreement during sentence processing. He also included sentences in which there was an actual violation in agreement between subject and verb: *the fire in the apartment was cause for.../the fires in the apartment was cause for*. Again, his L2 learners did not show a significant slow down on the verb when it did not agree with the controlling subject. Although suggestive of what might happen in our study, we note here that a major problem in extrapolating from Jiang’s study (and others like it in English) is that all sentences in his study used the copular or auxiliary *be* in the past tense. Under most accounts, the various forms of this verb are lexicalized and not inflected, as would be the case with *walk/walks* and *eat/eats* in the present tense. Thus, it is not clear whether his results are due to a lexical problem (i.e. irregulars may be learned as full lexical items) or a true morphological (inflectional) problem. What is more, the neutralization of *was/were* is well-attested in spoken English and prominent in the famed gangster movies of the 1930s and 1940s (and still evident in many movies today as well as in the speech of certain communities in the United States) as depicted in this fictional example: *So, we was standin’ by the bank, mindin’ our own business. And these other guys, see, they was casin’ the joint...* Our point here is that it is almost impossible to use results from a study on English irregular verbs to predict what would happen in morphologically rich languages like Spanish. It could be that our results will be similar to Jiang’s or not. Our prediction is that they will be the same (i.e. learners will not show sensitivity to violations of subject-verb agreement), but not because of processing problems.

What is more, we are not testing knowledge of lexicalized irregulars. Our test of grammatical sensitivity to subject-verb agreement contains only items involving productive and regular rules of present-tense inflection that aren't targets of neutralization in Spanish. Our hypothesis is that non-advanced learners simply won't have robust enough representations for morphological inflections in Spanish to be able to make use of them in an on-line task.

Only one other study on subject-verb agreement is relevant to the present study, Shibuya and Wakabayashi (2008). In that study, the researchers tested Japanese learners of English L2 on grammatical sensitivity to subject-verb agreement using self-paced reading with sentences such as *You eat* **eats a good meal everyday* and *The chefs cook* **cooks the shrimp in butter every time*. What they found was that their intermediate-level learners demonstrated sensitivity to subject-verb agreement violations except when the subject was a determiner (Det) + N type of sentence (*the chefs*) or when the DP contained non-nominal lexical items that encoded number (*these two girls*). More specifically, they found that learners were sensitive to the overuse of 3rd-person *-s* inflection but not to its absence. They concluded that learners were more sensitive to violations of subject-verb agreement when it involved person (e.g. *you go* **goes*) than when it involved number (e.g. *the chefs go* **goes*). It is not clear what this kind of study indicates for a morphologically rich language such as Spanish. In English it might be easier to detect morphological problems because only one form is inflected in the present tense. Although not a major focus of our study, we will conduct detailed analyses to see if there is a difference between sensitivities to person and number as found in Shibuya and Wakabayashi's study.

1.3 Subject-verb inversion and adverb placement

Any investigation into morphological representation ought to compare that representation with something else in order to test the efficacy of the methodology used. In other words, limiting oneself to testing representation of verbal morphology alone leaves the researcher open to various problems in interpreting the outcomes. If, for example, learners demonstrated underlying representation via the methodology used, then one could conclude that the accounts of a mapping problem are correct; the morphological deficits observed in previous research are production problems. If, on the other hand, learners demonstrated a problem with underlying representation of verbal morphology — without comparison to something else — one could argue that the methodology itself didn't really tap into representation (but see below on on-line methodology). To avoid this problem, we have decided to include two surface manifestations of underlying syntactic operations involving

verb movement in Spanish: subject-verb inversion in *wh*-questions and adverb placement (cf. Bruhn de Garavito, 2003). We describe these now.

Under a Minimalist account, lexical verbs in Spanish must move out of their VP and up into TP to get particular features checked, and up into CP when a *wh*- element (Q feature) is present (Biberauer & Roberts, 2010; Montrul, 2004; Rizzi, 1996; Zagona, 2002). The results of this movement, as is widely known, are various word orders that are impossible in English. With *wh*- questions, the result is obligatory subject-verb inversion in most dialects of Spanish, as shown in (5a) (*comen* = verb, *tus padres* = subject):

- (5) a. ¿Dónde comen tus padres/*tus padres comen cuando vienen de visita?¹
 b. 'Where do your parents eat/*eat your parents when they come to visit?'

The underlying representations for (5a) and (5b) are depicted in (6a) and (6b) (with some details left out):

- (6) a. [_{CP} Dónde comen_i [_{TP} tus padres_j e_i [_{VP} e_j e_i [_{CP} cuando vienen de visita]]]]
 b. [_{CP} Where do_i [_{TP} your parents_j e_i [_{VP} e_j eat [_{CP} when they come to visit]]]]

As can be seen, only in Spanish does the lexical verb move out of VP. In English, lexical verbs do not move up into TP (although auxiliaries and modals can move up into CP).

Also because of verb movement, there are certain word orders in Spanish as regards adverb placement that are impossible in English. For example, *no más* 'no longer' requires that the lexical verb in Spanish appear to the left of the adverb *más*, something that is not possible in English (*visita* = verb, *Juan* = subject):

- (7) a. Juan no visita más/*no más visita a Francia porque no tiene los fondos.
 b. 'Juan no longer visits/*no visits longer France because he doesn't have the funds.'

The underlying representations for (7a) and (7b) are depicted in (8a) and (8b), again with certain details omitted:

- (8) a. [_{TP} Juan_i no visita_j [_{VP} más e_i e_j a Francia [_{CP} porque no tiene los fondos]]]²
 b. [_{TP} Juan_i no longer [_{VP} e_i visits France [_{CP} because he doesn't have the funds]]]

Again, as can be seen, the Spanish verb has moved out of VP whereas the lexical verb in English has not.

We note here that word order involving subject-verb inversion and adverb placement are not taught or learned explicitly in Spanish curricula — and clearly, no instructor teaches learners about verb movement as a property of Spanish. However, subject-verb inversion is readily available in the input. From their first

day of encounter with Spanish, learners are confronted with both *yes-no* and *wh*-questions in Spanish in which verbs appear to the left of subjects. We believe this to be clear and robust data for the resetting of the relevant parameter involved (in this case, feature strength within TP).³ On the other hand, adverb placement between verbs and their complements is an infrequent structure in Spanish, and it is unlikely that learners with limited to no naturalistic exposure would converge on a representation allowing this word order if they relied on input data alone. However, they could have knowledge of this order if it were derived from the more general operation of verb movement. That is, learners could come to know (implicitly) that the *no-V-más* word order of Spanish is both possible and required if they had reset the particular parameter responsible for verb movement based on the data contained in *wh*-questions. We are thus including two surface syntactic reflexes derived from verb movement in our study: one readily observable in the input (subject-verb inversion) and one that is not (adverb placement).⁴

To be sure, under earlier accounts, it was argued that morphological richness in the form of person-number inflections was a requirement/trigger for verb movement (e.g. Rohrbacher, 1999; Vikner, 1994, 1995). However, other accounts have rejected this position, arguing that verb movement can occur without rich person-number agreement (Bobaljik, 2002; Sprouse, 1998).⁵ More recently, Biberauer and Roberts (2010) argue that what underlies verb movement is not person-number agreement, but rich tense inflections; that is, distinct inflections for tense, mood, and aspect. For the purpose of the present study, the theoretical relationship between syntactic operations such as verb movement and verbal morphology is not relevant. Again, we are concerned only with having a non-morphological test of grammatical sensitivity as a check on our methodology. As previous research has shown, even when an accepted relationship exists between morphology and syntax, the two need not go hand in hand during acquisition and it is generally the case that underlying syntactic operations are acquired before morphological inflections are fully present in learners' output (e.g. Haznedar, 2001; Lardiere, 2007; Prévost & White, 2000; Verrips & Weissenborn, 1992).

Thus, the second part of our study tests learners' underlying representation for syntactic operations related to verb movement. Our prediction is that verb movement will be in evidence for our population of L2 learners. What is more, if we are correct about our predictions for both morphology and syntax, then we will have evidence that the problem in morphology is most likely representational with our learners. That is, if they show sensitivity in the syntactic domain but not in the morphological domain, then this would bolster our argument that the source of the difference is representational.

1.4 The use of on-line methods for testing grammatical sensitivity

On-line methods (e.g. self-paced reading, eye-movement tracking, ERPs) have been used in L1 research to investigate implicit language processing for a number of decades (Carreiras & Clifton, 2004), and have crept into L2 research just within the last 15 years or so (see the review in Frenck-Mestre 2005). On-line methods keep the participant's focus on meaning (via comprehension questions related to stimuli the participant processes), and because the participant is engaged in the act of reading or listening, that person is unaware of the intent of the study. In the case of self-paced reading, which is the methodology used in the present experiment, what researchers look for in such studies are differences in reading times (measured in milliseconds) at particular regions in a sentence to see if reading is unconsciously affected by something in the stimulus. We will illustrate more fully in our methods and procedure section. The point to be made here is that on-line methods are an accepted psycholinguistic tool for getting at implicit processing of language that is not production oriented (Mitchell, 2004).

In the L2 context, on-line methods have recently begun to be used to compare how native and non-native speakers/readers deal with ungrammaticalities during processing (e.g. Hopp, 2006; Jiang, 2004, Keating, 2009). Again, comparison of reading times of particular regions in grammatical versus ungrammatical regions of sentences can indicate whether or not an ungrammaticality is being "picked up" while the participant's primary focus is on comprehension (reading for meaning). The advantage of on-line methods in L2 research is that they avoid the potential introspection and resultant tapping of explicit knowledge that can come from paper-and-pencil tests (or what are contrastively referred to as "off-line" measures).

In the present study, we use one kind of on-line method — self-paced reading — and we compare reading times at particular regions of matched grammatical and ungrammatical sentences in Spanish containing the following morpho-syntactic features in present tense sentences: (i) person-number agreement on verbs; (ii) subject-verb inversion in *wh*-questions; (iii) adverb placement with *no más*.

2. The present study

2.1 Participants

The participants consisted of 18 native Spanish speakers and 25 non-advanced learners of Spanish. The native speakers were international students enrolled in graduate or undergraduate degree programs at San Diego State University and Florida State University. They represented a variety of countries including Mexico,

Chile, Venezuela, Peru, and Spain. Crucially, we excluded speakers of Caribbean dialects of Spanish for whom lack of verb raising in *wh*-questions is possible (Torrego, 1984). All native speakers had arrived in the U.S. in adulthood (mean age of arrival = 22.56 years; range = 15–35 years) and had resided in the U.S. for an average of 1.96 years (range = 4 months–5.5 years). The average age for the group at the time of testing was 24.50 years (range: 20–37 years).

The L2 learners of Spanish were undergraduate students enrolled in third-year Spanish courses at Texas Tech University. All L2 learners spoke English as their native language and were raised monolingually by English-speaking parents. The learners' first exposure to Spanish occurred in an instructed setting beginning in middle school or later.⁶ The mean age of first exposure for the group was 13.88 years (range = 10–19 years). The mean age for the group at the time of testing was 20.84 years (range = 19–25). All participants completed a minimum of two years of high school Spanish ($M = 3$ years; range = 2–5 years). Of the 25 participants, 5 reported short-term exposure to Spanish in an immersion setting. These experiences were limited to short summer study abroad programs lasting six weeks or less, family vacations, or brief missionary trips. The L2 learners were characterized as non-advanced learners on the basis of course placement. An independent measure of participants' proficiency in Spanish was not obtained for several reasons. In other research that examines multiple levels of learners, proficiency tests are required to distinguish between, say, intermediate and advanced learners. This is particularly true of studies in which intermediate and advanced learners may show significant differences in knowledge/ability due to non-classroom exposure, years of study, choice of major/career, degree of assimilation into the target culture, and so forth. In our study, we do not compare levels of learners. Proficiency tests are also needed in research that examines near-native speakers, such as studies of ultimate attainment in SLA. Our study examines grammatical sensitivity in low-level learners and makes no claims about the end state of acquisition. Proficiency tests are also needed in studies that compare groups of learners that have distinct L1s, particularly when the L1 and the L2 are related for some learners but not for others. In our study, all learners had the same L1. What is more, the L2 learners in our study were homogeneous with respect to the type and quantity of exposure to Spanish they received prior to testing. They were largely classroom-only learners at one institution, with limited or no informal exposure. All participants completed the same four-semester sequence of basic college-level Spanish at Texas Tech University (two semesters each of first- and second-year Spanish) and were enrolled in third-year Spanish courses, including Intermediate Spanish Conversation, Intermediate Spanish Grammar,⁷ Introduction to Hispanic Life and Culture, and Introduction to Hispanic Literature. The profile of the learners in our study is typical of non-advanced, college-aged learners of Spanish (and

other foreign languages) in the United States and stands in contrast to the profile of college-aged learners of ESL in the United States, who vary greatly with respect to L1, education, exposure to ESL, and so forth.

2.2 Materials

2.2.1 Verbal morphology

To test for knowledge of overt verbal morphology, we created 16 experimental quadruplets that involved person-number agreement between subjects and verbs. In half of the quadruplets, first- and third-person singular subjects were crossed with first- and third-person singular verb forms to create agreement mismatches, as illustrated in (9a–d).

- (9) a. Ahora Pedro toma el refresco en el salón.
 now Pedro_{3rd-Sing} drinks_{3rd-Sing} the soft drink in the living room
- b. * Ahora Pedro tomo el refresco en el salón.
 now Pedro_{3rd-Sing} drink_{1st-Sing} the soft drink in the living room
- c. Ahora yo tomo el refresco en el salón.
 now I_{1st-Sing} drink_{1st-Sing} the soft drink in the living room
- d. * Ahora yo toma el refresco en el salón.
 now I_{1st-Sing} drinks_{3rd-Sing} the soft drink in the living room

In the remaining eight quadruplets, agreement mismatches were created by crossing second-person singular and third-person plural subjects and their corresponding verb forms, as in (10a–d).

- (10) a. Ahora tú tocas el piano para muchas personas.
 now you_{2nd-Sing} play_{2nd-Sing} the piano for several people
- b. * Ahora tú tocan el piano para muchas personas.
 now you_{2nd-Sing} play_{3rd-Pl} the piano for several people
- c. Ahora ellos tocan el piano para muchas personas.
 now they_{3rd-Pl} play_{3rd-Pl} the piano for several people
- d. * Ahora ellos tocas el piano para muchas personas.
 now they_{3rd-Pl} play_{2nd-Sing} the piano for several people

The person-number manipulations depicted in (9) through (10) yielded a variety of agreement violations while also controlling for verb length within quadruplets. Creating mismatches between other person-number combinations, such as first- and second-person singular, would have resulted in verbs of unequal length (e.g. *tomo* ‘I drink’ vs. *tomas* ‘you drink’). As illustrated in the examples, subjects and verbs always appeared adjacent to each other. In addition, all verbs belonged to the class of –AR verbs and appeared in the present tense.

2.2.2 Subject-verb inversion

To test for knowledge of subject-verb inversion in *wh*-questions, we created 16 *wh*-questions, each of which had a grammatical and an ungrammatical version that formed a minimal pair, as in (11a) and (11b).

- (11) a. ¿Dónde comen tus padres cuando hacen visita a Chicago?
 where eat your parents when (they) visit Chicago
 b. *¿Dónde tus padres comen cuando hacen visita a Chicago?
 where your parents eat when (they) visit Chicago
 ‘Where do your parents eat when they visit Chicago?’

In the grammatical version of each item the verb appeared to the left of the subject — evidence that it raised from V° to I° — and in the ungrammatical version the verb appeared to the right of the subject — evidence that it remained in V° .

2.2.3 Adverb placement

To test for knowledge of adverb placement, we created 12 sentences that included the adverb *más* ‘anymore/longer’ in negative sentences. Each sentence in the adverb placement condition had a grammatical and an ungrammatical version, as illustrated in (12a) and (12b).

- (12) a. Alfredo no viaja más en tren porque no tiene el dinero necesario.
 Alfredo no travels longer by train because no has the money necessary
 b. * Alfredo no más viaja en tren porque no tiene el dinero necesario.
 Alfredo no longer travels by train because no has the money necessary
 ‘Alfredo no longer travels by train because he doesn’t have the necessary money.’

In the grammatical version of each sentence, the verb appeared to the left of the adverb — evidence that it raised from V° to I° — and in the ungrammatical version it appeared to the right of the adverb — evidence that it remained in V° .

As is typical in experiments of this type, participants only read one version of each experimental item. The 44 critical items were intermixed among 56 distractors⁸ and distributed across 4 different presentation lists. Items within each list were pseudo-randomized to ensure that ungrammatical sentences of the same type never appeared consecutively. Each stimulus sentence was followed by a comprehension probe. Given that *wh*- and (pragmatically appropriate) yes/no comprehension questions in Spanish require subject-verb inversion — the phenomenon under investigation in the current study — asking Spanish comprehension questions could have influenced participants’ performance on the critical items involving subject-verb inversion. For this reason, comprehension probes appeared in English. Each probe began with the question, ‘Is the following true based on what

you just read?’ and was followed by a summary statement that participants indicated as true or false. For example, the *wh*-question stimulus in (11) was followed by the comprehension item below.

- Is the following true based on what you just read?
 Your parents never go to Chicago.
 A. True B. False

Half of the summary statements required true answers and half false.

2.3 Procedure

Participants were tested individually in one session lasting approximately 30 minutes. Participants first completed a consent form and background questionnaire followed by the on-line sentence comprehension task. Reading times for the on-line comprehension task were collected using the noncumulative moving-window technique (Just, Carpenter, & Woolley, 1982). In the moving-window procedure, participants read sentences on a computer screen one segment at a time. Each press of a pacing button displays the next segment of the sentence to the right of the preceding segment, at which point the preceding segment disappears from view (i.e. readers cannot view segments of a sentence previously read once the next segment is displayed). Reading times on critical segments of matched sentences serve as measures of implicit sensitivity to grammatical violations.

The stimulus sentences in the present study were presented on a 17-inch monitor in black letters (20 point Tahoma font) against a grey background. Each trial began with a series of underscores that indicated the length of each segment in the sentence. Participants pressed a pacing button on a response pad to display each segment of the sentence. Reading times between button presses were recorded in milliseconds. The sentences in each condition were divided into five segments or regions of interest. The sentences testing knowledge of verbal morphology were divided as indicated in (13a) through (13d).

- (13) a. Ahora / Pedro / toma / el refresco / en el salón.
 b. * Ahora / Pedro / tomo / el refresco / en el salón.
 c. Ahora / yo / tomo / el refresco / en el salón.
 d. * Ahora / yo / toma / el refresco / en el salón.
 1 2 3 4 5

‘Right now Pedro is (I am) drinking a soda in the living room’

For these sentences, we examined reading times in two key regions: region 3 (the main verb) and region 4 (the segment immediately following the main verb; that

is, the spill-over region).⁹ The spill-over region in these sentences always consisted of a masculine singular noun.

The sentences testing knowledge of subject-verb inversion in *wh*-questions were divided as indicated in (14a) and (14b).

- (14) a. ¿Dónde / comen tus padres / cuando / hacen visita / a Chicago?
 b. *¿Dónde / tus padres comen / cuando / hacen visita / a Chicago?
 1 2 3 4 5
 ‘Where do your parents eat when they visit Chicago’

We examined reading times in region 2, which contained the subject and the verb, and in region 3, the spill-over region. The spill-over segment in all sentences consisted of the subordinating conjunction *cuando* ‘when.’

The sentences testing knowledge of adverb placement with *más* were divided as shown in (15a–b).

- (15) a. Alfredo / no viaja más en tren / porque / no tiene / el dinero necesario.
 b. *Alfredo / no más viaja en tren / porque / no tiene / el dinero necesario.
 1 2 3 4 5
 ‘Alfredo no longer travels by train because he doesn’t have the required money’

Region 2 served as the critical region because it contained the verb and the adverb. Region 3 served as the spill-over region and always contained the subordinate conjunction *porque* ‘because.’

Reading times on sentence segments and responses to comprehension questions were collected via SuperLab 4.0. The experiment began with a brief description of the moving-window procedure and instructions for answering the comprehension questions. The experimental items were preceded by five practice sentences to familiarize participants with the procedure. Participants responded to comprehension questions by pressing either the A (True) or B (False) buttons on a Cedrus RB-730 response pad.

2.4 Reading time measures

The native speakers and L2 learners answered 90.32% (L1 Spanish: 90.97%; L2 Spanish: 89.86%) of the end-of-trial comprehension questions correctly. An independent-samples t-test revealed no difference between the groups on comprehension of the items: $t(41) = .573$, $p = .570$. Thus, the sentences were not harder or easier for a particular group to read compared to the other.

For all statistical analyses, only reading times for correctly answered trials were included. In addition, reading times that exceeded ± 2 SDs from a participant's mean in each condition (structure type, sentence region, grammaticality) were replaced with the participant's mean for that condition, affecting 4.7% of the overall data. The breakdown for each sentence type was as follows: subject-verb agreement, 4.2%; adverb placement, 5.7%; *wh*- subject-verb inversion, 3.5%. For each structure and region of interest, mean reading times were submitted to a 2×2 ANOVA (by participant and by item) with group (native speakers, L2 learners) as the between-subjects factor and grammaticality (grammatical, ungrammatical) as the within-subjects factor. If a significant interaction between group and grammaticality obtained, an analysis of simple main effects with a Bonferroni adjustment was conducted to explore the interaction. ANOVAs were conducted not only on the critical and spill-over regions of sentences, but also on non-critical segments appearing prior to the critical region. The results of ANOVAs conducted on non-critical segments are only reported when a significant main effect or interaction obtained. An alpha level of .05 was set for all statistical tests.

Of primary interest are main effects of grammaticality, which indicate that readers respond differently to grammatical and ungrammatical regions of interest during real-time comprehension. Also of interest are interactions between grammaticality and group, which reflect the fact that one group behaves differently than the other with respect to grammaticality. We also report main effects of group, which, when significant, would reflect the fact that native speakers read faster than L2 learners, but otherwise do not inform answers to our research questions.

3. Results

3.1 Verb morphology

Three sets of analyses were conducted on the verb morphology data. First, we report the results of all person-number manipulations together in the same analyses. Next, we report the results separately for the two experimental person-number manipulations (i.e. 1st- and 3rd-person singular subjects crossed with 1st- and 3rd-person singular verb forms, and 2nd-person singular and 3rd-person plural subjects crossed with 2nd-person singular and 3rd-person plural verb forms). Finally, we report the results separately for the four subject manipulations (i.e. 1st-person singular subjects crossed with 1st- and 3rd-person singular verb forms, and 3rd-person singular subjects crossed with 1st- and 3rd-person singular verb forms).

3.1.1 All person-number manipulations

Table 1 provides an overview of participants' mean reading times at each region for sentences targeting person-number agreement. Prior to the verb region, the ANOVA revealed a significant interaction between group and grammaticality at region 1, $F_1(1, 41) = 4.79, p = .034, \eta^2_{\text{partial}} = .105$; $F_2(1, 30) = 55.49, p < .001, \eta^2_{\text{partial}} = .649$. Pairwise comparisons revealed that this interaction was due to the fact that L2 learners had slower reading times than native speakers for ungrammatical sentences only ($p < .05$). There was also a significant effect for grammaticality at region 2, $F_1(1, 41) = 4.72, p = .036, \eta^2_{\text{partial}} = .103$; $F_2(1, 30) = 55.49, p < .001, \eta^2_{\text{partial}} = .649$. This effect was due to slower reading times at this region for grammatical sentences than for ungrammatical sentences. At the verb region (region 3), the ANOVA revealed a main effect of group, $F_1(1, 41) = 12.34, p = .001, \eta^2_{\text{partial}} = .231$; $F_2(1, 30) = 55.49, p < .001, \eta^2_{\text{partial}} = .649$. No other significant effects or interactions were found.

At the spillover region (region 4), the ANOVA revealed a main effect for grammaticality, $F_1(1, 41) = 25.10, p < .001, \eta^2_{\text{partial}} = .380$; $F_2(1, 30) = 25.40, p < .001, \eta^2_{\text{partial}} = .458$; and a significant interaction between group and grammaticality, $F_1(1, 41) = 8.54, p = .006, \eta^2_{\text{partial}} = .172$; $F_2(1, 30) = 8.00, p = .008, \eta^2_{\text{partial}} = .210$. Pairwise comparisons (for subject and item analyses) revealed that native speakers had significantly slower reading times in ungrammatical sentences compared to grammatical sentences ($ps < .001$), but L2 learners did not ($ps > .10$). In addition, L2 learners' reading times were significantly slower than those of native speakers for grammatical sentences ($ps < .05$), but not for ungrammatical sentences ($ps > .10$). These findings suggest that only native speakers demonstrated sensitivity to person-number agreement violations on verbs.

Table 1. Mean reading times in milliseconds and standard deviations (in parentheses) for morphological inflections by region and condition

Condition	Region					
	1	2	3	4	5	6
L1 Spanish						
Grammatical	635 (224)	528 (141)	543 (182)	622 (247)	469 (92)	1161 (401)
Ungrammatical	577 (129)	518 (118)	636 (294)	883 (208)	466 (82)	1101 (439)
L2 Spanish						
Grammatical	766 (332)	679 (220)	1029 (513)	797 (218)	464 (86)	957 (300)
Ungrammatical	835 (375)	589 (160)	924 (431)	865 (294)	497 (168)	1101 (439)

3.1.2 *1st-person singular versus 3rd-person singular*

Tables 2 and 3 display the means and standard deviations for reading times by the two experimental person-number manipulations (1st and 3rd singular; 2nd singular and 3rd plural). For 1st- and 3rd-person singular, there were no effects for grammaticality and no significant interactions between group and grammaticality prior to the verb, ($F_s < 3$, $p_s > .10$). At the verb, the ANOVA revealed a main effect of group, $F_1(1, 41) = 10.59$, $p = .002$, $\eta^2_{partial} = .205$; $F_2(1, 14) = 30.32$, $p < .001$, $\eta^2_{partial} = .684$. There was also a significant interaction between group

Table 2. Mean reading times in milliseconds and standard deviations (in parentheses) for morphological inflections (1st and 3rd person singular) by region and condition

Condition	Region					
	1	2	3	4	5	6
L1 Spanish						
Grammatical	544 (146)	539 (192)	528 (192)	630 (294)	460 (102)	1061 (464)
Ungrammatical	530 (141)	513 (134)	605 (285)	788 (276)	461 (70)	1019 (442)
L2 Spanish						
Grammatical	739 (497)	709 (305)	1027 (465)	836 (228)	461 (95)	939 (353)
Ungrammatical	731 (363)	626 (206)	605 (285)	931 (361)	486 (146)	974 (384)

Table 3. Mean reading times in milliseconds and standard deviations (in parentheses) for morphological inflections (2nd person singular and 3rd person plural) by region and condition

Condition	Region					
	1	2	3	4	5	6
L1 Spanish						
Grammatical	711 (330)	511 (124)	555 (180)	604 (211)	477 (97)	1262 (482)
Ungrammatical	626 (168)	517 (114)	666 (335)	956 (278)	467 (96)	1185 (564)
L2 Spanish						
Grammatical	810 (302)	666 (235)	1020 (580)	760 (244)	468 (91)	976 (322)
Ungrammatical	915 (440)	557 (141)	974 (483)	809 (325)	503 (182)	1060 (453)

and grammaticality in the subject analysis, $F_1(1, 41) = 10.45, p = .002, \eta^2_{\text{partial}} = .203$; but not in the item analysis, $F_2(1, 14) = 1.95, p = .184, \eta^2_{\text{partial}} = .122$. For the subject analysis, pairwise comparisons revealed that L2 learners' reading times were significantly slower in the grammatical condition than in the ungrammatical condition ($p = .001$). In addition, native speakers' reading times were significantly faster than those of L2 learners for grammatical sentences ($p < .001$).

At the spillover region, there was a main effect for group in the subject analysis, $F_1(1, 41) = 4.51, p = .040, \eta^2_{\text{partial}} = .099$; but not in the item analysis $F_2(1, 14) = 3.11, p = .100, \eta^2_{\text{partial}} = .182$. There was also a main effect for grammaticality, $F_1(1, 41) = 10.26, p = .003, \eta^2_{\text{partial}} = .200$; $F_2(1, 14) = 39.96, p = .007, \eta^2_{\text{partial}} = .416$. There was no interaction between group and grammaticality, suggesting similar performance between the two groups. Pairwise comparisons revealed a clear significant difference for the native speaker group in the analyses by subjects ($p = .012$) and items ($p = .019$). For the L2 group, however, the pairwise comparisons did not reveal a clear difference, although they were suggestive of a trend: subject analysis ($p = .07$); item analysis ($p = .093$).

3.1.3 2nd-person singular versus 3rd-person plural

For the 2nd-person singular and 3rd-person plural data, prior to the verb there was a main effect for grammaticality at region 2 in the subject analysis, $F_1(1, 41) = 4.99, p = .031, \eta^2_{\text{partial}} = .108$; but not in the item analysis, $F_2(1, 14) = 2.97, p = .107, \eta^2_{\text{partial}} = .175$. In region 2, there was also a significant interaction between group and grammaticality in the subject analysis, $F_1(1, 41) = 6.16, p = .017, \eta^2_{\text{partial}} = .131$; and the interaction in the item analysis approached significance, $F_2(1, 14) = 4.43, p = .054, \eta^2_{\text{partial}} = .240$. Pairwise comparisons revealed that L2 learners' reading times at this region were significantly slower for grammatical sentences than for ungrammatical sentences ($ps < .05$). The ANOVA at the verb region (region 3) revealed a main effect of group, $F_1(1, 41) = 11.06, p = .002, \eta^2_{\text{partial}} = .212$; $F_2(1, 14) = 26.12, p < .001, \eta^2_{\text{partial}} = .651$. There were no other main effects or significant interactions. At the spillover region, there was a main effect for grammaticality, $F_1(1, 41) = 17.83, p < .001, \eta^2_{\text{partial}} = .303$; $F_2(1, 14) = 19.60, p = .001, \eta^2_{\text{partial}} = .583$; as well as a significant interaction between grammaticality and group, $F_1(1, 41) = 10.19, p = .003, \eta^2_{\text{partial}} = .199$; $F_2(1, 14) = 12.33, p = .003, \eta^2_{\text{partial}} = .468$. Pairwise comparisons in both subject and item analyses revealed that native speakers' reading times were significantly slower for ungrammatical sentences than for grammatical sentences ($ps < .001$) but the L2 learners' were not. Furthermore, L2 learners' reading times for grammatical sentences were significantly slower than those for native speakers ($ps < .05$).

3.1.4 *1st-person singular*

Table 4 displays the means and standard deviations for the sentences with 1st-person subject pronouns. At the regions prior to the verb, there were no effects for grammaticality, nor were there significant interactions between group and grammaticality ($F_s < 1, p_s > .10$). The ANOVA at the verb region revealed a main effect of group, $F_1(1, 41) = 4.48, p = .041, \eta^2_{partial} = .105$; $F_2(1, 14) = 15.68, p = .001, \eta^2_{partial} = .528$. There were no other main effects or significant interactions. At the spillover region, there was a main effect for group, $F_1(1, 41) = 7.62, p = .009, \eta^2_{partial} = .168$; $F_2(1, 14) = 6.80, p = .021, \eta^2_{partial} = .327$. A main effect for grammaticality was obtained in the subject analysis, $F_1(1, 41) = 6.98, p = .012, \eta^2_{partial} = .155$; but not in the item analysis, $F_2(1, 14) = 2.77, p = .118, \eta^2_{partial} = .165$. There was no significant interaction between group and grammaticality in the subject analysis, $F_1(1, 41) = 1.33, p = .256, \eta^2_{partial} = .034$; however, this interaction approached significance in the item analysis, $F_2(1, 14) = 4.17, p = .061, \eta^2_{partial} = .229$. Pairwise comparisons in both subject and item analyses revealed that only native speakers' reading times were significantly slower for ungrammatical sentences than for grammatical sentences ($p_s < .05$).

3.1.5 *3rd-person singular*

Table 5 reports the descriptive statistics for the sentences with 3rd-person singular subject pronouns. At the regions prior to the verb, there were no effects for grammaticality, nor were there significant interactions between group and grammaticality in the subject analyses (regions 1 and 2) and in the item analysis for region 2 ($F_s < 1, p_s > .10$); however, an interaction between group and grammaticality approached significance in the item analysis for region 1, $F_2(1, 14) = 4.49, p = .052$,

Table 4. Mean reading times in milliseconds and standard deviations (in parentheses) for morphological inflections (1st person) by region and condition

Condition	Region					
	1	2	3	4	5	6
L1 Spanish						
Grammatical	545 (216)	471 (159)	513 (196)	549 (155)	416 (95)	1032 (500)
Ungrammatical	567 (154)	456 (124)	636 (444)	798 (291)	458 (83)	1044 (620)
L2 Spanish						
Grammatical	751 (548)	663 (350)	902 (505)	863 (336)	479 (165)	916 (358)
Ungrammatical	781 (613)	627 (309)	951 (914)	961 (453)	488 (416)	881 (339)

Table 5. Mean reading times in milliseconds and standard deviations (in parentheses) for morphological inflections (3rd person singular) by region and condition

Condition	Region					
	1	2	3	4	5	6
L1 Spanish						
Grammatical	537 (157)	562 (267)	519 (222)	662 (387)	474 (112)	1039 (546)
Ungrammatical	510 (150)	581 (181)	646 (335)	709 (358)	451 (76)	1034 (495)
L2 Spanish						
Grammatical	577 (188)	644 (203)	1140 (699)	795 (236)	435 (80)	889 (384)
Ungrammatical	625 (252)	649 (289)	813 (376)	868 (419)	480 (195)	911 (431)

$\eta^2_{\text{partial}} = .253$. The ANOVA at the verb region revealed a main effect of group, $F_1(1, 41) = 8.82, p = .005, \eta^2_{\text{partial}} = .197$; $F_2(1, 14) = 32.18, p < .001, \eta^2_{\text{partial}} = .697$. There was also a significant interaction between group and grammaticality in the subject analysis, $F_1(1, 41) = 10.59, p = .002, \eta^2_{\text{partial}} = .227$; but not in the item analysis, $F_2(1, 14) = 1.20, p = .291, \eta^2_{\text{partial}} = .079$. Pairwise comparisons in the subject analyses revealed that reading times were significantly slower for ungrammatical sentences than for grammatical sentences ($p < .05$) for the L1 Spanish speakers only. At the spillover region, no main effects or significant interactions were observed in any of the analyses ($F_s < 3, p_s > .10$).

3.1.6 2nd-person singular

Table 6 displays the means and standard deviations for the sentences with 2nd-person subject pronouns. At the regions prior to the verb, there were no effects for grammaticality, nor were there significant interactions between group and grammaticality ($F_s < 3, p_s > .10$). The ANOVA at the verb region revealed a main effect of group, $F_1(1, 41) = 10.41, p = .003, \eta^2_{\text{partial}} = .211$; $F_2(1, 14) = 19.49, p = .001, \eta^2_{\text{partial}} = .582$. There were no other main effects or significant interactions. At the spillover region, a main effect for grammaticality was obtained in the subject analysis, $F_1(1, 41) = 15.09, p < .001, \eta^2_{\text{partial}} = .279$; and the item analysis approached significance, $F_2(1, 14) = 4.04, p = .064, \eta^2_{\text{partial}} = .224$. There was also a significant interaction between group and grammaticality, $F_1(1, 41) = 19.99, p < .001, \eta^2_{\text{partial}} = .339$; $F_2(1, 14) = 11.33, p = .005, \eta^2_{\text{partial}} = .447$. Pairwise comparisons in both subject and item analyses revealed that only native speakers' reading times were significantly slower for ungrammatical sentences than for grammatical sentences ($p_s < .05$).

Table 6. Mean reading times in milliseconds and standard deviations (in parentheses) for morphological inflections (2nd person) by region and condition

Condition	Region					
	1	2	3	4	5	6
L1 Spanish						
Grammatical	703 (435)	491 (121)	469 (108)	528 (156)	459 (92)	1031 (420)
Ungrammatical	630 (212)	496 (117)	601 (399)	1021 (441)	481 (119)	1227 (566)
L2 Spanish						
Grammatical	824 (410)	604 (241)	989 (709)	734 (228)	456 (101)	908 (330)
Ungrammatical	834 (301)	523 (178)	887 (412)	700 (268)	481 (119)	1009 (439)

3.1.7 3rd-person plural

Table 7 displays the means and standard deviations for the sentences with 3rd-person plural subject pronouns. At the regions prior to the verb, there were no effects for grammaticality, nor were there significant interactions between group and grammaticality ($F_s < 3$, $p_s > .10$). The ANOVA at the verb region revealed a main effect of group, $F_1(1, 41) = 7.00$, $p = .012$, $\eta^2_{\text{partial}} = .152$; $F_2(1, 14) = 22.04$, $p < .001$, $\eta^2_{\text{partial}} = .612$. There were no other main effects or significant interactions. At the spillover region, there was a main effect for grammaticality, $F_1(1, 41) = 10.35$,

Table 7. Mean reading times in milliseconds and standard deviations (in parentheses) for morphological inflections (3rd person plural) by region and condition

Condition	Region					
	1	2	3	4	5	6
L1 Spanish						
Grammatical	681 (269)	499 (129)	587 (248)	619 (295)	487 (120)	1312 (580)
Ungrammatical	629 (213)	539 (180)	748 (476)	971 (368)	465 (100)	1186 (650)
L2 Spanish						
Grammatical	755 (220)	697 (299)	965 (454)	784 (340)	484 (136)	988 (373)
Ungrammatical	940 (486)	584 (175)	1051 (625)	901 (471)	513 (151)	1085 (492)

$p = .003$, $\eta^2_{\text{partial}} = .210$; $F_2(1, 14) = 21.37$, $p < .001$, $\eta^2_{\text{partial}} = .604$; reflecting the fact that reading times for ungrammatical sentences were slower than for grammatical ones. However, a pairwise comparison showed that only the native speakers had significantly slower reading times on the ungrammatical sentences as compared to the grammatical sentences ($p = .003$), whereas the L2 learners did not ($p = .233$).

3.2 Subject-verb inversion

Table 8 displays the means and standard deviations for the sentences testing subject-verb inversion in *wh*-questions. Prior to the target region (region 1), there were no effects for grammaticality, nor were there significant interactions between group and grammaticality in the subject and item analyses ($F_s < 3$, $p_s > .10$). At the target region (region 2), the ANOVA revealed a main effect for group, $F_1(1, 41) = 29.23$, $p < .001$, $\eta^2_{\text{partial}} = .416$; $F_2(1, 30) = 191.86$, $p < .001$, $\eta^2_{\text{partial}} = .865$. No other significant effects or interactions were found. At the spillover region (region 3), there was a main effect for grammaticality, $F_1(1, 41) = 7.97$, $p = .007$, $\eta^2_{\text{partial}} = .163$; $F_2(1, 30) = 11.76$, $p = .002$, $\eta^2_{\text{partial}} = .282$. There was no main effect for group in the subject analysis, $F_1(1, 41) = 1.68$, $p = .203$, $\eta^2_{\text{partial}} = .039$; but there was in the item analysis, $F_2(1, 30) = 6.91$, $p = .013$, $\eta^2_{\text{partial}} = .187$. There was no significant interaction between group and grammaticality, $F_1(1, 41) = 0.18$, $p = .734$, $\eta^2_{\text{partial}} = .003$; $F_2(1, 30) = 0.215$, $p = .646$, $\eta^2_{\text{partial}} = .007$. These results are due to the consistently higher RTs for ungrammatical sentences than for grammatical sentences for both native speakers and L2 learners, suggesting that both groups demonstrated sensitivity to violations involving subject-verb inversion.

Table 8. Mean reading times in milliseconds and standard deviations (in parentheses) for subject-verb inversion by region and condition

Condition	Region				
	1	2	3	4	5
L1 Spanish					
Grammatical	535 (115)	989 (238)	581 (114)	621 (168)	1108 (290)
Ungrammatical	537 (135)	1017 (264)	701 (239)	671 (181)	982 (299)
L2 Spanish					
Grammatical	619 (170)	1803 (670)	664 (194)	1002 (347)	1101 (375)
Ungrammatical	567 (209)	1809 (630)	758 (262)	944 (312)	994 (355)

3.3 Adverb placement

The means and standard deviations for participants' reading times for sentences with *no más* are displayed in Table 9. Prior to the target region (region 1), there were no effects for grammaticality, nor were there significant interactions between group and grammaticality in the subject and item analyses ($F_s < 2$, $p_s > .10$). At the target region (region 2), the ANOVA revealed a main effect for group, $F_1(1, 41) = 10.90$, $p = .002$, $\eta^2_{partial} = .210$; $F_2(1, 22) = 42.23$, $p < .001$, $\eta^2_{partial} = .657$. There was also a main effect for grammaticality, $F_1(1, 41) = 10.41$, $p = .002$, $\eta^2_{partial} = .202$; $F_2(1, 22) = 13.04$, $p = .002$, $\eta^2_{partial} = .372$, but no significant interaction between group and grammaticality, $F_1(1, 41) = 0.57$, $p = .454$, $\eta^2_{partial} = .014$; $F_2(1, 22) = 0.69$, $p = .417$, $\eta^2_{partial} = .030$, which reflects the fact that reading times for native speakers and L2 learners were significantly slower in ungrammatical than in grammatical sentences. At the spillover region (region 3), there were no significant main effects or interactions (all $F_s < 1$).

3.4 Summary of results

In sum, our analyses of reading times to test grammatical sensitivity revealed the following: (i) native speakers, but not L2 learners, consistently demonstrated on-line sensitivity to violations involving person-number agreement. Only in the 1st-sing/3rd-sing items did the L2 learners show evidence of a trend toward grammatical sensitivity; however, performance on individual person-number groups (i.e. 1st-singular, 3rd-singular, 2nd-singular, 3rd-plural) revealed grammatical

Table 9. Mean reading times in milliseconds and standard deviations (in parentheses) for adverb placement with *más* by region and condition

Condition	Region				
	1	2	3	4	5
L1 Spanish					
Grammatical	556 (153)	1615 (691)	592 (166)	523 (131)	990 (358)
Ungrammatical	544 (163)	1853 (611)	580 (157)	531 (120)	986 (302)
L2 Spanish					
Grammatical	641 (244)	2226 (753)	582 (165)	568 (217)	1057 (372)
Ungrammatical	597 (203)	2610 (834)	596 (187)	628 (242)	954 (257)

sensitivity for the L1 speakers only and not for the L2 learners; (ii) both native speakers and L2 learners demonstrated sensitivity to violations of subject-verb inversion in *wh*-questions; (iii) both native speakers and L2 learners were sensitive to violations involving adverb placement with *no más*.

4. Discussion and conclusion

The results of the present study suggest that non-advanced learners of Spanish have underlying representation related to verb movement but do not have robust representations of morphological inflections on verbs. Their slower reading times at key points in the sentences with violations of subject-verb inversion as well as *no más* placement parallel those of the native speakers, demonstrating that they are sensitive to word order violations involving verb movement, even for those word orders they could not have gleaned from the input. This performance offers evidence that these learners have reset the parameter related to verb movement.

At the same time, these non-advanced learners did not demonstrate any real sensitivity to subject-verb agreement violations. Unlike the native speakers who consistently slowed down after encountering subject-verb mismatches, the L2 learners in this study did not slow down, seemingly treating the ungrammatical morphological inflections no differently from the grammatical ones. However, we did note that for the 1st-SING/3rd-SING items in our morphology test there was a trend toward significance (Section 3.1.2.). But when we broke the analyses down we did not see any significant differences in reading times for grammatical versus ungrammatical sentences. That is, when we looked at agreement violations when the subject was *yo* (1st-SING), the L2 learners did not demonstrate any sensitivity to grammaticality (Section 3.1.4.). Likewise, when the subject was a 3rd-person singular noun, they did not show any sensitivity to grammaticality (Section 3.1.5.). They also did not demonstrate any sensitivity to grammaticality when the subject was *tú* (2nd-SING) or *ellos* (3rd-PL), but we'd like to focus here on the 1st-SING/3rd-SING items. According to previous research (e.g. McCarthy, 2006), 3rd-person singular should be a default form that is less likely to cause agreement problems when it is substituted for another verb form. The same cannot be said of 1st-person singular verb forms. Thus, if learners were to show grammatical sensitivity anywhere, they should have shown it when 1st-person singular verb forms were used in a 3rd-person singular context. This did not surface in our results. In fact, learners seemed to show no sensitivity overall to any combinations of ungrammaticality when it came to verbal morphology in this study. When compared to McCarthy's production data, then, we do not see that at the level of representation our non-advanced L2 learners of Spanish have an inflectional system with 3rd-person

singular as a default. This discord between representation and production with verbal morphology merits further investigation, although the discrepancy could be a matter of learner level. McCarthy's study included advanced speakers of Spanish L2 whereas our learners were clearly all non-advanced. The implication is that the representation for morphological inflections takes longer than what many of us may have previously thought (see below in our final paragraph).

Along related lines, the reader will recall that Shibuya and Wakabayashi (2008) found that their non-advanced learners of English L2 (Japanese L1) were sensitive to subject-verb agreement violations only when there was a violation involving person, but not number. Our results did not show this: the learners did not show any sensitivity to person violations (1st- SING and 3rd- SING) and none to the number contrast (2nd- SING and 3rd- PL). Our argument is that because of the inflectionally rich nature of Spanish verb endings, it takes longer for L2 learners of Spanish (compared to English) to build up some kind of representation of the forms themselves. Thus, our findings speak to the need to not rely on studies of English subject-verb agreement to make extrapolations into inflectionally rich languages.

Because no production tests were involved in our study, we do not see the results suggesting some kind of performance problem for these learners. In addition, because we did not use a paper-and-pencil type test, we do not believe that explicit knowledge (or any kind of explicit reflection) was tapped during learner performance on the task. This conclusion is bolstered by two facts. The first is that morphological inflections are explicitly learned, practiced, and tested throughout the L2 participants' formal course of study. Thus, the L2 learners did not seem to rely on any conscious knowledge of verbal morphology or they would have slowed down on the morphological violations. The second is that subject-verb inversion and adverb placement are not explicitly learned, practiced, or tested during formal coursework — and as highlighted earlier, verb movement resulting in V-Adv-Complement order is not readily available in classroom input. Thus, learners could not rely on conscious knowledge for these particular sentences. Given these distinct learning scenarios for the two sets of targeted items along with the differential outcomes in the current study, we believe that self-paced reading (SPR) served as a good means of tapping underlying implicit knowledge. In addition, we remind the reader that in our study, SPR involved reading for meaning; the goal of reading a given sentence was to answer a question about its content afterwards. In this way, participants' attention is not directed toward grammaticality, as it would be in a grammaticality judgment test, for example.

One possible objection, as raised by an anonymous reviewer, is that our methodology inadvertently caused the difference in sensitivities because the sentence regions containing word order violations were longer than the sentence regions containing subject-verb agreement violations. The reader will remember that all

sentences had five regions, and for inversion, those regions are exemplified in the following sentence: *Donde/ tus padres viven/ cuando/ vienen/ de visita?* For subject-verb violations, those regions were: *Ahora/ ellos/ tomas/ un refresco/ en la cafetería.* The objection is that the grouping of */tus padres viven/* somehow made the violation more salient compared with */tomas/*, a verb that stood alone. There are two issues here that merit discussion. The first is that the sentences had to be constructed this way so that the “trigger” for a violation appeared immediately before the violation and not as part of the same region. For inversion, it was the question word immediately prior to the region of interest and for the verb form it was the subject pronoun immediately prior. Second, the particular groupings used to create the regions yielded the expected pattern for the native speakers; thus, validating them as groupings for this kind of measure (i.e. SPR). That is, native speakers detected violations for both syntactic and verb agreement phenomena, regardless of region length. Third, the subject and verbs in the subject-verb violation sentences were right next to each other; a participant saw the subject NP/pronoun and then immediately the verb after pressing a button to advance. It is difficult to imagine a scenario in which a large group of participants could not remember the subject NP/pronoun that immediately preceded the verb, especially given that we controlled for known and frequent vocabulary for L2 learners. What makes more sense, given the results of previous research as well as the participants’ overall behavior in this experiment, is that the L2 learners, unlike the native speakers, simply were not sensitive to agreement violations on verbs (or that only a few of the L2 learners were, as noted above).

Our conclusion, then, is that the non-nativelike performance of L2 learners with morphological inflections may be traceable to representational issues and not performance issues. However, compared to previous research (e.g. Lardiere, 2007), our study focused on limited exposure learners who cannot be considered advanced. This leads us to the possibility that morphological problems for L2 learners may begin as representational problems but then later become performance problems once there is a more robust representation for morphological inflections in the grammar. In other words, in the earlier stages of acquisition, morphological inflections are not represented robustly enough (if at all) in the grammar, and later — assuming they are fully represented — learners may continue to show morphological weakness due to a mapping problem during production. Future research on this matter would include non-advanced and advanced learners of L2 Spanish on the same properties used in the current study, but in addition to using an on-line task such as SPR, research would include a production measure. If we are correct about a representation issue underlying non-advanced learners’ performance but a mapping problem underlying the performance of advanced learners, such a study ought to find both a representational (using an on-line task)

and a mapping problem (using a production task) with non-advanced learners, but only (or largely) a mapping problem with advanced learners.

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Notes

1. In some dialects of Spanish, notably various Caribbean dialects, lack of subject-verb inversion with *wh*-questions has been attested along with erosion of certain person-number endings on verbs and increased use of subject pronouns. However, in the present study, our native speakers do not represent any of these dialects and are speakers of Spanish in which subject-verb inversion is obligatory with *wh*-questions (see Torrego, 1984, for example).
2. Adverbs can be generated in a number of positions in Spanish (e.g. in IP, in VP). When verbs appear to the left of the adverb, it is generally assumed the adverb appears high up in the VP and that the verb moves over it into TP (Zagona, 2002).
3. See Lightfoot and Hornstein (1994) for discussion of the relevant data for triggering of verb movement in L1 acquisition (namely, appearance of verbs to the left of subjects).
4. In Spanish, there are two ways of conveying “no more” or “no longer.” One involves our example with *no más* and the other involves *ya no* (lit: now no). The latter is the frequent and colloquial (spoken) version but the word order is similar to English in that the adverbial appears before the verb (although in reverse order with the negative: *Roberto ya no visita a Francia...* ‘Robert no longer visits France...’). Again, we have chosen the structure that is different from English word order and is not readily available in the input to which these learners have been exposed.
5. Bobaljik (2002) also argued that the relationship was unidirectional: that verb movement did not imply rich verbal morphology, but rich morphology would imply verb movement.
6. One participant reported exposure to Spanish in elementary school (age 6) as part of an enrichment program. However, that participant placed into first semester Spanish at the university

when beginning his college career and worked his way up into third-year courses as did every other L2 participant in the study.

7. The linguistic phenomena investigated in this study were not covered in the intermediate Spanish grammar course.

8. The distractors tested linguistic phenomena unrelated to the purpose of the current study with one exception: 12 distractors tested adverb placement with *frecuentemente* 'frequently'. These items served as pilot data for another study and are not discussed here.

9. A reviewer queried whether the use of nouns like Pedro created a false sense of agreement when the verb was *tomo* for our L2 learners (i.e. learners might be tuned into a false gender agreement issue by matching *-o* with *-o*). Although this is possible, this type of sentence is actually a strength of our study, given that learners' representation for subject-verb agreement should not be based on noun endings but on underlying features of person and number.

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