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The role of subordinating conjunctions in the interpretation of null and overt subject pronouns in native Peninsular Spanish

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Abstract

Subject pronoun interpretation in native Spanish has generally been approached under the Position of Antecedent Strategy, a parsing strategy which claims that null pronouns bias toward subject antecedents and overt pronouns toward object antecedents. While some studies align with the predicted patterns, others present mixed evidence. To further clarify this, our study tests the offline interpretation of null and overt subject pronouns in 55 native Peninsular Spanish speakers. We additionally tested the role played by different temporal subordinating conjunctions (*mientras* “while” vs. *cuando* “when”) in modulating subject pronoun interpretation preferences. Our findings reveal that overt pronouns bias toward object antecedents independently from the subordinating conjunction. Conversely, null pronouns bias toward subject antecedents, but their interpretation is influenced by the type of subordinating conjunction, with higher rates of subject interpretations in the *mientras* “while” condition. These results lend support to theoretical accounts such as the Form-Specific Multiple-Constraints approach, which asserts that referring expressions are subject to different constraints and to varying degrees. These findings thus extend beyond purely structural accounts and underscore the complexity of subject pronoun interpretation in Spanish.

Keywords: interpretation; null; overt; Peninsular Spanish; subject pronouns; subordinating conjunctions

Introduction

Research on the interpretation of null and overt subject pronouns in null-subject languages such as Italian, Greek, or Spanish has generally been conducted following the Position of Antecedent Strategy (PAS, henceforth) (Carminati, 2002). This parsing strategy, which was formulated for Italian intrasentential anaphora, claims that null pronouns tend to bias toward antecedents in subject position (SpecIP in Carminati’s terms) and overt pronouns are largely interpreted as coreferential with

object antecedents or antecedents that occupy a syntactic position below the preverbal subject as illustrated in the example below.

1. *Marta_i scriveva frequentemente a Piera_j quando pro_i/lei_j era negli Stati Uniti.*
“Marta frequently wrote to Piera when (she)/she was in the United States.”

Following Carminati’s proposal, research has explored whether the predictions from the PAS can be extended to other null-subject languages such as Spanish. Interestingly, while some authors have exclusively replicated the subject-null association bias in Spanish (Clements & Domínguez, 2017; Jegerski et al., 2011; Keating et al., 2011), others have only reported a PAS-like behavior for overt pronouns (Chamorro, 2018; Chamorro et al., 2016; Schimke et al., 2018). Additionally, both (Contemori & Di Domenico, 2021; de la Fuente, 2015) or none (Giannakou & Sitaridou, 2020; Leonetti-Escandell & Torregrossa, 2024) of these interpretations patterns have been attested.¹ To explain this variability in pronoun biases, previous research has explored several factors that could influence subject pronoun interpretation in native Spanish, including clausal order, implicit causality, and rhetorical relations, among others.

Notably, most studies testing the PAS in native Spanish have generally employed similar experimental designs with some minor variations, that is, either main-subordinate or subordinate-main configurations where null or overt subjects can be coreferential with either subject or object noun phrase (NP) antecedents. While previous research has found that clausal order can affect interpretation preferences for null and overt subject pronouns (Bel & García-Alcaraz, 2015, 2018; de Rocafiguera & Bel, 2022), this factor alone has not sufficiently explained the inconsistent findings reported so far. It is, however, crucial to highlight that other factors such as the subordinating conjunction linking main and subordinate clauses have been overlooked, despite the evidence that conjunction semantics can impact pronoun resolution (Fukumura & van Gompel, 2010; Hwang, 2023). In previous studies, these linkers have been either kept constant (Chamorro, 2018; Chamorro et al., 2016; Contemori & Di Domenico, 2021), or different temporal subordinating conjunctions such as *mientras* “while” or *cuando* “when” have been included without being counterbalanced (Clements & Domínguez, 2017; Jegerski et al., 2011).

Even though the syntactic position might to some extent account for interpretation preferences of null and overt subject pronouns following the PAS, it could be argued that the semantics of the clause introduced by the subordinating conjunction where the referring or anaphoric expression is embedded could in part modulate such interpretation preferences.² Despite the accumulated evidence that semantics can play a significant role in pronoun resolution as illustrated by the effect of verb semantics (Garvey et al., 1974), implicit causality (Goikoetxea et al., 2008), or animacy in some languages such as European Portuguese or English (Fiéis et al., 2022; Fukumura & van Gompel, 2011), the effect of the type of temporal subordinating conjunction in modulating interpretation preferences of null and overt subject pronouns in Spanish remains largely underexplored. Notably, the use of these conjunctions has been a source of variability in previous experimental designs in Spanish, and investigating it further could help clarify part of the inconsistent findings in the literature, which is one of the main goals of this paper.

In addition, following the Form-Specific Multiple-Constraints (FSMC) approach (Kaiser & Trueswell, 2008), which argues that different referring expressions are subject to different constraints and to varying degrees, it could be hypothesized that null and overt subject pronouns in Spanish could be differently affected by different subordinating conjunctions as evidenced for other referring expressions in Finnish (Kaiser & Trueswell, 2008) or Polish (Wolna et al., 2022). Crucially, this manipulation could most likely affect the interpretation of null pronouns, as they have been found to be more malleable to language internal factors such as clause order (de Rocafiguera & Bel, 2022) or topicality (de Rocafiguera, 2023), whereas overt pronouns have been found to be affected by language external factors such as language dominance or exposure (Chamorro et al., 2016; de Rocafiguera, 2023; Martín-Villena, 2023).

Therefore, the aim of this paper is to explore the role played by two temporal subordinating conjunctions in modulating offline pronoun resolution in native Peninsular Spanish as well as to ascertain whether both types of pronouns are equally sensitive to such factor following the claims made within the FSMC approach (Kaiser & Trueswell, 2008). To do so, a modified version of the picture selection task used in Tsimpili et al. (2004), which additionally manipulated the type of subordinating conjunction used, was employed with a group of native Spanish speakers. This design helped us carefully disentangle whether the different preference patterns attested in previous studies on Spanish could in part be attributed to the use of different linking devices between main and subordinate clauses. This paper is thus structured as follows. First, the PAS is introduced, followed by the main findings on subject pronoun interpretation in Spanish under this account. The following sections illustrate the main claims made by the FSMC approach as well as the potential modulating role of subordinating conjunctions in pronoun interpretation. The subsequent section introduces the aims and hypotheses of this study, which precede the methodological section, the main results of this paper, and finally, a general discussion, and a conclusion.

The Position of Antecedent Strategy

To account for interpretation preferences of null and overt subject pronouns in native Italian, Carminati (2002) formulated the PAS. Using intrasentential subordinate-main stimuli (see example 1), a division of labor for null and overt subject pronouns in Italian speakers was established: null pronouns were interpreted as coreferential with subject antecedents and overt pronouns preferentially selected an object interpretation in sentences like 1) above. Therefore, null pronouns are expected to mark topic continuity contexts, whereas overt pronouns are more likely to be associated with a topic shift.

This account, based on the syntactic prominence of the antecedents, is in line with accessibility accounts such as Ariel's (1990, 1991) Accessibility Hierarchy or Gundel et al.'s (1993) Givenness Hierarchy, among others. Antecedents in (preverbal) subject position are more prominent than those in object position (i.e., lower positions in the hierarchical sentence structure) and thus require to be recovered by less explicit material. Interestingly, while the subject-null preference

was widely attested, the preference for the overt pronoun to select object antecedents was milder in native Italian and was more dependent on contextual factors, for example, (un)ambiguity of antecedents (Carminati, 2002). In general, this trend has been replicated in studies addressing Spanish (Alonso-Ovalle *et al.*, 2002; Filiaci *et al.*, 2014; Keating *et al.*, 2011), where the interpretation of the overt pronoun does not always comply with the predictions formulated by Carminati (2002). However, although less consistently, several studies have not reported a subject-null coreference pattern in Spanish (Chamorro, 2018; Chamorro *et al.*, 2016; Giannakou, 2018; Leonetti-Escandell & Torregrossa, 2024; Schimke *et al.*, 2018). Therefore, considering the variability attested in previous research, it could be argued that the interpretation of both null and overt subject pronouns is not exclusively driven by syntactic prominence but is constrained by a multiplicity of factors, a claim put forth by Kaiser and Trueswell (2008) in their FSMC approach, which would go beyond the structural claims made by Carminati (2002). The following section will examine the current evidence on pronoun interpretation in Spanish from the perspective of the PAS, followed by an account of the main claims of the FSMC approach.

The interpretation of null and overt subject pronouns in native Spanish under the PAS

Following Carminati's (2002) influential proposal, several authors investigated whether Italian PAS-like interpretation preferences could be replicated in Spanish. The first study to test this, Alonso-Ovalle *et al.* (2002), found that Peninsular Spanish speakers interpreted null pronouns as coreferential with subject antecedents using an offline questionnaire which contained intersentential configurations, differently from the original intrasentential design included in Carminati (2002). Importantly, using such intersentential linking could in fact minimize or affect interpretation biases. In line with the attested pattern for null pronouns, Bel and García-Alcaraz (2015) and Bel, García-Alcaraz *et al.* (2016) used an acceptability judgment task controlling for implicit causality of the verb in the main clause (Goikoetxea *et al.*, 2008) and included a counterbalanced design with *mientras* "while" and *cuando* "when" subordinate clauses. They found that null pronouns tend to select antecedents in subject position in subordinate-main syntactic configurations and not in main-subordinate ones (similar results in Bel, Sagarra *et al.*, 2016; and de Rocafiguera & Bel, 2022). It is worth noticing, however, that the participants included in the aforementioned studies by Bel and colleagues (except for de Rocafiguera & Bel, 2022) tested PAS preferences in Spanish-Catalan bilinguals who were thus not raised monolingually. Based on the findings from de Rocafiguera (2023), where differences in interpretation patterns of null and overt subject pronouns were found depending on how dominant in Spanish or Catalan bilinguals were when tested in Spanish, results should thus be interpreted cautiously when making generalizable claims about the offline interpretation of subject pronouns in native Peninsular Spanish.

Other studies that replicated the same subject-null bias were Jegerski *et al.* (2011) and Keating *et al.* (2011), who used an offline sentence interpretation task, and their results also point toward a rather clear subject-null association. Importantly for the

present study, the interpretation bias of null pronouns toward subject antecedents was visually or statistically stronger in sentences that used the subordinating conjunction *mientras* “while” when compared to those that contained *antes/después de* “before/after” and *cuando* “when.”³ However, the participants in their study, all of whom were tested in an L2-speaking environment (i.e., USA), had differing levels of L2 English proficiency, lengths of residence, and varieties (i.e., Peninsular, Nicaraguan, Mexican, or Chilean Spanish, to name but a few). Notably, changes in these variables (i.e., L2 (English) proficiency, length of residence in the L2 (English) environment, or the inclusion of different Spanish varieties) can introduce potential differences in the interpretation of subject pronouns as several studies have shown (Chamorro et al., 2016; Contemori & Di Domenico, 2021; Giannakou, 2018; Martín-Villena, 2023). Therefore, the introduction of these potentially confounding factors makes it more difficult to generalize the findings from these studies to how interpreting ambiguous subject pronouns generally unfolds in Spanish.

The study by Clements and Domínguez (2017), which made use of a picture verification task adapted from Tsimpli et al. (2004) to test offline interpretation preferences of null and overt subject pronouns in Spanish, also reported a tendency for null pronouns to corefer with subject antecedents (similar results in Contemori & Di Domenico, 2021 for Mexican Spanish). While Contemori and Di Domenico (2021) kept the conjunction constant (i.e., *cuando* “when”) and observed a lower subject-null bias of 62%,⁴ Clements and Domínguez (2017) used both *mientras* “while” and *cuando* “when” stimuli in a non-counterbalanced design. In addition, similar biases of null pronouns toward subject antecedents were also attested in a study by de la Fuente (2015), where a sentence interpretation task with sentences only containing the subordinating conjunction *cuando* “when” was used.

Despite these findings, other studies have not replicated the Italian-like PAS preference for null pronouns to select subject antecedents. The offline data presented in Chamorro et al. (2016) show that null pronouns do not specialize in antecedent selection in an acceptability judgment task. The native Spanish speakers tested as part of the control group in the aforementioned study accepted null subjects as coreferential with both subject and object antecedents and did not show a strong preference for either of the two. Moreover, similar results were found in Chamorro (2018) using an offline interpretation task where participants had to select their interpretation preference for null and overt subject pronouns (similar results in Schimke et al., 2018). Moreover, Giannakou and Sitaridou (2020), who tested the same property in Spanish speakers from Chile, show that null pronouns do not specialize in selecting between a subject or an object referent either. Nevertheless, it is important to highlight that, despite the potentially confounding variables introduced in the picture in the studies by Chamorro et al. (2016), Chamorro (2018), and Giannakou and Sitaridou (2020) (i.e., different length of residence and varieties), these experiments exclusively used the subordinating conjunction *cuando* “when” to link main and subordinate clauses, a factor that is shown to play an important role in subject pronoun interpretation in native Peninsular Spanish as the results from this paper reveal.

Notably, these same results (i.e., an unclear interpretation preference for null pronouns) are also reported in Bel, García-Alcaraz et al. (2016) when focusing exclusively on main-subordinate configurations and Leonetti-Escandell and

Torregrossa (2024), who used an acceptability judgment task with main-subordinate scenarios linked exclusively with *mientras* “while.” It is worth noticing that participants in Chamorro *et al.* (2016) and Chamorro (2018) were living in the L2 English environment at the time of testing. Although length of residence was reported to be low, this could have influenced particularly the results with overt pronouns. Additionally, Giannakou and Sitaridou (2020) tested Spanish speakers from Chile, and potential differences between Chilean and Peninsular Spanish cannot be disregarded.

On another note, regarding the interpretation of overt pronouns, several studies have replicated the pattern attested in L1 Italian in PAS contexts, that is, a bias toward object antecedents. The studies by Bel and colleagues (Bel, García-Alcaraz *et al.*, 2016; Bel, Sagarra *et al.*, 2016; de Rocafiguera & Bel, 2022) prove that overt pronouns tend to prefer object antecedents in contextually ambiguous sentences both in main-subordinate and subordinate-main syntactic configurations, as well as when the two clausal orders are collapsed, that is, when they are analyzed together. Similarly, the results from Clements and Domínguez (2017) and de la Fuente (2015) also demonstrate that overt pronouns preferentially select object antecedents, a finding that is also illustrated in Contemori and Di Domenico (2021) for Mexican Spanish speakers and Schimke *et al.* (2018) for Spanish speakers of different varieties (e.g., Peninsular, Chilean, or Peruvian Spanish, among many others).

Despite the results from the aforementioned studies, there is additional evidence in Spanish where the expected PAS bias for overt pronouns is not exhibited. First, in the study by Alonso-Ovalle *et al.* (2002), overt pronouns displayed a non-categorical bias. Interestingly, the authors note that, although Carminati (2002) tested intrasentential contexts and their study included intersentential scenarios, Carminati (2002) also conducted an acceptability judgment task with two-sentence discourses and found that the most natural continuation for a subject antecedent was with a null and not an overt pronoun. This finding was further corroborated in native Spanish in a second experiment run by Alonso-Ovalle *et al.* (2002). However, they do not account for interpretation differences of the overt pronoun, where more differences might be attested between inter- and intrasentential contexts (Carminati, 2002). Furthermore, four other studies where overt pronouns have not been found to display a strong bias toward either a subject or an object interpretation are Jegerski *et al.* (2011), Keating *et al.* (2011), Giannakou and Sitaridou (2020), and Leonetti-Escandell and Torregrossa (2024).

Finally, it is important to note that the only study tangentially exploring the role of *mientras* “while” and *cuando* “when” in modulating null and overt pronoun interpretation in native Spanish is de Rocafiguera and Bel (2022). They reported no effect of conjunction, as shown by a non-significant four-way interaction between conjunction, clause order, pronoun, and antecedent. However, it is worth emphasizing that their study did not set out to specifically examine the role of temporal subordinating conjunctions. As a result, their design lacked lexically matched comparisons to assess potential conjunction effects on pronoun interpretation. Their primary manipulation involved clause order, and given that our paper focuses on main-subordinate configurations, a more relevant and comparable analysis should consider the three-way interaction of conjunction, pronoun, and antecedents exclusively in main-subordinate scenarios given that one could expect a conjunction by clause order interaction, which should be pursued in

future studies. Lastly, given that de Rocafiguera and Bel (2022) used an acceptability judgment task rather than a forced-choice task, methodological differences may also explain potential variation in findings.

Overall, considering the current evidence on the offline interpretation of null and overt subject pronouns in native Spanish, it appears that the results to date are not conclusive and present rather mixed findings. On the one hand, several confounding variables such as differing L2 English proficiency levels, where reported, lengths of immersion in the L2 environment, or the variety of Spanish spoken by the participants could in part explain some of the attested differences in the extent to which null and overt pronouns adhere to the interpretation biases put forth by the PAS (Carminati, 2002). On the other hand, modifications introduced in the design, that is, the selection of *cuando* “when” or *mientras* “while” as the only subordinating conjunction to link main and subordinate clauses could also be an explanatory factor, which has been unexplored to date. Interestingly, this could differentially affect the interpretation of null and overt subject pronouns, as suggested by accounts such as the FSMC approach (Kaiser & Trueswell, 2008), which the next section develops in more detail.

The Form-Specific Multiple-Constraints approach

Alternatively to purely structural accounts, Kaiser and Trueswell (2008) proposed the FSMC approach to account for pronoun resolution. In their proposal, rather than opting for a single-factor approach where salience of a given referent is determined by one factor (e.g., word order or linear order), they argued that salience of a referent would be determined by the added weights of different constraints. Apart from understanding pronoun resolution as the result of the weighted combination of multiple interacting cues, different referring expressions were thought to be sensitive to different constraints and to different degrees. This multifactorial account is not then compatible with others that assume all referring expressions to be sensitive to the same constraint(s) and to the same degree (Kaiser & Trueswell, 2008), which is, to some extent, on the basis of accounts such as the PAS by Carminati (2002). The interpretation of sentences containing referring expressions (e.g., null and overt subject pronouns) requires, according to Kaiser and Trueswell (2008, p. 741), the activation of two representations of the prior linguistic input:

“a. The syntactic-semantic representation of the preceding sentences, which we assume includes information about grammatical and thematic roles.

b. The comprehender’s mental model of the discourse, which we assume includes information about the situation or event being described and the entities involved in it.”

Under this approach, salience of referents is ranked both at the syntactic-semantic level and on the mental discourse model level. For instance, in their study investigating interpretation preferences of the gender-neutral overt pronoun *hän* “s/he” and the demonstrative *tämä* “this” in Finnish (Kaiser & Trueswell, 2008), the overt pronoun was found to link back to subject antecedents irrespective of word order (i.e., it was largely sensitive to syntactic role), whereas the demonstrative preferred postverbal, discourse-new, especially object antecedents (i.e., as it was

mostly sensitive to word order). Their findings support the claim that different referring expressions are sensitive to different constraints (e.g., grammatical role and word order) and to different degrees, and therefore, salience of a referent should not be unified in a single scale.

Interestingly, most of the research carried out under the FSMC approach has been done on non-null-subject languages such as Finnish, Estonian, German, Dutch, or English, among others, where several overt forms can alternate (Kaiser, 2010, 2011). However, recent research has used this framework to explore interpretation and processing of null and overt pronouns in Polish (Wolna et al., 2022), Estonian (Hint et al., 2023), or Spanish and Catalan (de Rocafiguera, 2023). Therefore, the claim that different, but informationally equivalent, referring expressions could be differentially sensitive to different cues is a working hypothesis that deserves being further explored in languages such as Spanish, where null and overt pronouns (can) alternate. According to Wolna et al. (2022), the FSMC approach could account for the differential processing costs attested in Italian and Spanish when forcing coreference of the overt pronoun toward the subject, which appears to be more evident in Italian than in Spanish (Contemori & Di Domenico, 2021; Filiaci et al., 2014). This could arguably be the result of a difference in degree of sensitivity to specific syntactic-semantic cues in the two languages.⁵ Therefore, we predict different syntactic-semantic cues (e.g., different subordinating conjunctions) to affect interpretation of null and overt pronouns differently in Spanish. It could be hypothesized that changes in the semantics introduced by the subordinating conjunction could differentially modulate interpretation preferences of null and overt pronouns considering that different types of referring expressions are arguably subject to different constraints and display different degrees of sensitivity to these factors as argued by the FSMC approach. The potential impact of different temporal subordinating conjunctions is more likely to emerge exclusively in the interpretation of null pronouns, as these have been found to be more sensitive to other language internal factors such as topicality and clausal order (de Rocafiguera, 2023; de Rocafiguera & Bel, 2022). Alternatively, overt pronouns have been shown to be more dependent on language external factors such as language dominance and exposure (Chamorro et al., 2016; Chamorro & Sorace, 2019; de Rocafiguera, 2023; Martín-Villena, 2023) and could be hypothesized to be insensitive to subordinating conjunction manipulations.

The role of subordinating conjunctions

As already anticipated, a relevant factor that arguably plays a role in modulating antecedent biases of null and overt subject pronouns are (subordinating) conjunctions (e.g., Holler & Suckow, 2016). Conjunctions largely express coherence relations between clauses such as (a) causal, (b) temporal, or (c) concessive, as the following example illustrates.

2. *El niño_i golpeó su juguete {(a) porque/(b) cuando/(c) aunque} Ø_i estaba enfadado.*
 “The child_i hit his toy because/when/although he_i was mad.”

They can help establish a coherent discourse representation (Xu et al., 2019), which can in turn increase the prominence of a given antecedent and thus decrease

referential uncertainty (Kehler et al., 2008). Hence, conjunctions are a crucial element to establish relationships between propositions and help understand the meaning of a given piece of discourse, that is, their relation to discourse, which is essential to interpret (ambiguous) referring expressions (Holler & Suckow, 2016).

Importantly, different discourse relations have been found to trigger or suppress pronoun interpretation preferences (Kehler et al., 2008; Kehler & Rohde, 2019). For instance, causal conjunctions such as *because* tend to trigger a subject antecedent interpretation for the overt pronoun *he* in a sentence like *John disappointed Bill because he . . .*. By contrast, consequential conjunctions are more likely to strengthen a bias toward an object antecedent in a sentence like *John disappointed Bill so he . . .* (Stevenson et al., 1994). Moreover, there is additional evidence that other conjunction types are associated with different interpretation biases in anaphora resolution (Ellert & Holler, 2011; Fukumura & van Gompel, 2010; Holler & Suckow, 2016; Kehler, 2002; Koornneef & Sanders, 2013; Miltsakaki, 2007; Stevenson et al., 2000; Xu et al., 2019). As suggested by Stevenson et al. (2000), connectors are key in triggering a given interpretation of a sentence. Following a similar line of reasoning, Holler and Suckow (2016, p. 65) claim that connectors, like conjunctions, “have their own semantic and structural properties in a discourse” and these properties in turn are expected to affect the salience of antecedents.

It is worth noticing that a large body of research exploring interpretation preferences of null and overt subject pronouns in null-subject languages, and particularly testing the PAS (Carminati, 2002), has adapted the stimuli used in Tsimpli et al. (2004) in Italian (Belletti et al., 2007; Sorace & Filiaci, 2006), Spanish (Clements & Domínguez, 2017; Martín-Villena, 2023), or Greek (Kaltsa et al., 2015; Papadopoulou et al., 2015; Peristeri & Tsimpli, 2013). The set of sentences included in their studies contained sentential configurations where a subordinate clause was linked to a main clause through the temporal conjunctions *when* and *while*. However, both temporal conjunctions used have not been investigated or counterbalanced in most of these studies. Hence, even though both conjunctions could be said to express the same or a very similar meaning, they present nuanced subtleties that could arguably trigger different interpretation preferences, a factor which has not been thoroughly tested to date and which is the focus of the present paper.

Concerning the meaning of the two subordinating conjunctions at play, several authors have pointed out that *mientras* “while” is more restricted in meaning than its counterpart *cuando* “when” both in Spanish (Bosque & Demonte, 1999; Rodríguez Barreiro, 2003) and in other languages such as English (Kupersmitt & Nicoladis, 2021; Silva, 1991; Winskel, 2003, 2004). On the one hand, *mientras* “while” is largely used to express simultaneity, which implies that two events are overlapping almost completely. The temporal overlap created with *mientras* “while” might reinforce the continuity of reference and thus be linked to a stronger subject-null association. On the other hand, *cuando* “when” can have either a simultaneity or a sequentiality or posteriority reading, among others. Winskel (2004) argues that connectives with multiple senses are especially sensitive to the sentence context: for instance, interpreting *when* as simultaneous or sequential could be influenced by the aspect of the clause or world knowledge (Kavanaugh, 1979; Keller-Cohen, 1981), a factor to which we return below. It could then be argued that *mientras* “while” is

usually straightforwardly assigned a simultaneous reading, whereas *cuando* “when” could accept more than one interpretation as illustrated below.

3. *Ella se distrajo cuando/mientras escribía el informe.*
“She got distracted when/while she was writing the report.” (Simultaneous)
4. *Ella se distrajo cuando/*mientras terminó de escribir el informe.*
“She got distracted when/*while she finished writing the report.” (Sequential)

This could arguably modulate interpretation preferences of null and overt subject pronouns considering the tighter or more relaxed link that could be established between the main and subordinate clause, which interacts with aspectuality, as described below. Importantly, this underexplored manipulation in native Peninsular Spanish will be the main focus of this paper to potentially account for the mixed findings available to date.

As anticipated, there appears to be an interaction between conjunctions and the temporality introduced by other clausal elements, especially past verb tenses. Notably, this interaction is primarily influenced by aspectuality. Beyond the aspect encoded by predicates, conjunctions like *mientras* “while” and *cuando* “when” also contribute to aspectuality. These temporal subordinating conjunctions influence how actions in subordinate clauses are framed temporally, which in turn affects their interpretation in terms of completion, duration, and simultaneity. *Cuando* “when” could be said to be associated with a specific (punctual) moment within the time frame of the verb’s action, while *mientras* “while” can highlight a more prolonged (durative) time of actions. Consequently, clauses linked with *cuando* “when” largely indicate a sequence of events, that is, they typically convey sequentiality, whereas those with *mientras* “while” generally imply actions taking place simultaneously, that is, simultaneity.

In terms of verbs, the imperfect past tense in Spanish tends to express simultaneity, while the indefinite past tense, with its more punctual or telic nature, is less suited for simultaneity. Lexically, the compatibility of a predicate with either *cuando* “when” or *mientras* “while” depends on whether it describes an activity, an accomplishment, or an achievement. It could be said that *mientras* “while” primarily favors activities (e.g., working or reading) as they describe ongoing processes without a clear endpoint. By contrast, *cuando* “when” can be particularly suited for accomplishments (e.g., finished) and achievements (e.g., arrived) as they tend to denote completed actions that occur at specific moments in time (Comrie, 1976). Given these nuances, a clause with *cuando* “when” can convey simultaneity, but perhaps not as naturally as one with *mientras* “while.” Furthermore, *cuando* “when” may also suggest habituality instead of simultaneity. In addition, previous studies in English have attested that the imperfective tends to favor subject biases, whereas the indefinite triggers more object biases (Sileo *et al.*, 2024). Therefore, additionally controlling for verb tenses (imperfect or indefinite) is essential.

Notably, some authors in fact argue that the meaning of *cuando* “when” depends on the combination of tense, aspect, and mode, which makes its interpretation more variable and dependent on additional temporal factors (García Fernández, 1999, 2000; Gerardo-Tavira, 2018; Guerrero, 2021; Guerrero & Gerardo-Tavira, 2021; Olguín Martínez, 2023). On a final note, previous corpus studies have attested a

higher incidence of *cuando* “when” sentences with multiple meanings over *mientras* “while,” which is less widespread and more restricted to a simultaneity meaning (Guerrero & Gerardo-Tavira, 2021).

Aims and predictions

In line with the main evidence on subject pronoun interpretation in Spanish to date, this paper aims to explore whether the predictions from the PAS (Carminati, 2002) are observed in Peninsular Spanish in main-subordinate clause configurations. In addition, this study investigates the role played by the subordinating conjunction used to link main and subordinate clauses in modulating interpretation preferences of null and overt subject pronouns in Peninsular Spanish to partly account for the mixed findings available in the literature. We thus explore the following two interrelated research questions:

- 1) To what extent are the PAS predictions observed in native Peninsular Spanish in main-subordinate clause configurations?
- 2) What is the role played (if any) by the subordinating conjunction linking main and subordinate clauses in modulating interpretation preferences of null and overt subject pronouns in Peninsular Spanish?

The main predictions for research questions 1 and 2 are as follows. In the first place, we expect null pronouns to be interpreted as coreferential with subject antecedents in line with the PAS in Italian (Contemori & Di Domenico, 2021; Filiaci et al., 2014) in main-subordinate contexts as previously evidenced in forced-choice tasks (Alonso-Ovalle et al., 2002; Clements & Domínguez, 2017; de la Fuente, 2015; Jegerski et al., 2011; Keating et al., 2011), despite the counterevidence provided in the studies conducted by Bel and colleagues.⁶ Overt pronouns, by contrast, will be more likely to be interpreted as signaling a topic shift, that is, biasing toward object antecedents as previous studies suggest (Bel, García-Alcaraz et al., 2016; Bel & García-Alcaraz, 2015; Contemori & Di Domenico, 2021; de la Fuente, 2015; de Rocafiguera & Bel, 2022, among others).

Regarding research question 2, we followed the prediction from the FSMC approach (Kaiser & Trueswell, 2008) that different subject referring expressions can be differentially sensitive to different cues as well as previous evidence showing that null pronouns are more likely to be influenced by language internal factors (e.g., clausal order or topicality), while overt pronouns are largely shaped by external factors (e.g., language dominance or exposure). Therefore, we expect that a change in the subordinating conjunction between main and subordinate clauses will exclusively modulate the interpretation of null pronouns, overt pronouns remaining insensitive to such temporal manipulation. Considering the simultaneous-only reading of clauses linked by *mientras* “while,” which is enhanced by the durative meaning of imperfective aspect in Spanish that is included in our stimuli, null pronouns in the subordinate clause in such scenarios will be more tightly linked to the main clause referent and will more predominantly select subject antecedents. Arguably, the temporal overlap created with *mientras* “while” and the durative

nuance added by the imperfective might reinforce the continuity of reference. This trend, although replicated in clauses linked by *cuando* “when,” will be significantly milder given that *cuando* “when” can also have other interpretations (e.g., sequential) that Peninsular Spanish natives might entertain and may not combine as naturally with the Spanish imperfective, which will make the subject-null association less strong. Therefore, this potential availability of multiple meanings for *cuando* “when” added to the comparative decrease in the likelihood of the *cuando* “when” and imperfective combination will result in more varied responses, and thus, a comparatively less categorical subject-null bias.

Overall, this study will provide new evidence on how additional unexplored modulating variables (i.e., the role played by different temporal subordinating conjunctions) might contribute to unsettling current controversial results in the interpretation of null and overt subject pronouns in native Peninsular Spanish.

Methodology

Participants

The participants in this study were 55 Peninsular Spanish speakers who were born and raised in an environment where most of the speakers were functional monolinguals of Spanish, that is, none of them had been raised as simultaneous bilinguals in a bilingual community in Spain (e.g., Catalonia or Galicia). Their age ranged from 19 to 39 years, with a mean of 28.18 ($SD = 5.87$). They reported mostly using Spanish daily (98.55%, $SD = 4.83$) and all of them considered themselves to be dominant in it. In terms of knowledge or use of other languages, despite having studied English as an L2 in compulsory secondary education, they (self-)reported their proficiency level to be negligible as were their L2 English exposure and use daily. Importantly, only participants with minimal to negligible L2 English proficiency and very low current L2 use and exposure were included in the study in order to avoid a potential effect of the L2 on the L1 despite being in an L1-dominant environment as recent research suggests (Martín-Villena, 2023). Participants intensively exposed to an L2 in an L1-dominant setting and who are proficient in the language can also undergo potentially reversible attrition(-like) effects given the interaction of the languages in the bilingual brain. All the participants voluntarily participated in the study in an online format.

Experimental stimuli

A picture selection task was used in which participants identified the referent of an ambiguous pronoun. In this experiment, the original sentences included in Tsimpli *et al.* (2004) were translated into Spanish,⁷ consisting of 20 experimental items where the form of the pronoun had been manipulated (10 overt pronouns and 10 null pronouns). Each experimental item contained a main clause with two animate antecedents (lexical NPs) in subject and object position, respectively, followed by a subordinate clause introduced by a temporal conjunction. The subordinate clause contained a null or overt ambiguous pronoun that matched in gender and number with the antecedents presented in the main clause. In addition, verb tenses were

maintained in all stimuli, with main clauses introducing a verb in the indefinite and subordinate clauses in the imperfect to maintain consistency with previous studies (Chamorro, 2018; Chamorro et al., 2016; Contemori & Di Domenico, 2021; de la Fuente, 2015; Schimke et al., 2018) and to ensure the grammatical and semantic coherence of the sentences. Two experimental items are illustrated in the following examples⁸:

5. *La anciana_i saludó a la mujer_j cuando/mientras ella_{i/j} cruzaba la calle.*
 “The old lady_i greeted the woman_j when/while she_{i/j} was crossing the street.”
6. *El abuelo_i habló rápido al nieto_j cuando/mientras Ø_{i/j} leía el libro.*
 “The grandfather_i spoke fast the grandson_j when/while (he)_{i/j} was reading the book.”

Two balanced lists were created and randomized to test whether the use of different temporal conjunctions such as *cundo* “when” and *mientras* “while” can modulate interpretive biases of null and overt subject pronouns in native Spanish to address research question 2. The two lists were randomized.

For each of the experimental and filler sentences, participants were presented with three pictures from which they had to choose the one that best matched the sentence they were presented with. The experimental pictures,⁹ presented in random order, contained the subject or the object of the main clause as agents, or an external referent, as illustrated below.

7. *La anciana saludó a la mujer cuando ella cruzaba la calle.*
 “The old lady greeted the woman when she was crossing the street.”



Thus, participants were required to choose their preferred interpretation for the null or overt pronoun in the subordinate clause. Differently from the original experiment, participants could only select one of the three possible interpretations to encourage them to choose their preferred interpretation. Kaltsa et al. (2015) also argue that allowing participants to choose more than one option would encourage optionality and would weaken participants’ preferences.¹⁰ This would then target their preferred interpretation for each type of pronoun in a forced-choice manner, similarly to other studies on pronoun resolution (e.g., Contemori, 2021).

In addition, the experiment contained 30 filler items, which were translated and adapted from the Greek stimuli in Peristeri and Tsimpli (2013). None of the fillers tested another grammatical structure and each sentence could be uniquely identified with only one of the three pictures presented, as shown in the following example.

8. *Dos de los tres gatos encima de la mesa son blancos.*
“Two of the three cats on the table are white.”



Data analysis

Regarding the analysis, the data¹¹ from this experiment were analyzed fitting a generalized linear mixed-effects model with a binomial family using the *glmer* function of the *lme4* package (Bates et al., 2015) in the R programming environment (v. 4.2.2, R Core Team, 2021). Both dummy-coded predictors, that is, Pronoun (Null/Overt) and Conjunction (*Cuando* “when”/*Mientras* “while”), as well as their motivated interaction were included in the model as fixed effects. Regarding the random-effects structure, both participants and items were tested along with varying slopes that were supported by the data and the best random-effects structure was selected using the *anova* function of the *stats* package comparing models with simplified random structures following Matuschek et al. (2017). Crucially, the dependent variable included in this model was binary,¹² whereby subject answers were coded as 1 and object answers as 0. The output of the model included the log odds for selecting or not a subject antecedent for the null and overt pronoun sentences. The final model of best fit (*glmer(subject_answer ~ pronoun*conjunction+(1+pronoun|participant)+(1|item))*) was selected using maximum likelihood ratio comparisons and differences between conditions in the experimental manipulations used were obtained using the “*emmeans*” package (Lenth et al., 2022). Thus, the resulting final model of best fit included the interaction of Pronoun*Conjunction as fixed effects, a by-participant varying intercept and slope for pronoun, and a varying intercept for item.

<i>Cuando</i> “When”				<i>Mientras</i> “While”		
	Subject	Object	External	Subject	Object	External
Null	64.4% (177/275)	34.9% (96/275)	0.7% (2/275)	76% (209/275)	23.3% (64/275)	0.7% (2/275)
Overt	25.8% (71/275)	70.2% (193/275)	4% (11/275)	26.9% (74/275)	68.7% (189/275)	4.4% (12/275)

Results

The percentages of selection of a subject antecedent are presented by pronoun and conjunction type (with standard deviations) in Figure 1 and in Table 1. As can be observed (see Figure 1 and Table 1), null pronouns were largely associated with subject antecedents and overt pronouns dispreferred subject antecedents, that is, they more likely selected object antecedents.

Additionally, Figure 2 and Table 2 illustrate the proportion of subject antecedent selection by type of pronoun and conjunction (with standard deviations). It is worth noticing that, while no difference between the selection of subject antecedents seems to be visually apparent in the overt pronoun condition, more subject antecedents are selected for null pronouns when the sentence they are embedded in is linked by *mientras* “while” as opposed to those connected by *cuando* “when” (see Figure 2 and Table 2).

Table 1. Proportion of subject antecedent selection by pronoun type (sd)

	Subject
Null	386/546 – .71 (.46)
Overt	145/527 – .28 (.48)

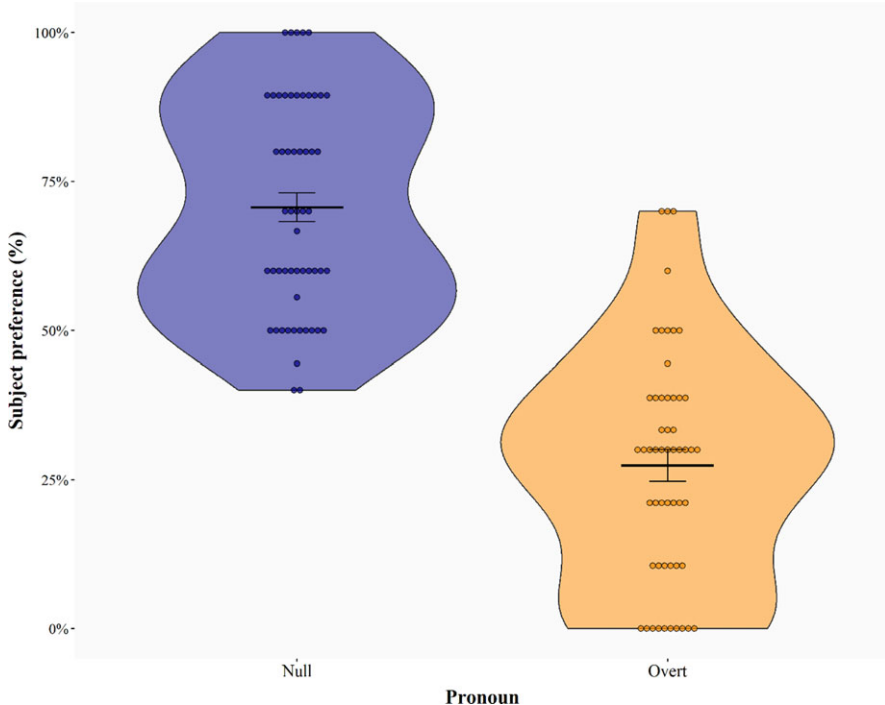


Figure 1. Proportion of subject antecedent selection by pronoun type.

Table 2. Proportion of subject antecedent selection by pronoun and conjunction type (sd)

	<i>Cuando</i> “When”	<i>Mientras</i> “While”
Null	177/273 – .65 (.48)	209/273 – .77 (.42)
Overt	71/264 – .27 (.44)	74/263 – .28 (.45)

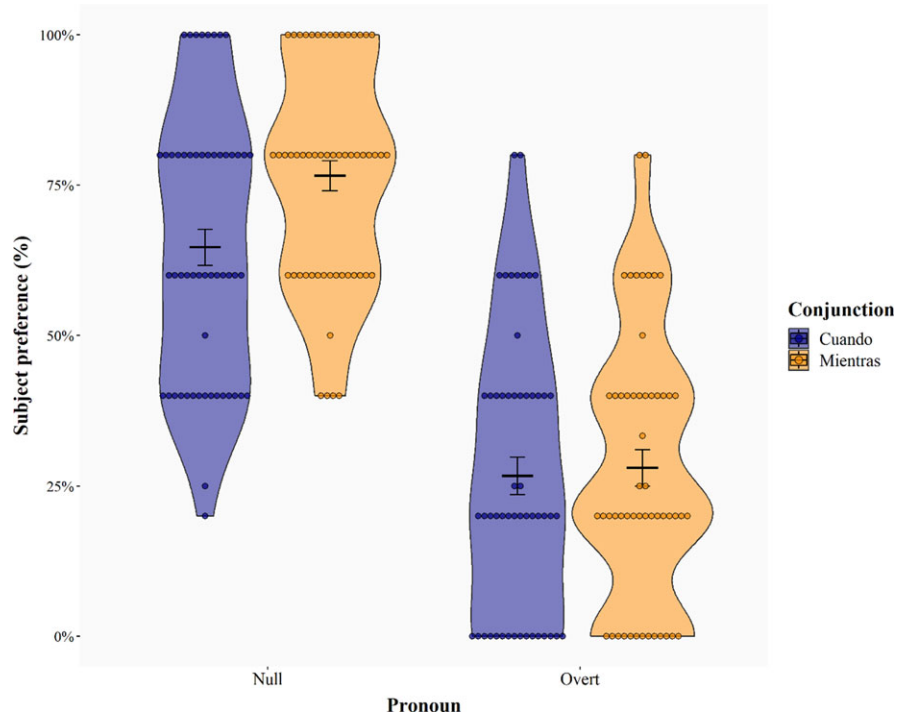


Figure 2. Proportion of subject antecedent selection by pronoun and conjunction type.

After fitting a logistic mixed model to predict Subject answers with Pronoun*Conjunction (see Table 3), the model’s total explanatory power is substantial (conditional $R^2 = .46$), which means that the whole model explains 46% of the variability present in the data, and the part related to the fixed effects alone (marginal R^2) is of .24. The model’s intercept, corresponding to Pronoun = null and Conjunction = *Cuando*, is at .78 (95% CI [.16, 1.39], SE = .31, $z = 2.48$, $p = .013$). Within this model, the effect of Pronoun is statistically significant and negative ($\beta = -2.06$, 95% CI [-2.95, -1.18], SE = .45, $z = -4.57$, $p < .001$), which indicates that significantly fewer subject interpretations are selected when experimental stimuli contain overt pronouns in the subordinate clause. Additionally, the effect of Conjunction is statistically significant and positive ($\beta = .70$, 95% CI [.28, 1.11], SE = .21, $z = 3.30$, $p < .001$), which highlights that sentences that contain the subordinating conjunction *mientras* “while” are more

Table 3. Model summary: fixed effects

Fixed effects	Estimate	95% CI	SE	z	p
(Intercept)	.78	[.16, 1.39]	.31	2.48	.013
Pronoun	−2.06	[−2.95, −1.18]	.45	−4.57	<.001
Conjunction	.70	[.28, 1.11]	.21	3.30	<.001
Pronoun*Conjunction	−.60	[−1.20, −.01]	.30	−2.00	.045

likely to trigger a subject interpretation than those which include *cuando* “when.” Finally, the interaction between Pronoun*Conjunction emerged as significant ($\beta = -.60$, 95% CI $[-1.20, -.01]$, $SE = .30$, $z = -2.00$, $p = .045$). To further explore this significant interaction, pairwise contrasts were computed using the “emmeans” package (Lenth et al., 2022). The results from this interaction suggest that the selection of subject antecedents was significantly higher when null pronoun sentences contain the conjunction *mientras* “while” when compared to those containing *cuando* “when” ($\beta = -.69$, $SE = .21$, $z = -3.30$, $p = .001$), a finding not replicated with overt pronouns ($\beta = -.09$, $SE = .22$, $z = -.42$, $p = .67$). However, the results from binomial tests reveal that both biases for null pronouns in the two conjunction conditions differ from chance (see <https://osf.io/bc9ta/>).

Discussion

The main aim of this paper was to explore whether the PAS offline preferences attested in Italian intrasentential anaphora would also hold in Peninsular Spanish speakers in main-subordinate syntactic configurations. Concerning the interpretation of null-subject pronouns, our results have clearly shown that they are more likely to be interpreted as referring to the subject of the main clause, a finding which is in line with previous studies (Alonso-Ovalle et al., 2002; Contemori & Di Domenico, 2021; de la Fuente, 2015, among others). By contrast, overt pronouns have been found to receive an object interpretation in Peninsular Spanish in main-subordinate contexts in line with previous research (Bel, García-Alcaraz et al., 2016; Bel & García-Alcaraz, 2015; Chamorro, 2018; Chamorro et al., 2016; de la Fuente, 2015). Thus, a division of labor has been established in the interpretation of null and overt subject pronouns following the claims made by Carminati (2002) in the formulation of the PAS. Therefore, the results from this study are fully in line with those from the studies by Contemori and Di Domenico (2021) and de la Fuente (2015), where both expected PAS-like biases were replicated in Spanish using an offline interpretation task. However, although it is important to note that the former tested Mexican Spanish speakers and the latter included participants who spoke different varieties of Spanish (Spain, Mexico, and Colombia),¹³ no further information about the participants (e.g., L2 English proficiency, or immersion status, among many others) is provided, which can complicate extrapolating the results and establishing faithful comparisons across varieties of Spanish.

Despite these results clearly patterning with the two aforementioned studies which exhibit a clear division of labor of Spanish null and overt subject pronouns, they clearly contrast with other previous studies. In particular, no clear subject preference for null pronouns has been previously reported (particularly in Chamorro, 2018; Chamorro *et al.*, 2016; Giannakou & Sitaridou, 2020), a finding to which we will return while answering research question 2. In addition, research conducted by Bel and colleagues (Bel & García-Alcaraz, 2015; Bel, García-Alcaraz *et al.*, 2016; de Rocafiguera & Bel, 2022) has demonstrated that the subject-null association bias is additionally dependent on clausal order. While this subject-null pattern is attested in subordinate-main syntactic configurations, they report that null pronouns do not appear to clearly bias toward subject antecedents in main-subordinate syntactic configurations. In light of the current results, it appears that other factors might better account for the potential differences between our study and those where no subject-null association has been found in the main-subordinate syntactic scenario. As de Rocafiguera and Bel (2022) discuss, the discrepancy in the results exhibited could be due to the fact that different tasks have been used (*cf.* production results in Contemori & Di Domenico, 2023). In fact, they report that García-Alcaraz (2015) finds PAS-like biases in Spanish using a forced-choice preference task which includes similar temporal experimental stimuli to those used in the studies conducted by Bel and colleagues. Therefore, our results confirm that the PAS predictions for null pronouns can be met in main-subordinate contexts in Spanish (Clements & Domínguez, 2017; Jegerski *et al.*, 2011; Keating *et al.*, 2011), although, as we will explain later, these specific null pronoun biases can be further modulated and interact with other factors such as the temporal subordinating conjunction used to link main and subordinate clauses.

Regarding the results from overt pronouns, other studies have also found that overt pronouns in main-subordinate syntactic configurations can follow the PAS-sanctioned route, that is, they link back to object antecedents (Bel & García-Alcaraz, 2015; Bel, García-Alcaraz *et al.*, 2016; Chamorro, 2018; Chamorro *et al.*, 2016; de Rocafiguera & Bel, 2022; Schimke *et al.*, 2018). Nevertheless, there is also counterevidence in the sense that no such clear bias for overt pronouns was reported (Alonso-Ovalle *et al.*, 2002; Clements & Domínguez, 2017; Giannakou, 2018; Jegerski *et al.*, 2011; Keating *et al.*, 2011; Leonetti-Escandell & Torregrossa, 2024). On the one hand, differences in the results reported could be due to a number of variables such as the distinction between inter- and intrasentential pronoun resolution regarding overt pronouns (Alonso-Ovalle *et al.*, 2002; Carminati, 2002; Contemori & Di Domenico, 2023), the varieties included (*e.g.*, Mexican or Peninsular Spanish), or differing levels of L2 English proficiency or lengths of L2 English immersion (Jegerski *et al.*, 2011; Keating *et al.*, 2011). Additionally, it is worth highlighting that these differences may in part be due to the fact that the division of labor is arguably slightly more complex than traditionally assumed, with null pronouns marking topic continuity (Martín-Villena & Lozano, 2020) but NPs (and, occasionally, overt pronouns) marking topic shift in native Spanish (Lozano & Quesada, 2023), among others. Moreover, (prolonged) immersion in the L2 environment and high proficiency in the L2, which has to date been barely controlled for in studies investigating pronoun interpretation in Spanish, could in fact have a

strong impact in how overt pronouns are interpreted as L1 attrition(-like) effects are likely to emerge (Chamorro et al., 2016; Martín-Villena, 2023; Tsimpli et al., 2004).

In addition to the general research question on the division of labor of subject pronouns following the PAS, this study set out to explore whether the subordinating conjunction used to link main and subordinate clauses would trigger different interpretive biases of null and overt subject pronouns. In part, this factor was explored in order to address the imbalance in the subordinating conjunctions employed in different studies testing the interpretation of subject pronouns in Spanish (Giannakou & Sitaridou, 2020; Jegerski et al., 2011; Keating et al., 2011), which could arguably explain some of the variability attested. As evidenced by a significant Pronoun*Conjunction interaction, both the temporal subordinating conjunctions *cuando* “when” and *mientras* “while” were found to trigger different association strengths, particularly in the null pronoun condition. Null pronouns in sentences containing the subordinating conjunction *mientras* “while” were significantly more likely to select subject antecedents than those that were linked by *cuando* “when,” even though a rather clear subject-null bias was attested in both conjunction conditions. Interestingly, this finding was not replicated in the study by de Rocafiguera and Bel (2022), where they did not report a significant interaction. However, added to the fact that their study was not originally designed to test the effect of different temporal subordinating conjunctions, they included both main-subordinate and subordinate-main scenarios in their stimuli and used an acceptability judgment task instead of the forced-choice experiment employed in this study, both of which could lie behind potential differences found between our studies.

Notably, our results can be explained in terms of the meaning associated with each conjunction as well as their contribution to aspectuality. First, the meaning of the conjunction is key in establishing relationships between propositions and discourse relations (Holler & Suckow, 2016), which can in turn trigger or suppress pronoun interpretation preferences (Kehler et al., 2008; Kehler & Rohde, 2019). Even though the two subordinating conjunctions analyzed might arguably convey similar temporal meanings, *while* “*mientras*” is more restricted in meaning in that it almost exclusively allows for a simultaneous reading of the two clauses. Conversely, *cuando* “when” can additionally trigger a sequential reading apart from a simultaneous one (Kupersmitt & Nicoladis, 2021; Silva, 1991; Winskel, 2003, 2004). Although such sequential reading is not the most immediate interpretation in our current experiment, participants could arguably entertain such meaning upon encountering *cuando* “when,” which could have contributed to the increased variability observed in such items and, therefore, its weaker subject-null bias. Hence, a simultaneous-only reading for clauses linked by *mientras* “while” arguably triggers a tighter link between the two clauses, which is heightened by the use of the imperfective as described below, and this can then favor a strong subject-null association (i.e., topic continuity) as illustrated in the results from this task. Furthermore, from a processing perspective, the multiplicity of meanings of *cuando* “when” may impose an additional processing effort, potentially contributing to the increased variability in reference assignment observed in our data. This tentative explanation presents a promising direction for future research employing more fine-grained (reaction) time measures.

In addition, temporal conjunctions contribute to aspectuality. Whereas *cuando* “when” conveys a punctual meaning, focusing on a specific point within the duration of actions expressed by the verb, *mientras* “while” is durative, emphasizing the continuity or extended duration of an event. As a result, *mientras* “while” is more likely to co-occur with the imperfective aspect in Spanish, which also conveys simultaneity. By contrast, *cuando* “when” tends to be less compatible with simultaneity, pairing more naturally with the indefinite past tense rather than the imperfect. Importantly, our stimuli exclusively contained verbs in the imperfect in the subordinate clause. Therefore, clauses linked with *mientras* “while” combined both the durative meaning of the conjunction and the simultaneity expressed by the imperfect. This temporal overlap created in this condition likely strengthens the continuity of reference, that is, topic continuity, maintaining the same subject between the main and subordinate clause. Moreover, the imperfective has been found to trigger more subject interpretations in languages such as English (Sileo *et al.*, 2024), and this could be hypothesized to also apply to Spanish. However, in the condition where clauses are linked by *cuando* “when,” there may be an apparent temporal mismatch between the punctual meaning of the conjunction and the simultaneity expressed by the imperfect. Although a simultaneous interpretation is not incompatible with this conjunction, it is more likely influenced by the interaction of tense, aspect, and mode (García Fernández, 2000; Olguín Martínez, 2023; Winskel, 2004). Given that its interpretation varies significantly depending on context and additional temporal factors (Guerrero, 2021; Guerrero & Gerardo-Tavira, 2021), this could lead to greater variability in interpretation patterns, a result clearly reflected in our findings.

It is important to mention that the results on the effect of different subordinating conjunctions are likely to address inconsistencies shown in previous studies on the interpretation of null and overt subject pronouns in native Spanish. Notably, several studies that have not replicated the subject-null association bias (Chamorro, 2018; Chamorro *et al.*, 2016; Giannakou & Sitaridou, 2020) have in fact only used the subordinating conjunction *cuando* “when” in their stimuli, which might in part explain this decreased association strength of null pronouns toward the previous subject. In addition, even though Contemori and Di Domenico (2021) found interpretation patterns predicted by the PAS, the percentage of subject selection for null pronouns was comparatively lower (62%) when compared to that found in other studies. These less polarized results might arguably be justified considering the stimuli in Contemori and Di Domenico (2021) were also linked using the subordinating conjunction *cuando* “when.” On a final note, Schimke *et al.* (2018) used *before* clauses and did not report a significant bias of null pronouns toward subject antecedents. While the linker used is different, it could be argued that it also conveys a sequential reading making it more similar to *cuando* “when,” which could have lowered the association strength between the null pronoun and a subject antecedent. Both the presence of the subordinating conjunction *cuando* “when,” arguably in combination with other factors (e.g., different varieties of Spanish, participant profiles, or different experimental manipulations), may have led to such patterns of results. Interestingly, considering the above, further research could additionally explore whether different subordinating conjunctions could

differentially affect processing demands involved in the integration or updating of contextual cues (Sorace, 2011, 2016).

Considering these results, it is worth emphasizing their relationship with the predictions made by the FSMC approach (Kaiser & Trueswell, 2008). The exploration of a language internal factor, such as the use of different temporal subordinating conjunctions, has shown that different pronominal forms, that is, null and overt pronouns, can be subject to different constraints as well as to varying degrees (Wolna et al., 2022). Specifically, our data suggest that only null pronouns appear to be sensitive to the different conjunctions used, which might influence antecedent salience, while overt pronouns appear to be insensitive to this particular cue. These findings are consistent with the broader framework of the FSMC approach, which emphasizes that referring expressions are not uniformly sensitive to a single set of constraints but respond differentially depending on various linguistic factors. Our results align with earlier research on languages such as German, English, or Dutch (Kaiser, 2010, 2011), where different syntactic-semantic cues have been shown to influence pronoun interpretation. The fact that null pronouns, rather than overt pronouns, were primarily affected by this specific constraint in our study, that is, the manipulation of conjunctions, further supports the claim that different types of referring expressions are sensitive to distinct constraints, reinforcing the FSMC approach's argument against a one-size-fits-all model of salience ranking, such as Ariel's (1990, 1991) Accessibility Hierarchy or Gundel et al.'s (1993) Givenness Hierarchy.

Moreover, this pattern is consistent with the findings from de Rocafiguera and Bel (2022) and de Rocafiguera (2023), who observed that null pronouns were more affected by clausal order and topicality in their studies, while overt pronouns remained largely unaffected by these factors. This similarity suggests that null pronouns in Spanish are particularly sensitive to structural and semantic cues, whether these are derived from clausal arrangement or the nature of the conjunctions used to link main and subordinate clauses. By contrast, overt pronouns seem to be governed more by external factors (Chamorro & Sorace, 2019), rather than by internal syntactic-semantic factors. Thus, these results contribute to a growing body of evidence suggesting that null and overt pronouns in Spanish, much like in other languages, are subject to different processing mechanisms and are influenced by different linguistic and cognitive constraints (Kaiser & Trueswell, 2008). The differential sensitivity of null pronouns to conjunctions highlights the role of specific syntactic-semantic interactions in shaping pronominal resolution, while overt pronouns appear to be less malleable to such changes. This asymmetry offers a compelling avenue for further exploration, particularly in investigating how different linguistic cues interact to shape pronoun interpretation across a variety of null-subject languages.

Limitations

On a final note, we would like to acknowledge several potential limitations of our study that future research should carefully consider. First, from a methodological perspective, counterbalancing null and overt pronoun conditions would have been desirable. Nevertheless, in order to maintain consistency with the original stimuli we

adapted (Tsimpli *et al.*, 2004) and to enable direct comparisons with studies conducted in other null-subject languages replicating the same experimental paradigm (Belletti *et al.*, 2007; Clements & Domínguez, 2017; Papadopoulou *et al.*, 2015; Sorace & Filiaci, 2006), we opted to preserve the stimuli as closely as possible to the original ones. Future research should address this limitation by fully counterbalancing both pronoun type and temporal conjunctions, which would allow for stronger and more generalizable conclusions about the role of subordinating conjunctions in modulating subject pronoun preferences, not only in Spanish but also in other (null-subject) languages. In addition, the original experimental design incorporated both direct and indirect objects in object position, which may occupy different syntactic positions. Investigating whether direct and indirect objects differ in their salience as antecedents would provide further insights into this phenomenon. Finally, the verbs included in the subordinate clause included a variety of activities, achievements, and accomplishments. Given the interactions between these verb types and aspect, added to the potential role of conjunctions in shaping aspectual interpretation, future studies should control for this variable (*i.e.*, lexical aspect) to ensure a more precise understanding of its impact.

Conclusion

Overall, the results from this study uncover a more comprehensive understanding of subject pronoun interpretation in Peninsular Spanish. The present study sheds light on the intricate interplay between the PAS and contextual factors, specifically the impact of semantics introduced by subordinating conjunctions in native Spanish. While the study aligns with the PAS predictions, it highlights the insufficiency of this parsing strategy in capturing the full complexity of offline subject pronoun interpretation. The observed modulation by multiple factors, such as clause order, conjunction semantics, verb type, and implicit causality, among others, suggests a nuanced interplay beyond purely syntactic structural constraints. This prompts further investigation into the multiplicity of factors influencing pronoun interpretation and their intricate interactions. Future research endeavors should delve into systematically manipulating these factors or their combinations to refine our comprehension of the intricate dynamics shaping subject pronoun interpretation in Spanish as well as in other null-subject languages.

Replication package. All research materials, data, and analysis code are available at <https://osf.io/bc9ta/>.

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Competing interests. The authors declare none.

Notes

- 1 Other studies have found that the division of labor is rather between null pronouns (subject bias) vs. NPs and overt pronouns (object bias) (Lozano & Quesada, 2023).
- 2 As suggested by one of the reviewers, apart from the semantics of the subordinating conjunctions, adjunct clauses headed by different conjunctions (e.g., if, when) may also have different attachment points (Carminati, 2002).
- 3 The authors explore the role played by discourse coordination and subordination instead of exploring the effect of different temporal subordinating conjunctions.
- 4 See Lozano and Quesada (2023) for an illustration of the percentages of subject/object selection for null and overt subject pronouns in each of the studies reviewed.
- 5 For an alternative explanation based on two differing properties of the grammar of Spanish (i.e., flexible word order, allowing SVO, VSO, and VOS, and the existence of differential object marking (DOM)), see Leonetti-Escandell and Torregrossa (2024).
- 6 The latter, however, have used graded answers, for example, acceptability judgements, and differences might in fact be expected between these two types of tasks (de Rocafiguera, 2023; Martín-Villena, 2023).
- 7 All research materials, data, and analysis code are available at <https://osf.io/bc9ta/>.
- 8 The stimuli in this study were kept as close to the original as possible, despite potential condition asymmetries, because they were also used in a separate segment-by-segment self-paced reading task. In the null pronoun condition, additional phrases were included to ensure both conditions contained the same number of segments.
- 9 For consistency, some pictures were modified so that the subject always appeared to the left of the picture and the object to the right, a manipulation which was not always present in the original study by Tsimpli et al. (2004).
- 10 Interestingly, the external referent option is generally very infrequently selected by participants in other studies (e.g., Chamorro, 2018).
- 11 The frequencies of answer selection (i.e., subject, object, or external) by pronoun and conjunction type are presented below.
- 12 It is important to mention that the responses where an external referent was selected only amounted to 2.45% (27/1100) of the total number of responses provided. Therefore, these answers were deleted considering their limited selection rate and to focus primarily on the main subject-object dichotomy as well as to better compare the results with studies that have not introduced a third external referent (e.g., Alonso-Ovalle et al., 2002; Jegerski et al., 2011; Keating et al., 2011). Similarly, those studies where a third option has been introduced have exhibited very few responses to such alternative (e.g., Chamorro, 2018).
- 13 Differences could be expected in subject interpretation patterns based on the rate of pronoun use in different varieties of Spanish (Carvalho et al., 2015).

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