

Pronoun interpretation in Italian: Exploring the effects of prosody

Lydia White, McGill University

Heather Goad, McGill University

Guilherme Duarte Garcia, Université Laval

Natália Brambatti Guzzo, Université Laval

Liz Smeets, York University

Jiajia Su, National Research Centre for Foreign Language Education, Beijing Foreign Studies University

Abstract

We explore potential effects of prosody on pronoun interpretation in Italian, building on previous research which has shown that second language learners/users (L2ers) assign non-target interpretations to overt pronouns. We investigate effects of contrastive stress and pause, proposing that these will result in changes to default antecedent preferences for overt and null pronouns, for L2ers and for native speakers. An experiment was conducted, involving English-speaking L2ers of Italian and Italian native speakers. Participants were presented with auditory stimuli like *Lorenzo ha scritto a Roberto quando Ø/lui si è trasferito a Torino* ‘Lorenzo wrote to Roberto when (he) moved to Turin’ and indicated their preferred antecedent for the pronoun. Overt versus null pronouns, presence versus absence of stress on overt pronouns, and presence versus absence of pause between clauses were manipulated. The results yielded significant differences for antecedent choices between null and overt pronouns, consistent with earlier literature. In addition, stress was significant for both groups. Implications of a prosodic approach to ambiguity resolution are discussed.

Keywords: prosody, stress, pronoun, Italian

1. Introduction

There has been increasing interest in recent years in examining the extent to which prosodic properties of the L1 and/or L2 can explain difficulties that learners exhibit in various linguistic domains, particularly morphology and core syntax. A case in point is the Prosodic Transfer Hypothesis (PTH), according to which transfer of prosodic representations from the L1 impacts the way that functional morphology is realized in the interlanguage grammar (see Goad & White, 2019, for a review).

The PTH has largely concentrated on word- and phrase-level prosody and its effects on the representation of functional morphology. There are, though, other levels of the grammar, notably clause-level syntax, where prosody comes into play. For example, recent research has investigated effects of constituent length and location of prosodic breaks on the interpretation of syntactically ambiguous sentences involving relative clause attachment and has found that L2ers are able to use such cues to help resolve ambiguity (e.g., Dekydtspotter et al. 2008; Goad et al., 2021). In this paper, we examine pronoun interpretation in null subject languages, in particular Italian, to see whether L2ers are sensitive to shifts in interpretation that are attributable to prosody.

In null subject languages, null and overt subjects are both possible. Syntactically, null subjects are constrained by the null subject parameter, including the requirement that they be licensed and identified (Chomsky, 1981; Jaeggli, 1982; Rizzi, 1982). To interpret a missing argument, there must be some way of recovering its content. Richness of inflection in Romance null subject languages provides the means for identification of a null subject.

However, null and overt pronominal subjects are not used in free variation; indeed, to some extent, they are in complementary distribution. While null subjects are licensed and identified syntactically, discourse is also implicated in determining likely antecedents for both null and overt subjects. The discourse notion of *topic* has been argued to be central. In an intra-sentential context like (1) (from Carminati, 2002), the discourse topic is the main clause subject

(*Lorenzo*), which is typically the antecedent of the null pronoun in the embedded clause. Use of an (unstressed) overt pronoun in the embedded clause, in contrast, signals that the preferred antecedent is not the topic; rather, it is an NP other than the subject, here, the complement (*Roberto*). In effect, ambiguity is reduced when topichood is taken into consideration.

- (1) Lorenzo ha scritto a Roberto quando Ø/lui si è trasferito a Torino.

Lorenzo has written to Roberto when (he) *REFL* is moved to Turin
 ‘Lorenzo wrote to Roberto when he moved to Turin.’

In the experimental research that has so far been brought to bear on this question, much of the focus has been on how L2ers interpret pronouns in sentences like (1) and whether the interpretation changes depending on the type of pronoun (null or overt) that occurs in the embedded clause.¹ However, there has been little consideration of whether sentence prosody might impact interpretation and, if so, how. This is the focus of the present paper.

1.1 Previous findings on anaphora resolution

Interest in how L2ers interpret pronouns in null subject languages is extensive and there are numerous studies on anaphora interpretation in L2 Italian and L2 Spanish (see Liceras, 1988, for an early perspective; see Quesada, 2015, for an overview). These studies report that L2ers may have difficulties in determining the conditions under which an overt pronoun is appropriate,

¹ The order of clauses in (1) is main clause followed by subordinate clause, and involves so-called forwards anaphora (FA), where the antecedent precedes the pronoun. Other word order permutations have also been tested, including cases where the subordinate clause precedes the main clause (Carminati, 2002, Exp 1) and also cases of backwards anaphora (BA), where the pronoun precedes its referent (Sorace & Filiaci, 2006). In this paper, our focus is on main-subordinate order with FA.

accepting them in circumstances where a null pronoun is preferable, except in some studies where the L1 and L2 fully coincide (see Kraš, 2008, on Croatian near native speakers of Italian).² In early work, Sorace (2000) attributed the overuse of overt pronouns to problems relating to topic continuity. Null pronouns in Italian refer to the current topic, whereas overt pronouns typically imply a topic shift. The issue, then, was seen to involve L1 transfer; in English, unlike Italian, overt pronouns are used in contexts of topic continuity.

Sorace and Filiaci (2006) propose a different account, the Interface Hypothesis (IH), which states that L2ers show a dissociation between narrow syntax, which is argued to be fully attainable, and linguistic phenomena at the interface between syntax and other cognitive domains, such as discourse, which may not be fully acquirable, even by near native speakers. If L2ers have difficulties integrating syntactic and discourse properties of the L2, overt pronouns will sometimes be accepted in discourse contexts where null pronouns would be more felicitous and will be interpreted as having topic antecedents, like null pronouns.

In particular, Sorace and Filiaci (2006) propose that Carminati's (2002) Position of Antecedent Hypothesis (PAH) is implicated. The PAH is a structurally-based strategy which guides pronoun interpretation in null subject languages. In intra-sentential contexts like (1), null pronouns prefer antecedents in a syntactically prominent position, namely in SpecIP, whereas overt pronouns prefer their antecedents not to be in SpecIP. In other words, syntactic position is

² In contrast to Kraš (2008), Lozano (2018) observes over-acceptance of overt pronouns for Greek learners of Spanish (intermediate to upper-advanced proficiency), even though these languages respect the same discourse constraints. This is explained by him as a developmental issue.

relevant in determining antecedent choice, rather than the grammatical or discourse function of the antecedent—neither the notion *subject* nor *topic* is invoked by the PAH.³

Carminati (2002) reports on several experiments in which Italian native speakers show a significant interaction between type of pronoun and position of antecedent. In her Experiment 2, which involves sentences like those in (1), subject antecedents were chosen for null subjects 81% of the time, while antecedents not in SpecIP were chosen for overt pronouns 83% of the time. The PAH has also been explored in other null subject languages. For Spanish, Alonso-Ovalle et al. (2002) found that native speakers strongly preferred antecedents for *pro* to be in SpecIP, as was the case for Italian. However, preferences with respect to overt pronouns were less categorical than in Italian, with antecedents in SpecIP being accepted to a similar extent as antecedents elsewhere in the structure (see also Contemori & Di Domenico, 2021; Jegerski et al., 2011).

In addition to intra-sentential antecedent choice, there is also the fact that a pronoun can refer to someone not mentioned in the linguistic discourse but present in the non-linguistic context. For example, in (1), the overt pronoun could refer to someone other than Lorenzo or Roberto. Carminati (2002) discusses this in the context of single referents, as in (2). According to the PAH, in such structures, a null pronoun should prefer an intra-sentential referent, whereas an overt pronoun should expect the referent to be elsewhere, in this case, someone not otherwise mentioned. Consistent with this, native Italian speakers chose the unmentioned antecedent more often in the case of overt pronouns (14%) than null (3%) but there was nevertheless a strong preference for the sentence-internal subject to be the antecedent in both cases (86% for overt; 97% for null). Carminati suggests that this is because, in isolated sentences, participants prefer the antecedent for the pronoun to be within the linguistic context.

³ Constituents in SpecIP are not necessarily subjects and subjects are not always in SpecIP. In the experiments under discussion, the constituent in SpecIP is always the grammatical subject, so we will refer to it as such.

- (2) Giovanni ha detto che Ø/lui è malato.

Giovanni has said that (he) is ill

'John said that he is ill.'

Using similar sentences with overt pronouns in Spanish, Alonso-Ovalle et al. (2002) found that the obviative reading for overt pronouns (unstressed and stressed) was around 30%.

Sorace and Filiaci (2006) report on an offline picture verification task, where participants (near native and native speakers of Italian) were presented with sentences like those in (3) involving null or overt pronouns. Each sentence was accompanied by three pictures (see Figure 1). All three pictures included the two mentioned NPs (subject, complement); one also involved an external referent not mentioned in the sentence.

- (3) La mamma dà un bacio alla figlia, mentre Ø/lei si mette il cappotto.

'The mother gives a kiss to her daughter while she puts on her coat.'

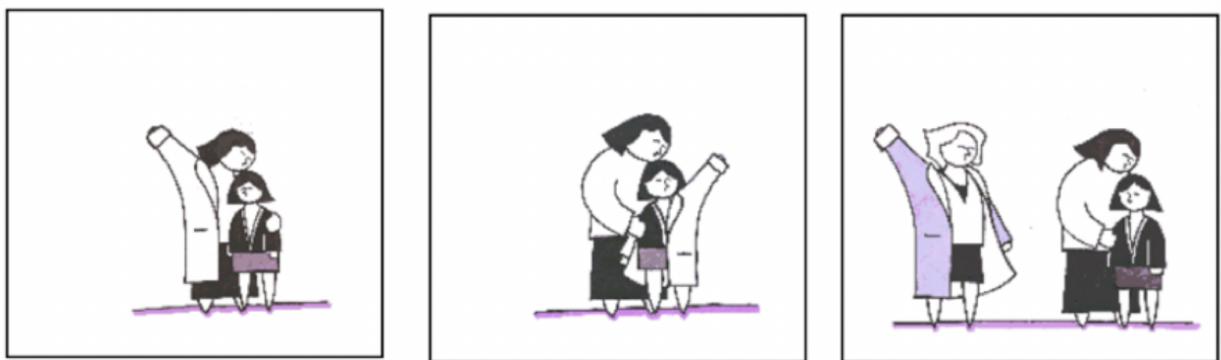


Figure 1. Example test item from Sorace and Filiaci (2006).

The task was to select the picture (or pictures) that best conveyed the meaning of the sentence. For overt pronouns, results showed that the unmentioned external antecedent (the other woman) was chosen about 10% of the time by both groups. The predominant response was to

select the sentence internal non-subject antecedent (*the daughter*); however, near native L2ers allowed significantly more subject antecedents (~26%) than native speakers, who performed as expected by the PAH (~8%). The authors take this as evidence that L2ers have problems at the syntax-discourse interface. With null pronouns, the two groups behaved alike; non-subject antecedents (either internal or external to the sentence) were selected around 49% of the time by the native speakers and 54% of the time by the L2ers, a rate much higher than predicted by the PAH.

In summary, evidence from previous studies suggests that L2ers allow subject antecedents for overt pronouns somewhat more often than native speakers do, even at near native levels of proficiency. There are discrepancies in the results that remain unexplained, including the fact that native speakers and L2ers interpret a null pronoun as taking a non-subject antecedent around 50% of the time (Belletti et al., 2007; Sorace & Filiaci, 2006), compared to Carminati's (2002) results for native speakers (81% subject antecedents). This is unexpected on any account of pronoun distribution.

As we have seen, much of the literature assumes that either the grammatical function of subject, the discourse notion of topic, or the syntactic position of SpecIP is relevant for determining whether a null or overt pronoun is preferable. We do not take a stand on which of these analyses is correct; in fact, they overlap to a considerable extent. We assume with Calabrese (1986) that the relevant notion is *expectedness* (i.e., high probability of occurrence). We suggest below that manipulating the prosody can overturn expected preferences, leading to differences in choice of antecedent and, hence, in the interpretations that are adopted.

1.2 Prosodic effects on pronoun interpretation

Missing from previous accounts of pronoun interpretation is a consideration of prosody. It has been well-documented that prosodic cues can be used to disambiguate potentially ambiguous sentences across many constructions, for example high versus low attachment of relative clauses by native speakers (e.g., Fodor, 2002; Jun, 2003; Maynell, 1999, 2000) and

L2ers (Dekydtspotter et al., 2008; Goad et al., 2021) or PP attachment as NP versus VP modifiers by native speakers (Snedeker & Yuan, 2008) and L2 acquirers (e.g., Jackson & O'Brien, 2011). However, the way in which native speakers and L2 learners use prosodic cues for disambiguation is often not the same, neither in sentence interpretation nor in production. For example, in relative clause attachment, for which the effects of prosody have been examined more extensively, it has been found that L2 learners, unlike native speakers, are often not sensitive to the effect of relative clause length in disambiguation (e.g., Dekydtspotter et al., 2008; Liljestrand Fultz, 2007). In addition, in the production of ambiguous sentences with relative clauses, L2 learners often resolve ambiguity with different phrasing or intonational strategies relative to native speakers (e.g., de la Cruz-Pavía & Elordieta, 2015; Fernández, 2005).

In the present study, we consider two prosodic effects that could impact pronoun interpretation in native speakers and L2 learners of Italian whose L1 is English: (i) contrastive stress, which necessarily affects only overt pronouns; (ii) a pause between clauses, which could affect interpretation of both types of pronouns. As our concern is with pronoun interpretation, and pronouns are canonically unstressed, we henceforth use the term *stress* to refer exclusively to contrastive stress.

In languages like English, the presence or absence of stress on a pronoun has been shown to influence interpretation (e.g., Akmajian & Jackendoff, 1970). As discussed by Grimshaw and Rosen (1990) and Samek-Lodovici (1996), English unstressed pronouns prefer an antecedent that is prominent in the discourse, typically a topic. Stressed pronouns, in contrast, prefer non-topic antecedents. The unstressed pronoun in (4a) sounds natural and is interpreted as referring to *Mary*, the discourse topic. However, in (4b), *John* is the discourse topic and an unstressed pronoun in the second sentence sounds unnatural. If the pronoun *she* is stressed, though, *Mary* becomes felicitous as the antecedent (examples from Grimshaw & Rosen, 1990). Stress thus signals a change in expectedness.

- (4) a. Mary went swimming with John. She dived in.
 b. John went swimming with Mary. She dived in.

Concerning null subject languages, Luján (1986) describes stress on a pronoun in Spanish as having an *overturning* effect, leading to a difference in interpretation from its unstressed counterpart; in a related vein, Montrul (2004) states that a stressed pronoun can refer to the sentence subject. For Italian, Carminati (2002, p. 320) proposes that the PAH does not hold for stressed pronouns (see also Sorace and Filiaci, 2006, footnote 12). In general, it seems that stress can result in an overturning effect, such that overt pronouns are no longer restricted to antecedents outside of SpecIP.

Evidence from production is consistent with stress as overturning. Gargiulo and colleagues examined effects of stress and pause on the production of overt pronouns in Italian (Gargiulo, 2020) and Swedish (Gargiulo et al., 2019). Participants first read a context, establishing the likely referent for a pronoun. They then read aloud a target sentence containing the pronoun (like the Italian example in (1)). For Italian, when the context established that the antecedent was the sentence subject (unexpected for overt pronouns), speakers produced greater prominence on the pronoun than when the antecedent was the complement. For Swedish, when the context established that the antecedent was the complement (unexpected for overt pronouns), speakers produced greater prominence on the pronoun than when the antecedent was the subject. In other words, the way that participants in these studies interpreted the contexts resulted in prosodic effects on their production of overt pronouns. We assume that English patterns like Swedish.

To summarize, in Italian, there is a three-way contrast, between null pronouns and unstressed and stressed overt pronouns. In English, there is a two-way contrast, between unstressed and stressed pronouns. Null pronouns in Italian and unstressed pronouns in English typically prefer antecedents that are subjects. Overt unstressed pronouns in Italian usually prefer

antecedents that are not subjects, in other words, complements. Stressing of overt pronouns in both languages can result in an overturning effect. In Italian, the overturning effect is at the expense of complements (resulting in an increase in subjects and/or external referents). In English, overturning is at the expense of subjects (leading to an increase in complements and/or external referents). These cross-language differences are summarized in Table 1.

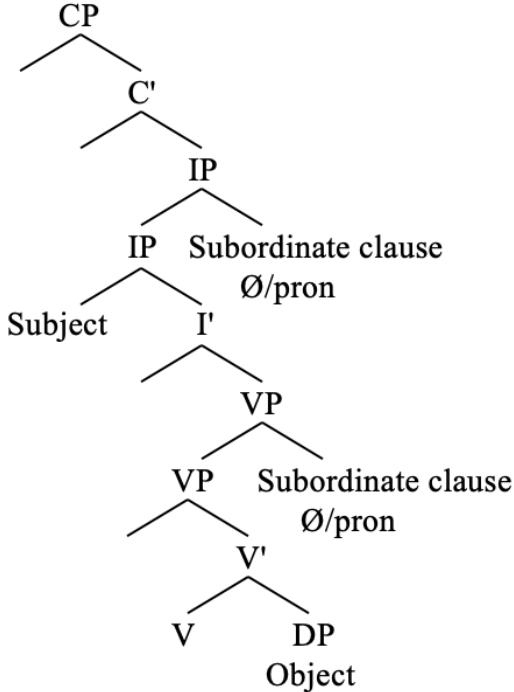
Table 1. Preferred antecedents for pronouns in Italian and English.

		Null pronoun	Overt pronoun	
			Unstressed	Stressed (overturning)
Italian	Subject	Complement	Increase in subject and/or external	
English	n/a	Subject	Increase in complement and/or external	

A second prosodic factor that may affect the interpretation of potentially ambiguous sentences is the presence of a clause-final pause. Building on Carminati (2002), we consider how the presence of a pause between clauses could impact anaphora resolution in Italian. Following the principles of Late Closure (Frazier, 1978) or Recency (Gibson et al., 1996), we assume that incoming clauses are generally attached to the clause currently being processed. This means that a subordinate clause following a main clause would normally attach low (to VP). However, Carminati (2002) observes that the attachment position of the subordinate clause can vary, affecting antecedent choice. Comparing conditional clauses starting with *se* ('if') and temporal clauses starting with *quando* ('when'), the former are more likely to allow a pause, suggesting to her that they attach high. In other words, the two types of subordinate clause are attached to different syntactic positions, either adjoined high (to IP) (i.e., *if* clauses) or low (to VP) (i.e., *when* clauses) (see (5), based on Carminati (2002, p. 80)). Carminati suggests that, when the clause attaches high, this will affect antecedent choices for null pronouns because the subordinate clause containing the pronoun is further away from the lower VP, so there will be

less inclination for a null pronoun to accept a closer non-subject as antecedent. In support of this, she found even more subject antecedent choices for null pronouns in *if* clauses than *when* clauses (89% vs. 76%).

(5) Attachment positions of subordinate clauses:



The finding of Sorace and colleagues (Belletti et al., 2007; Sorace & Filiaci, 2006) of a high incidence of complement antecedents for null pronouns by both native speakers and L2ers might be attributable to this closeness effect: without a pause between clauses, the subordinate clause is attached to the VP and so the null pronoun is closer to the complement. If so, a pause between clauses should lessen the closeness effect and lead to an increase in subject or external antecedent choices, on the assumption that a pause results in the clause being attached higher in the structure than it normally would be.

As for overt pronouns, contrary to Carminati (2002, p.81), we assume that a pause between clauses may affect the behaviour of these pronouns as well. That is, if the subordinate

clause is attached high, the overt pronoun will be (syntactically) further away from its expected antecedent within the lower VP. This may result in overturning, namely an increase in selection of a more accessible (closer) subject antecedent or an antecedent not mentioned in the discourse. Since stress already results in the same overturning effect (see Table 1), pause should not have an additional effect with stressed pronouns.

Results reported by Gargiulo (2020) are consistent with overturning effects for pause in Italian. When the context established that the intended antecedent for the overt pronoun was the sentence subject, speakers produced a longer pause between clauses than when the antecedent was the complement.

Turning to English, we are not aware of any research on the effects of pause on the interpretation or production of pronouns in the structure we are interested in. However, Jasinskaja et al. (2005) examined pronoun interpretation in longer discourse in German. They show that the effect of a long pause between sentences is to make the pronoun interpretation shift from the typical, closest antecedent to an antecedent further away in the discourse. This is consistent with the idea that pause has an overturning effect. Concerning production, Gargiulo et al. (2019) found that Swedish speakers produced a longer pause between clauses when the antecedent was the complement, again consistent with overturning. In the absence of relevant studies on effects of pause in English, we assume that it works like other Germanic languages.

Possibilities relating to pause in Italian and English are summarized in Table 2.

Table 2. Proposed effects of pause on pronoun resolution in Italian and English.

Null pronoun		Overt pronoun (overturning)		
	No pause	Pause	No pause	Pause
Italian	Subject	Increase in subject	Complement	Increase in subject and/or external
English	n/a	n/a	Subject	Increase in complement and/or external

The effects of stress and pause on anaphora resolution in L2 sentence interpretation have not, to our knowledge, been explicitly studied, with the exception of preliminary work on L2 Italian by White et al. (2017). Here, we propose that prosodic factors may come into play and affect pronoun resolution for both native speakers and L2ers. In particular, presence of stress on overt pronouns or presence of a pause between clauses may lead to judgments that differ from those anticipated if only the interface between syntax and discourse is considered.

2. Experiment

We report on an experiment on the Italian of native speakers as well as English-speaking L2ers, examining the effects of prosody—stress and pause—on the interpretation of null and overt pronouns.⁴

In earlier studies, it is impossible to discern the prosody assumed by participants because the tasks employed orthographically-presented stimuli that participants read to themselves (see,

⁴ The research programs under which this experiment was conducted have been reviewed by the Research Ethics Board of McGill University and are deemed to comply with the ethical standards expected for research with human subjects.

for example, (3) from Sorace & Filiaci, 2006).⁵ One might question whether prosody could be involved in the interpretation of sentences that are not presented auditorily. Precisely this has been proposed by Fodor (1998, 2002) who argues that *implicit prosody*, the prosody that individuals impose when reading, affects interpretation. Since implicit prosody cannot be directly examined, we control the prosodic profiles of our stimuli by means of auditory presentation, examining whether interpretations of null and overt pronouns vary in response to overtly signalled manipulations relating to stress and pause. If so, it is plausible to assume that effects of implicit prosody might be implicated in some of the results from earlier studies that involved silent reading.

2.1 Predictions

Our predictions are provided in (6)-(8). Prediction 1 (see (6)), which does not implicate prosody, is the same as that proposed by other researchers. In other words, it constitutes the default assumption. For the L2ers, this presupposes that participants are aware that Italian permits null subjects.

- (6) **Prediction 1:** The expected antecedent for a null pronoun is the subject; the expected antecedent for an overt pronoun is a complement within the VP.

The next two predictions reflect our position that there will be prosodic effects on pronoun interpretation in Italian, for both native speakers and L2ers. For the L2ers, this is

⁵ There have been occasional studies that have used auditory stimuli when testing participants on the kinds of sentences that we are concerned with. For example, Serratrice (2007) tested monolingual and bilingual Italian children on a picture verification task using auditory stimuli, presumably because of the age of the participants. However, prosody was not manipulated; we assume that the overt pronouns were always unstressed.

because stress and pause have prosodic effects in the L1 and because previous literature has shown that L2ers can use prosodic cues for disambiguation. However, the precise effects of stress and pause in the two languages differ, as shown in Tables 1 and 2. One question, then, is whether English speakers are sensitive to the interpretive differences associated with overturning in Italian, and whether sensitivity increases with proficiency.

Prediction 2 concerns stress; see (7). While unstressed pronouns will prefer complement antecedents (within the VP), as per Prediction 1 and consistent with the PAH, stress on a pronoun will result in an increase in other responses, either the subject as antecedent or an external referent not mentioned in the immediate linguistic discourse.

- (7) **Prediction 2: Stress.** The presence of stress will lead to an increase in the proportion of subject and/or external antecedents.

Our third prediction concerns pause and is given in (8).

- (8) **Prediction 3: Pause.** The presence of a pause between the main clause containing the antecedent and the subordinate clause containing the pronoun will lead to an increase in the proportion of subject and/or external antecedents for both null and overt pronouns.

When there is a pause between the main clause containing the antecedent and the subordinate clause containing the pronoun, the same effects for null and overt pronouns are expected but for different reasons. For null pronouns, an increase is predicted in the proportion of subject and/or external antecedents because a null pronoun is ‘further away’ from the competing antecedent within the VP. For overt pronouns, there will also be an increase in the proportion of subject and/or external antecedents because an overt pronoun is ‘further away’ from its preferred antecedent within the VP.

2.2 Sentence types

We first present the various sentence types, before describing the experiment in detail. Target items all involved forwards anaphora in intra-sentential contexts, with main-subordinate clause order, the most commonly tested sentence type in the literature. Representative examples are provided in (9a-b). The experiment followed a 6x6 Latin square design. We used six sentence sets; within each set, the vocabulary other than the names was the same. Three factors were manipulated in each set: type of pronoun (null/overt), overt pronouns manipulated by stress (unstressed/stressed), and presence or absence of pause (no pause/pause), yielding a total of six conditions and 36 target items per participant. Proper names were used for potential antecedents (half male, half female).⁶ All names were three syllables long with penultimate stress; they began with a consonant and ended with *-o* for male names and with *-a* for female names. Antecedents and corresponding pronouns within the same sentence were either both male or both female, and therefore potentially ambiguous, as shown in (9a-b). Half of the subordinate clauses were introduced by *quando* ('when'), as in (9a), and half by *dopo che* ('after'), as in (9b), thereby restricting the items to temporal clauses, in line with most previous experiments (e.g., Sorace & Filiaci, 2006), while also including some lexical variation in the design.⁷

⁶ One of the 36 target items had a disproportionately high rate of external responses and is excluded from further analysis. We believe that one of the proper names employed in this particular stimulus (*Calisto*) is likely responsible. *Calisto* is the least frequent of all the proper names in our stimuli. Participants may have avoided selecting this name, choosing *Fernando*, the external response, instead.

⁷ No credible statistical effect of subordinator (*quando* vs. *dopo che*) was found in the data.

- (9) a. Lorenzo ha scritto a Roberto (//) quando Ø/lui/LUI si è trasferito a Torino.

‘Lorenzo wrote to Roberto (//) when (he) moved to Turin.’

- b. Marisa è diventata amica di Delfina (//) dopo che Ø/lei/LEI ha divorziato.

‘Marisa became friends with Delfina (//) after (she) got divorced.’

Stimuli were recorded by a female native speaker of Italian, taking account of the prosodic factors under consideration. In conditions involving stressed pronouns, stress was cued via higher pitch peaks, increased duration, and greater intensity relative to unstressed pronouns. In conditions involving a pause, pause length was fixed to ensure that there was no question as to whether or not a given sentence contained a pause; the duration of the pause was set to approximately 400ms, the average pause duration in the naturally produced stimuli. Figures 2 and 3 show how stress and pause were manipulated in our stimuli. In the figures, the lines in the spectrogram correspond to pitch movements. Segmentation in the figures mostly respects phonological domains—pronouns are annotated separately to highlight their duration and pitch profiles when stressed.

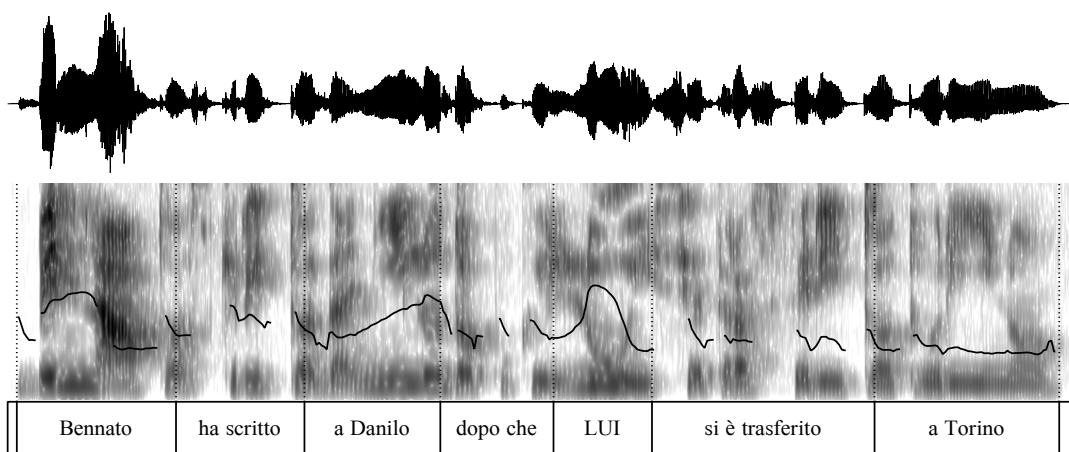


Figure 2. Example of test item with a stressed pronoun and no pause.

(Translation: ‘Bennato wrote to Danilo after HE went to Turin’.)

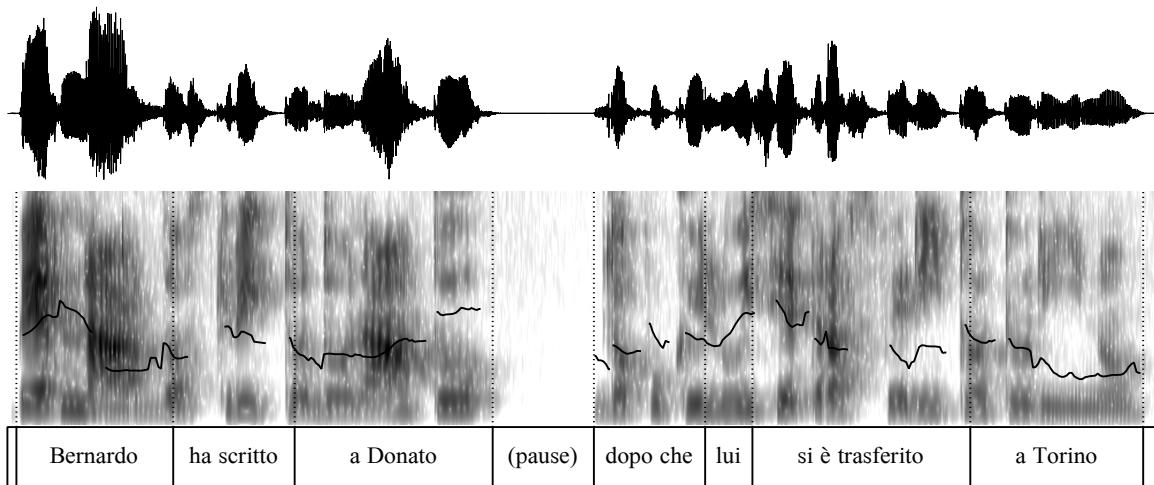


Figure 3: Example of test item with an unstressed pronoun and pause.

(Translation: ‘Bernardo wrote to Donato // after he went to Turin’.)

There were 24 fillers. Twelve of these were gender mismatch controls involving forwards anaphora with main-subordinate clause order, with unstressed overt pronouns which were disambiguated by the gender of the proper names (e.g., *Gustavo ha telefonato a Clarissa quando lui era in ufficio* ‘Gustavo phoned Clarissa when he was in the office’). These were included to ensure that participants were on task. The other 12 were sentences involving backwards anaphora with unstressed overt pronouns in main-subordinate clause order (e.g., *Lei era in ufficio, quando Carlotta ha telefonato a Susanna* ‘She was in the office, when Carlotta phoned Susanna’). A sentence-internal referent for the pronoun in the main clause is ungrammatical in both Italian and English in such sentences (a Condition C violation, Chomsky, 1981), so these sentences provide an indication of the extent to which participants choose an external referent when this is the only grammatical option. Finally, there were 18 distractors, which were potentially ambiguous sentences containing relative clauses; performance on these distractors is not discussed.

2.3 Participants

Participants were 22 English-speaking learners of Italian and 19 native speakers. Participants ranged in age from 19–46. All learners had been exposed to Italian oral language in classroom and/or naturalistic settings and, at the time of testing, listened to Italian (spoken in the media, by friends or co-workers, etc.) for 1–50 hours per week.

The 22 learners were divided into two proficiency levels, lower ($n=9$) and higher ($n=13$).⁸ Proficiency was established using the Italian Placement Test from the Oxford University Language Centre (<https://www.lang.ox.ac.uk/assess-my-level>), a 50-question forced choice cloze test that probes understanding of morphology and syntax.⁹

All participants completed a background questionnaire, which solicited basic demographic and language history information. Exclusionary criteria included the following: Participants had to have normal hearing and no chronic ear infections as children. Participants who reported higher than intermediate proficiency in another null subject language were excluded, given reports in the literature that null subject languages can vary in how they treat pronoun interpretation (e.g., Contemori & Di Domenico, 2021). L2ers had to have acquired Italian after the age of 10 and before the age of 50.¹⁰

⁸ With respect to the sample size, in section 2.5, we employ Bayesian data analysis which has been shown to be appropriate for small sample sizes (see discussion in Garcia (2023) and references therein).

⁹ Participants with a score <21 were categorized as ‘lower’ and those ≥ 21 as ‘higher, based on proficiency levels used by the Oxford University Language Centre.

¹⁰ In addition to the participants listed above, three native speakers and three learners were excluded due to advanced proficiency in another null subject language. Fourteen additional learners were excluded for the following reasons: age of onset of Italian ($n=4$); L1s other than English ($n=3$); technical difficulties ($n=2$); experimenter error ($n=2$); acquisition of Italian using online sources with limited naturalistic input ($n=3$).

2.4 Procedure

The experiment was conducted online, using Alchemer (<https://www.alchemer.com/>). The procedure is detailed in (10). Participants first read a context sentence on the computer screen, which introduced the two people to be named in the test sentence as well as another person (external referent). After a beep followed by a 1000ms pause, they heard the test sentence, following which they had to make a choice, indicating which person (subject, complement, external) was their preferred interpretation for the pronoun. The main experiment was preceded by three practice items to familiarize participants with the procedure.

The context sentence was written rather than presented aurally so that it would not bias participants' interpretation of the prosodic patterns present in the target sentence; providing it in auditory form could also tax listeners' working memory capacity. The order of names in the written context was systematically varied among the three possible referent types (subject, complement, external) in the subsequent test item. (This ordering had no effect on the results and will not be discussed further.) Order of names in the written context and choices matched, but the order of presentation of the names in the test sentences was systematically varied across items.

(10) Example test item (note that the English translations were not provided):

Written context (on screen)	Rebecca, Clarissa e Delfina stanno lavorando insieme a un progetto. 'Rebecca, Clarissa and Delfina are working on a project together.'
--------------------------------	---

Test sentence (audio)	Delfina ha telefonato a Rebecca, quando Ø era in ufficio. 'Delfina telephoned Rebecca when (she) was in the office'
-----------------------	--

Question (on screen)	Chi era in ufficio? 'Who was in the office?'
----------------------	---

Choices (on screen)	Rebecca, Clarissa, Delfina
---------------------	----------------------------

The procedure in (10) builds on the methodology used in earlier experiments (e.g., Sorace & Filiaci, 2006). The main differences are the auditory presentation of stimuli and the presence of an extra person explicitly introduced into the linguistic discourse (rather than in a picture). In addition, unlike in earlier experiments, participants were not allowed to provide more than one answer, as we were testing for the preferred interpretation rather than knowledge of ambiguity.

2.5 Results and analysis

In this section, we first report on the main results, followed by the fillers. We visually explore the patterns in our data, then present the statistical results of our models.

We begin by considering antecedent choices for null and overt pronouns independent of prosodic factors. As can be seen in Figure 4, subject antecedents are the predominant choice for null pronouns for all participants. For overt pronouns, the predominant response is a complement antecedent for native speakers (NS) and L2ers with higher proficiency. These results are consistent with the earlier literature and thus support prediction 1 (see (6)). The lower proficiency learners, however, do not distinguish between their choices of subject and complement antecedents for overt pronouns. These results are statistically confirmed in the models below.

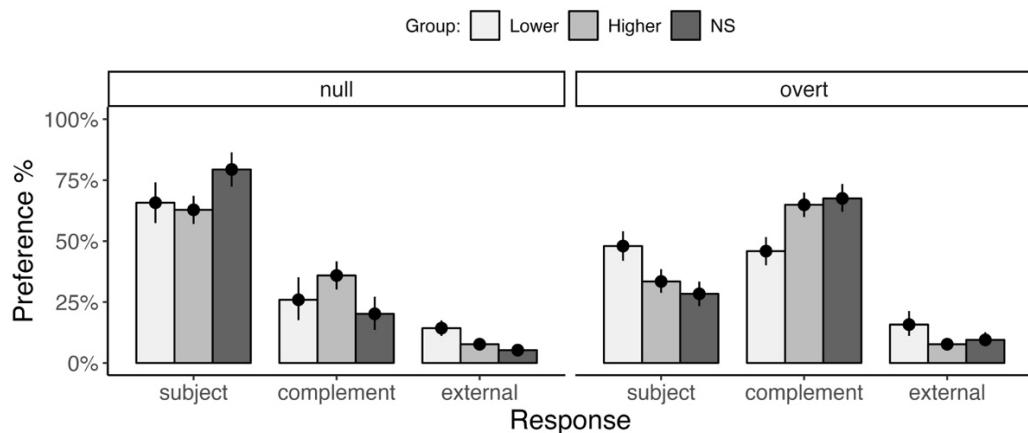


Figure 4. Mean preference for each response by pronoun and group, with associated 95% bootstrapped confidence intervals (across items).

Choices relating to the prosodic effects in the target sentences are shown in Figure 5, where we include pronoun type, stress (in the case of overt pronouns), and pause. Comparing the upper and lower panes (i.e., no pause vs. pause), we see that the patterns are overall similar, suggesting that pause does not play a role in the response patterns in our data, contrary to prediction 3 (see (8)); this is confirmed in the statistical models examined below.

Turning to the effects of stress, we observe some potential differences between the unstressed and stressed conditions, consistent with prediction 2 (see (7)). For example, as we move from unstressed to stressed, native speakers' preference for complement responses decreases while their preference for subject and external responses increases. However, the L2ers behave differently. The presence of stress results in an increase in the choice of external responses and a decrease in subject responses. Within L2ers, we also note potential effects of proficiency.

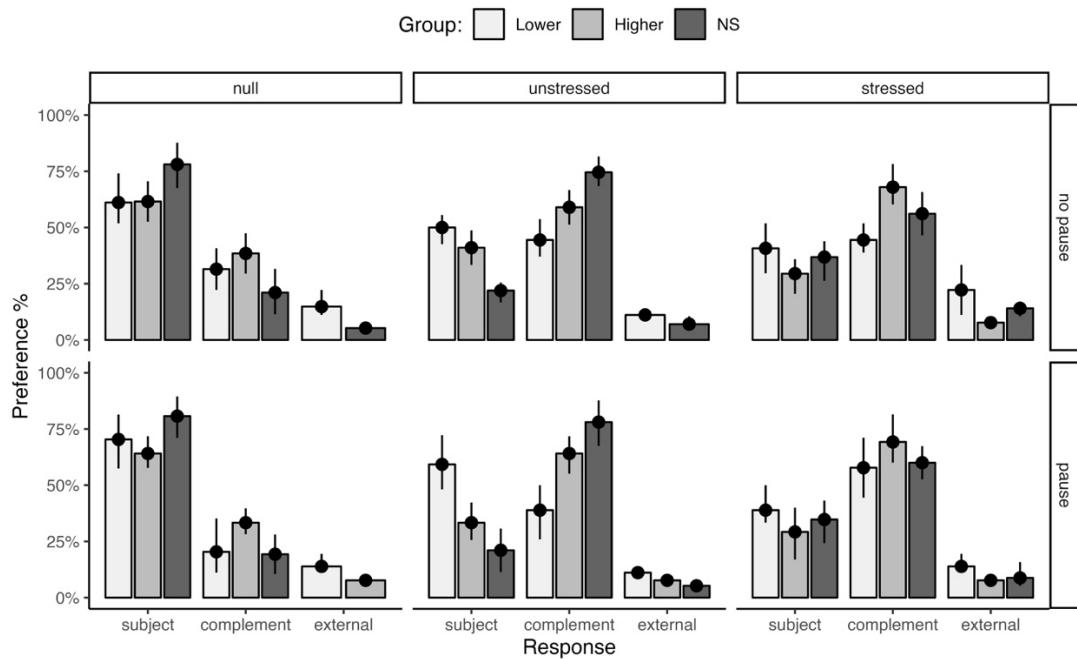


Figure 5. Mean preference for each response by pronoun/stress, pause and group, with associated 95% bootstrapped confidence intervals (across items).

Given that our experiment offered three response options, the data above were analysed with two Bayesian hierarchical multinomial regressions with by-item random intercepts and by-participant random slopes (for both stress and pause) and intercepts. The models were run using Stan (Carpenter et al., 2017) in R (R Core Team, 2023) using the brms package (Bürkner, 2021). Both the model for the native speakers and the model for the L2ers included stress and pause as main effects. The model for the L2ers also included proficiency as a main effect. A model with interacting terms was not statistically superior to one without interacting terms, so we only report the latter. Models included default weakly informative priors, four chains, and 10,000 iterations. \hat{R} was checked for all predictors, as were the effective sample sizes (the lowest value being above 5,000), and chains were visually inspected for convergence.

In the figures below, we visually report the models' estimates accompanied by means (dark grey lines), 50% (light grey areas) and 90% (remainder of the distribution) density intervals, also known as highest density interval (HDI). Unlike traditional Frequentist models, in Bayesian models each predictor yields a complete posterior distribution of effect sizes given the data. For that reason, it is often more intuitive to inspect results in a figure rather than in a statistical table with single point estimates as in Frequentist models. To interpret each posterior distribution, note that complement responses represent the reference level (no pause and unstressed being the reference levels for the pause and stress variables, respectively).

A distribution that does not cross zero (vertical line) provides strong statistical evidence for a given effect. However, if a distribution does include zero, it is essential to inspect where in the distribution zero is located; as we will see, zero may be at the tail of a given posterior distribution (predictors with an * in the discussion below). For example, the distribution for *subject-pause* in Figure 6 (native speaker model) is centred around zero. This indicates that we have no evidence for a main effect of pause in choosing subject responses (vs. complement responses, our reference level) for the native speakers.

As is expected from any multinomial model (Frequentist or Bayesian), the models discussed here contain two intercepts (*subject intercept* and *external intercept*) as a result of our

three response categories. In the native speaker model shown in Figure 6, both intercepts have a completely negative distribution, which means that both subject and external responses are dispreferred (vs. complement responses) when all other predictors are set to zero, that is, when we meet the conditions no pause and unstressed overt pronouns.

We can see in Figure 6 that we have positive effects (i.e., positive distributions) for three predictors, namely *subject-null*, *subject-stressed*, and *external-stressed**. Simply put, this means that null pronouns increase the probability of choosing subject (vs. complement) responses; stress increases the probability of choosing subject (vs. complement) responses; and stress increases the probability of choosing external (vs. complement) responses. Finally, we see two (mostly) negative distributions, namely *external-null** and *external-pause**. Both effects compare external to complement responses, so we can see that a pause reduces the probability of choosing external responses, as does the presence of a null pronoun (vs. an unstressed overt pronoun). It should be noted that some of these distributions (represented with an asterisk above) do contain zero. As a result, we cannot categorically conclude that these effects are statistically credible, but given that zero is at the tail of the distributions, the effect in question (positive or negative) is much more likely than the absence thereof.

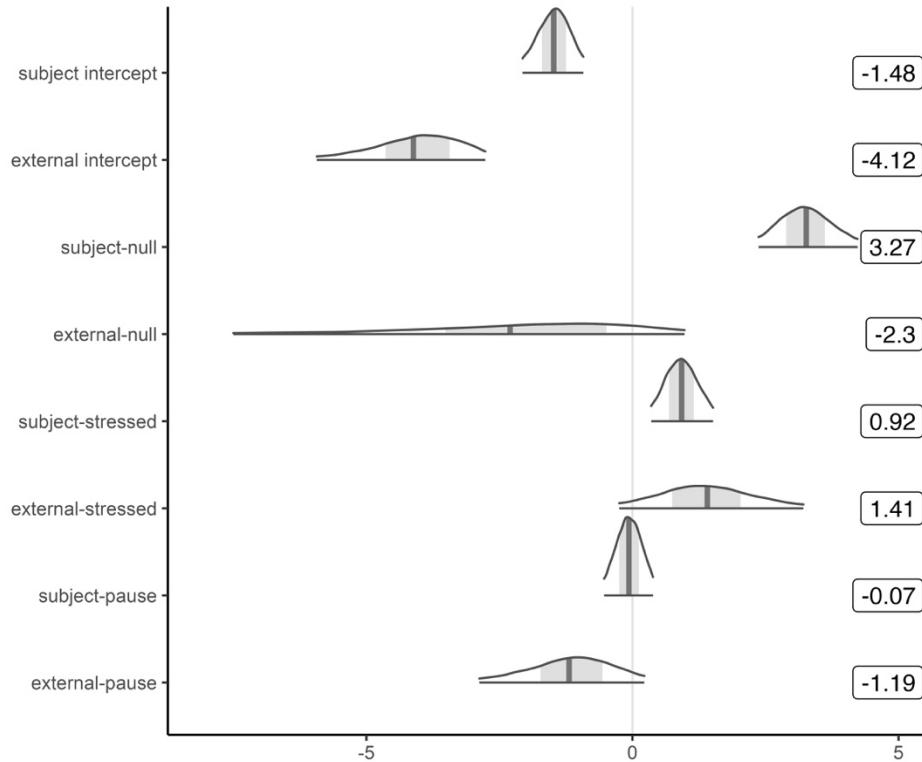


Figure 6. Posterior distributions of effect sizes (in log-odds) for each predictor in the model for native speakers.

(Note: Shaded grey areas represent the 50% most probable coefficient values given the data.
Mean effect sizes are provided on the right.)

We turn now to the L2ers' model, shown in Figure 7. Only one of our two intercepts has a reliable effect, namely *external-intercept*. This shows that lower proficiency L2ers (lower = reference level for proficiency) favour complement over external responses when we examine unstressed overt pronouns in the no pause condition. A similar trend is observed in the model for native speakers shown in Figure 6, where the posterior distribution in question is also completely negative. As we go down the posterior distributions in Figure 7, we observe effects of pronoun (*subject-null*), whereby a null pronoun increases the probability of choosing subject responses (vs. complement); this effect goes in the same direction as that observed in Figure 6 for the native speakers. There is also an effect of stress (*subject-stressed*), whereby stress reduces the

probability of choosing subject responses (vs. complement); this effect goes in the opposite direction of the effect observed for the native speakers in Figure 6, where the posterior distribution of *subject-stressed* is completely positive. Finally, we observe an effect of proficiency (*subject-higher* and *external-higher*), which shows that higher proficiency L2ers (vs. lower proficiency L2ers) are less likely to choose subject and external responses relative to complement responses. It should also be noted that one additional effect, *external-null*, shows an overwhelmingly positive distribution (cf. Figure 6), even though zero is found within the 90% highest density interval. This means that external responses are more probable than complement responses in the presence of a null pronoun (vs. an unstressed overt pronoun).

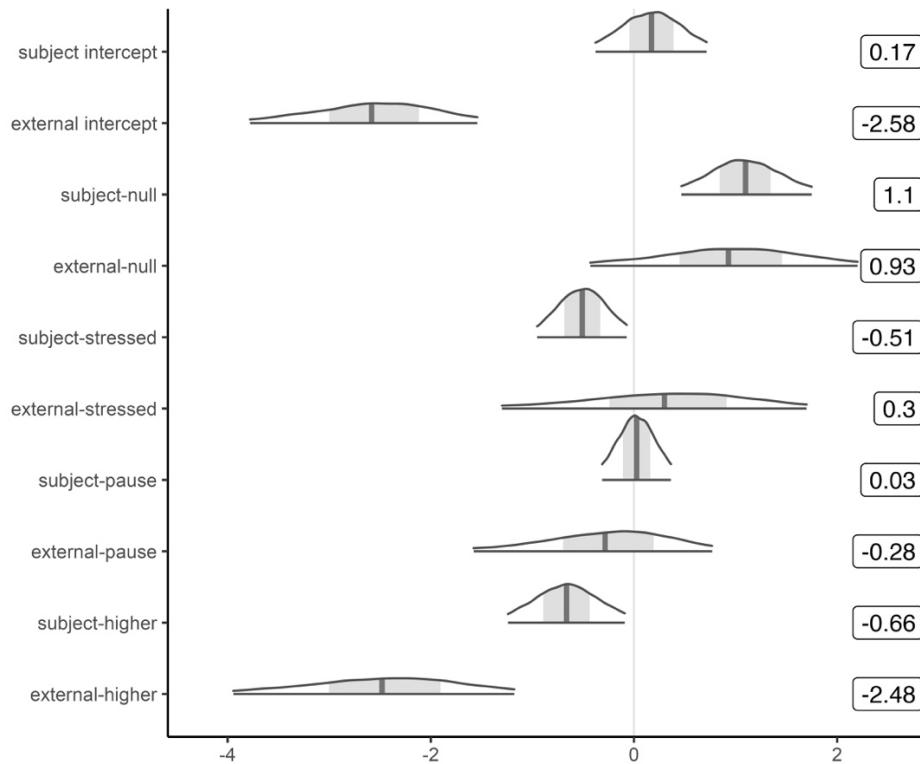


Figure 7. Posterior distributions of effect sizes (in log-odds) for each predictor in the model for L2ers.

(Note: Shaded grey areas represent the 50% most probable coefficient values given the data.
Mean effect sizes are provided on the right.)

Turning now to the two sentence types that were included as fillers, recall that there were 12 unambiguous sentences where gender determined the choice for sentence-internal antecedents. Results from these sentences are shown in Figure 8. All participants were very accurate, almost at ceiling, in choice of antecedents in these cases, for both subjects and complements, indicating that they were on task; they did not have any problem with the structure being investigated and they were familiar with the gender of the names used in the task.¹¹ Unsurprisingly, the patterns from Figure 8 are confirmed by an intercept-only hierarchical logistic regression with by-item and by-participant random intercepts ($\hat{\beta} = 4.43$, 90% HDI = [3.21, 5.61]).

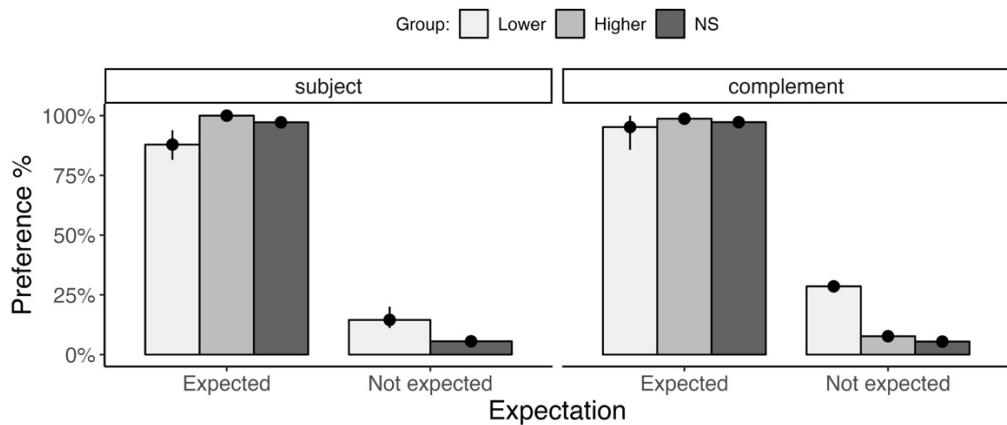


Figure 8. Accuracy in antecedent choice for sentences disambiguated by gender.

There were also 12 fillers involving backwards anaphora, where the pronoun was the subject of the main clause (e.g., *Lei era in ufficio, quando Carlotta ha telefonato a Susanna* ‘She was in the office, when Carlotta phoned Susanna’). In such cases, the expected response is to choose an external antecedent. Results from these fillers are shown in Figure 9. It can be seen that all three groups choose external antecedents to a much greater extent than they did for the target items (Figures 4 and 5); in other words, the external antecedent is indeed a possible choice

¹¹ There were very few external responses for these sentences (9 out of 228, or < 4%).

for them in principle. For the native speakers and the higher proficiency learners, choice of external antecedents was higher than for the other antecedent types. For the lower proficiency group, though, there was little difference in their choices of different types of antecedents.

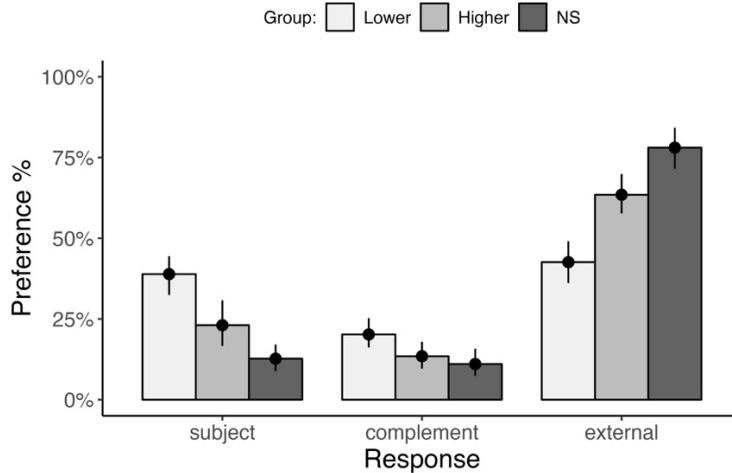


Figure 9. Antecedent choice for backwards anaphora sentences.

To analyse the data from Figure 9, we ran the same type of model used for the main results discussed above. We combine both native speakers and L2ers in a single model that includes a main effect of proficiency as well as by-participant and by-item random intercepts. This time, we use external responses and native speakers as our reference levels for responses and proficiency, respectively, to confirm that both subject and complement responses are less likely for the fillers in question. In this model, thus, our two intercepts represent the log-odds of choosing subject (vs. external) and complement (vs. external) by native speakers. Both intercepts are negative ($\hat{\beta} = -2.90$; $90\% HDI = [-4.38, -1.61]$; $\hat{\beta} = -3.24$, $90\% HDI = [-4.78, -1.97]$), which is consistent with what we see in Figure 9; native speakers choose external much more often than subject or complement responses, with higher proficiency learners trending in the same direction.

To summarize the results, the difference between choice of null and overt pronoun was statistically confirmed for the native speakers and L2ers. As for the prosodic factors we

examined, there were effects of stress: overturning was found, although it differed between the native speakers and L2ers. There were no categorical effects of pause, although the native speaker model does present a posterior distribution that is mostly negative for external responses (vs. complement).

3. Discussion

We have presented results from an experiment designed to investigate potential prosodic effects relating to stress and pause on pronoun interpretation in Italian. Results from our models showed a preference for subject antecedents for null pronouns and complement antecedents for overt pronouns, in line with prediction 1, for the native speakers and higher proficiency L2ers. However, this result is independent of the prosodic manipulation of our test items, and simply provides further confirmation of results already reported in the literature.¹² The lower proficiency group showed a similarly high preference for subject antecedents in the case of null pronouns, whereas their preferences in the case of overt pronouns were equally divided between subjects and complements (Figure 4). As noted in the Introduction, this pattern is in fact the one found in Spanish (e.g., Alonso-Ovalle et al., 2002; Contemori & Di Domenico, 2021; Jegerski et al., 2011). This result cannot be attributed to knowledge of Spanish since we specifically excluded participants who had knowledge of null subject languages other than Italian, precisely because of microvariation of this type. One possibility, then, is that this reflects the kind of situation

¹² However, recall from the Introduction that Sorace and Filiaci (2006) report an unexpectedly high selection of complement antecedents for null pronouns by both L2ers and native speakers (~50%) (see also Belletti et al., 2007). Our results do not replicate this finding. One possible reason for this is differences in task design: Sorace and colleagues, in contrast to Carminati (2002) and our own study, allowed participants to choose more than one response for each test item. This may have led to an increase in the types of antecedents selected for null pronouns.

reported elsewhere in the literature where learners arrive at an analysis that is neither that of the L1 nor that of the L2 but is, instead, that of some other language (e.g., Finer & Broselow, 1986; Schwartz & Sprouse, 1994). Another possibility is that these choices reflect L1 transfer, since in English an overt pronoun must be able to take either type of antecedent.

Turning now to prosodic effects, one prosodic effect that we manipulated was stress. According to prediction 2, the addition of stress to an overt pronoun would have an overturning effect, such that the preference for complement antecedents would be reduced and the alternatives, subjects and external antecedents, correspondingly increased. Stress proved to be statistically relevant for native speakers and L2ers. Interestingly, the choice of alternative antecedent differed between the groups. The native speakers increased their choice of subject antecedents with stressed pronouns, while the L2ers increased their choice of external antecedents but not subject antecedents, in fact reducing these. Thus, although stress has an overturning effect for both groups, the realization of such overturning differs.

The finding that the L2ers' choices of complement antecedents did not show a decrease may be attributable to L1 transfer since stress in English can result in an increase in preference for complement antecedents (Table 2). This suggestion is also supported by the finding that subject antecedent choices decreased with stress, as would be the case for native English. Overturning, then, resulted in an increase in external antecedent choices rather than subject choices. In other words, even though the L2ers were sensitive to the overturning effects of stress, the precise effects of stress in the L2 have yet to be acquired. These results, then, suggest that the PTH is relevant in domains beyond the level of the word and phrase, consistent with the findings of Liu and Lee (2022) relating to prosodic transfer in the production of English focus marking.

The other prosodic effect that we manipulated was presence or absence of a pause between clauses. Here, we predicted an increase in the proportion of subject or external antecedents (prediction 3): in both cases, the presumed effect of a pause would be to adjoin the subordinate clause higher in the structure, such that the pronoun would be further away from its typical potential antecedent. As noted in the results, pause was not significant for the L2ers or the

native speakers. A possible explanation for the absence of effects is that the clause is followed by a subordinator (*quando* ‘when’, *dopo che* ‘after’), leading participants to infer the existence of a break after the first clause. Thus, manipulating pause duration does not make a difference in how these sentences are interpreted. This is also consistent with observations from earlier experiments on Italian native speakers involving written stimuli. In the sentences reported in Filiaci (2002, 2010), there is always a comma between the two clauses, regardless of the type of pronoun involved. As already mentioned, effects of pause in production have been reported for the same kinds of sentences for native speakers of Italian and Swedish, with a pause signalling a shift away from the expected antecedent (Gargiulo, 2020; Gargiulo et al., 2019). We suggest that the reason why effects of pause are observed in production rather than interpretation is that the speaker has control over the utterance in the former situation and is, thus, able to indicate the intended interpretation to the hearer.

This is not to say that pause never has an effect on interpretation. In contrast to the results reported here, in a study on relative clause ambiguity resolution, Goad et al. (2021) did find that the location of a pause in sentences like those in (9) led to significant effects on interpretation:

- (9) a. The bartender served the cheerful outgoing cousin // of the actor that ate peanuts.
- b. The bartender served the cousin // of the cheerful outgoing actor that ate peanuts.

In such cases, it seems less likely that participants would be anticipating a break in one location or the other and this is confirmed by the fact that, in writing, a comma would not be found where the pause is located and, indeed, would be unnatural.

Another issue relates to choice of external antecedents which, in earlier research, has been found to be quite low. We added written contexts, in the hope that providing a context in the linguistic discourse would lead to an increase in external responses. The contexts introduced three characters, one of whom would be the subject of the main verb in the sentence they were about to hear, one the complement, and one not mentioned (the external referent). As it turned

out, choices of external referents were relatively low overall (similar to findings reported by Sorace and colleagues who presented a third character in pictures; see Figure 1). Although external referents were sometimes chosen by our L2 participants in conditions involving stress, it is not clear how much the contexts contributed to these choices. Failure to choose external referents may reflect the observation that it is more natural to assume that the referent will be within the closest spoken discourse, that is, in the sentence itself (Carminati, 2002). The results from our stimuli involving backwards anaphora show that native speakers and higher proficiency L2ers generally do not make such an assumption when the grammar does not permit it.

However, the backwards anaphora results are themselves somewhat puzzling. These sentences are ungrammatical with an internal antecedent. As reported above, for the native speakers, choice of external antecedents was only around 75% and for the L2ers, it was lower. One possibility is that this is a task effect. It could be related to the fact that the majority of test items for pronoun interpretation (80%) involved forwards anaphora, where subject or complement responses were preferable. In addition, as pointed out by a reviewer, the discourse context provided the three potential referents visually (in a written sentence)—participants may have found it difficult to switch from auditory memory to visual memory to recall who the third person (not mentioned in the sentence) was.

Alternatively, the relatively high rate of syntactic violations may relate to the aurally presented stimuli. The pronoun in the stimuli involving backwards anaphora was never stressed. We expect that stress is likely the most natural intonation for cases where the pronoun can only have an external antecedent and this merits further exploration. Furthermore, in constructions involving anaphora, the parser must initiate a search for the antecedent of the pronoun, having to keep the pronoun and the syntactic structure in working memory. With aurally presented stimuli, participants cannot backtrack to potentially rebuild the syntactic representation. In the absence of stress on the pronoun, it may be harder to keep track, resulting in Principle C violations. The fact that for the L2ers the choice of external antecedents was lower than for native speakers is in line with the idea that bilinguals typically have syntactic representations that are less strongly

activated in their less dominant language (Abutalebi et al., 2011; Green, 1986). This may have made it more challenging for L2 learners, especially those in the lower proficiency group, to keep track of syntactic constraints.

Finally, we suggest some possible lines of further research. One important question raised by our results is what the precise effects of stress and pause would be on the equivalent structures in English, the L1 of our participants. As already indicated, the literature contains some discussion of the effects of English stress in general and of the effects of pause in the production of other Germanic languages but more needs to be done in this area.

Another issue concerns proficiency. We have seen that both L2 groups show evidence of overturning effects of stress but that the overturning is not the same as it is for native speakers (L2ers increase choices of external antecedents; native speakers increase choices of subject antecedents), which we have suggested may be an L1 effect. One question, then, is how more advanced learners and near native speakers would perform. Sorace and colleagues argue that even near native speakers do not fully master properties at the syntax-discourse interface. Here, we have been looking at cases where prosody interfaces with syntax and discourse. It is an open question as to whether this remains subject to L1 influence.

A third issue relates to methodology. As described in the results, while there were no categorical effects for pause, the native speaker model does suggest an effect. Perhaps a different type of task is required in order to further explore the effects of pause on interpretation in the structures that we have been considering. Our task is somewhat metalinguistic and alternative designs might provide additional insights. One way round this might be to use the kind of task developed by Gargiulo for production but to convert it into a task involving interpretation. White et al. (2017) developed a task along these lines where participants did not themselves have to indicate their preferred antecedents; instead, they had to comment on someone else's interpretation of the sentences. However, these authors report that participants found the task quite difficult, so further work would be appropriate.

4. Conclusion

In sum, we have found prosodic effects in L1 and L2 Italian. The effects were limited to stress. For the native speakers, they were in the predicted direction, that is, an increase in choice of subject antecedents. For the L2ers, stress showed effects potentially attributable to the L1, with a reduction in subject antecedents. In the context of the Prosodic Transfer Hypothesis, which demonstrates transfer for word- and phrase-level prosody (e.g., Austin et al., 2022; Goad & White, 2019, 2024), our results point to the possibility that prosodic transfer is also found at the sentence level.

In conclusion, in this paper we have argued that investigations of pronoun interpretation should include consideration of prosodic factors in addition to syntactic and discourse constraints. We have demonstrated that prosody plays a role, in that stressing an overt pronoun in Italian can lead to an adjustment in interpretation, for both native speakers and L2ers. This work contributes to recent research which shows that prosody impinges on L2 sentence interpretation in contexts where the syntax is ambiguous.

Acknowledgements

We would like to thank Carlotta Lega and Simone Riva for help with recording of the Italian stimuli, Francie Freedman, Olivia Hyun and Marta Pogaccini for participant testing and Sepideh Mortazavinia for her participation in earlier aspects of this research. This work was supported by grants from the Social Sciences and Humanities Research Council of Canada and le Fonds de recherche du Québec – Société et culture.

References

- Abutalebi, J., Della Rosa, P. A., Green, D.W., Hernandez, M., Scifo, P., Keim, R., Cappa, S. F., & Costa, A. (2011). Bilingualism tunes the anterior cingulate cortex for conflict monitoring. *Cerebral Cortex*, 22, 2076–2086.
- Akmajian, A., & Jackendoff, R. (1970). Coreferentiality and stress. *Linguistic Inquiry*, 1, 124–126.
- Alonso-Ovalle, L., Fernández-Solera, S., Frazier, L., & Clifton, C. (2002). Null vs. overt pronouns and the topic-focus articulation in Spanish. *Italian Journal of Linguistics*, 14, 151–170.
- Austin, G., Chang, H., Kim, N., & Daly, E. (2022). Prosodic transfer across constructions and domains in L2 inflectional morphology. *Linguistic Approaches to Bilingualism*, 12, 657–686.
- Belletti, A., Bennati, E., & Sorace, A. (2007). Theoretical and developmental issues in the syntax of subjects: Evidence from near-native Italian. *Natural Language & Linguistic Theory*, 25, 657–689.
- Bürkner, P.-C. (2021). Bayesian item response modeling in R with brms and Stan. *Journal of Statistical Software*, 100, 1–54.
- Calabrese, A. (1986). Pronomina: Some properties of the Italian pronominal system. *MIT Working Papers in Linguistics*, 8, 1–46.
- Carminati, M. N. (2002). *The processing of Italian subject pronouns*. PhD dissertation, University of Massachusetts Amherst.
- Carpenter, B., Gelman, A., Hoffman, M. D., Lee, D., Goodrich, B., Betancourt, M., Brubaker, M., Guo, J., Li, P., Riddell, A. (2017). Stan: A probabilistic programming language. *Journal of Statistical Software*, 76, 1–32.
- Chomsky, N. (1981). *Lectures on government and binding*. Foris.

- Contemori, C., & Di Domenico, E. (2021). Microvariation in the division of labor between null- and overt-subject pronouns: The case of Italian and Spanish. *Applied Psycholinguistics*, 42, 997–1028.
- Dekydtspotter, L., Donaldson, B., Edmonds, A. C., Liljestrand Fultz, A., & Petrush, R. A. (2008). Syntactic and prosodic computations in the resolution of relative clause attachment ambiguity by English-French learners. *Studies in Second Language Acquisition*, 30, 453–480.
- de la Cruz-Pavía, I., & Elordieta, G. (2015). Prosodic phrasing of relative clauses with two possible antecedents in Spanish: A comparison of Spanish native speakers and L1 Basque bilingual speakers. *Folia Linguistica*, 49, 185–204.
- Fernández, E. M. (2005). The prosody produced by Spanish-English bilinguals: A preliminary investigation and implications for sentence processing. *Revista da ABRALIN*, 4, 109–141.
- Filiaci, F. (2002). The acquisition of the properties of Italian null and overt subjects by English native speakers. MSc thesis, University of Edinburgh.
- Filiaci, F. (2010). Null and overt subject biases in Spanish and Italian: A cross-linguistic comparison. In C. Borgonovo, M. Español-Echevarría & P. Prévost (Eds.), *Selected Proceedings of the 12th Hispanic Linguistics Symposium* (pp. 171–182). Cascadilla Press.
- Finer, D., & Broselow, E. (1986). Second language acquisition of reflexive-binding. *Proceedings of NELS 16*, University of Massachusetts at Amherst.
- Fodor, J. D. (1998). Learning to parse? *Journal of Psycholinguistic Research*, 27, 285–319.
- Fodor, J. D. (2002). Prosodic disambiguation in silent reading. In M. Hirotani (Ed.), *Proceedings of NELS 32* (pp. 113–132). Amherst, MA: GLSA.
- Frazier, L. (1978). *On comprehending sentences: Syntactic parsing strategies*. PhD dissertation, University of Connecticut.
- Garcia, G. D. (2023). Statistical modelling in L3/Ln acquisition. In J. Cabrelli, A. Chaouch-Orozco, J. González Alonso, S. M. Pereira Soares, E. Puig-Mayenco, & J. Rothman

- (Eds.), *Cambridge Handbook of Third Language Acquisition* (pp. 744–770). Cambridge University Press.
- Gargiulo, C. (2020). *On L1 attrition and prosody in pronominal anaphora resolution*. PhD dissertation, Lund University.
- Gargiulo, C., Tronnier, M., & Bernardini, P. (2019). The role of prosody in overt pronoun resolution in a null subject language and in a non-null subject language: A production study. *Glossa*, 4, 135. 1–21.
- Gibson, E., Pearlmuter, N., Canseco-Gonzalez, E., & Hickok, G. (1996). Recency preference in the human sentence processing mechanism. *Cognition*, 59, 23–59.
- Goad, H., Guzzo, N. Brambatti, & White, L. (2021). Parsing ambiguous relative clauses in L2 English: Learner sensitivity to prosodic cues. *Studies in Second Language Acquisition*, 43, 83–108.
- Goad, H., & White, L. (2019). Prosodic effects on L2 grammars. *Linguistic Approaches to Bilingualism*, 9, 769–808.
- Goad, H., & White, L. (2024). The syntax-phonology interface. In T. Ionin, S. Montrul & R. Slabakova (Eds.), *The Routledge handbook of second language acquisition, morphosyntax, and semantics*. Routledge.
- Green, D. W. (1986). Control, activation, and resource: A framework and a model for the control of speech in bilinguals. *Brain and Language*, 27, 210–223.
- Grimshaw, J., & Rosen, S. (1990). Knowledge and obedience: The developmental status of the binding theory. *Linguistic Inquiry*, 21, 187–222.
- Jackson, C., & O'Brien, M. G. (2011). The interaction between prosody and meaning on second language speech production. *Die Unterrichtspraxis/Teaching German*, 44, 1–11.
- Jaeggli, O. (1982). *Topics in Romance syntax*. Foris.
- Jasinskaja, E., Kölsch, U., & Mayer, J. (2005). Global prosodic parameters and anaphora resolution. In C. Auran, R. Bertrand, C. Chanet, A. Colas, A. Di Cristo, C. Portes, A.

- Reynier, & M. Vion (Eds.), *Proceedings of the International Symposium on Discourse-Prosody Interfaces*. Aix-en-Provence, France.
- Jegerski, J., Van Patten, B., & Keating, G. (2011). Cross-linguistic variation and the acquisition of pronominal reference in L2 Spanish. *Second Language Research*, 27, 481–507.
- Jun, S-A. (2003). Prosodic phrasing and attachment preferences. *Journal of Psycholinguistic Research*, 32, 219–249.
- Kraš, T. (2008). Anaphora resolution in near-native Italian grammars: Evidence from native speakers of Croatian. In S. Liszka, P. Leclercq, M. Tellier & D. Véronique (Eds.), *EUROSLA Yearbook 8* (pp. 107–134). John Benjamins.
- Liceras, J. (1988). Syntax and stylistics: More on the pro-drop parameter. In J. Pankhurst, M. Sharwood Smith & P. Van Buren (Eds.), *Learnability and second languages: A book of readings* (pp. 71–93). Foris.
- Liljestrand Fultz, A. (2007). Prosody in syntactic disambiguation in English-French interlanguage. In H. Cault-Nulton, S. Kulatilake, & I-h. Woo (Eds.), *BUCLD 31: Proceedings of the 31st annual Boston University Conference on Language Development* (pp. 394–405). Cascadilla Press.
- Liu, J., & Lee, Y.-c. (2022). Focus prosody by Korean learners of English. *Linguistic Approaches to Bilingualism*, 12, 748–777.
- Lozano, C. (2018). The development of anaphora resolution at the syntax-discourse interface: Pronominal subjects in Greek learners of Spanish. *Journal of Psycholinguistic Research*, 47, 411–430.
- Luján, M. (1986). Stress and binding of pronouns. *Proceedings of CLS*, 22, 248–262.
- Maynell, L. (1999). Effect of pitch accent placement on resolving relative clause ambiguity in English. Poster presented at the 12th Annual CUNY Conference on Human Sentence Processing, New York, NY.
- Maynell, L. (2000). Prosodic effects on relative clause attachment. Poster presented at the 13th Annual CUNY Conference on Human Sentence Processing, La Jolla, CA.

- Montrul, S. (2004). Subject and object expression in Spanish heritage speakers: A case of morphosyntactic convergence. *Bilingualism: Language and Cognition*, 7, 125–142.
- Quesada, M. (2015). *The L2 acquisition of Spanish subjects: Multiple perspectives*. De Gruyter.
- R Core Team (2023). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. <<https://www.R-project.org/>>.
- Rizzi, L. (1982). *Issues in Italian syntax*. Foris.
- Samek-Lodovici, V. (1996). *Constraints on subjects: An optimality theoretic analysis*. PhD dissertation, Rutgers University.
- Schwartz, B. D., & Sprouse, R. (1994). Word order and nominative case in nonnative language acquisition: A longitudinal study of (L1 Turkish) German interlanguage. In T. Hoekstra & B. D. Schwartz (Eds.), *Language acquisition studies in generative grammar* (pp. 317–368). John Benjamins.
- Serrratrice, L. (2007). Cross-linguistic influence in the interpretation of anaphoric and cataphoric pronouns in English–Italian bilingual children. *Bilingualism: Language and Cognition*, 10, 225–238.
- Snedeker J., & Yuan, S. (2008). Effects of prosodic and lexical constraints on parsing in young children (and adults). *Journal of Memory and Language*, 58, 574–608.
- Sorace, A. (2000). Differential effects of attrition in the L1 syntax of near-native L2 speakers. In C. Howell, S. Fish & T. Keith-Lucas (Eds.), *Proceedings of the 24th annual Boston University Conference on Language Development* (pp. 719–725). Cascadilla Press.
- Sorace, A. (2011). Pinning down the concept of “interface” in bilingualism. *Linguistic Approaches to Bilingualism*, 1, 1–33.
- Sorace, A., & Filiaci, F. (2006). Anaphora resolution in near-native speakers of Italian. *Second Language Research*, 22, 339–368.
- White, L., Goad, H., Su, J., Smeets, L., Mortazavina, M., Garcia, G., & Guzzo, N. (2017). Prosodic effects on pronoun interpretation in Italian. In M. Lamendola & J. Scott (Eds.),

Proceedings of the 41st Boston University Conference on Language Development (pp. 744–752). Cascadilla Press.

Competing Interests Declaration

The authors declare none.

Data availability statement

The full test and the results dataset will be made available through IRIS (<https://www.iris-database.org/>).