

Syntactic Priming of Passives in Late Bilinguals Evidence from Italian L1-Spanish L2 Speakers

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Abstract This study investigates the degree of integration of passive constructions in Italian L1-Spanish L2 late bilinguals using a syntactic priming paradigm. Patient animacy, L2 proficiency, and priming direction were considered. Results revealed a significant syntactic priming effect, stronger within language (Spanish-Spanish) than across languages (Italian-Spanish). Cross-linguistic priming showed a descriptively steeper increase at higher proficiency levels, although the proficiency-by-priming-direction interaction was not statistically significant. These findings support the 'separate-to-shared syntax' hypothesis, according to which highly proficient bilinguals progressively integrate syntactic representations across languages.

Keywords Syntactic priming. Passive constructions. Cross-linguistic priming. Late bilingualism. L2 proficiency. Italian-Spanish bilinguals.

Summary 1 Introduction. – 2 Language Production as a Window into Mental Representation. – 3 Syntactic Priming of Passives in Late Bilinguals: Our Experiment. – 4 Discussion. – 5 Conclusions.



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1 Introduction

The nature of syntactic representation in L2 learners remains contested, particularly with respect to the extent to which non-native speakers share abstract syntactic structures across their languages. Two main accounts have been proposed to explain how bilinguals organise syntactic knowledge (Hartsuiker, Pickering, Veltkamp 2004). According to the ‘separate-syntax’ account, bilinguals maintain language-specific syntactic representations, such that structures are stored independently in each language. The ‘shared-syntax’ account, in contrast, assumes that similar structures are represented jointly, allowing activation to spread between languages.

The present study contributes to this debate by investigating the mechanisms underlying structural persistence in second-language production. Specifically, it builds on Bernolet, Hartsuiker and Pickering’s (2013) proposal that L2 proficiency modulates storing strategies: less proficient late bilinguals would initially rely on separate syntactic representations, whereas increasing proficiency may lead to greater integration of representations across languages. By examining syntactic priming in Italian late learners of Spanish, the present research investigates within-language and cross-linguistic priming of passive constructions, while also considering the effects of animacy and proficiency.

Syntactic priming refers to the tendency for speakers to reuse a syntactic structure they have recently encountered, as prior exposure increases the likelihood of producing the same structure in subsequent speech. This paradigm is particularly useful for investigating bilingual syntactic representations because cross-linguistic priming effects provide evidence about whether syntactic structures are shared across languages or stored separately.

Passive constructions were selected as they provide a useful test of cross-linguistic syntactic representation. Their structural similarity in Italian and Spanish makes them a plausible candidate for shared representation, while their marked status compared with active structures makes them particularly suitable for syntactic priming. Given their syntactic complexity and pragmatic constraints, especially in Spanish, passives are relatively infrequent in spontaneous production, allowing priming effects to reveal underlying syntactic preferences.

The article is organised as follows. Section 2 introduces multilingual activation models, reviews research on cross-linguistic priming, and discusses the interplay between syntax and semantics in structural priming. Section 3 presents the current study in detail, outlining the research questions, methodology, and findings. Finally,

Section 4 discusses the implications of these findings and offers concluding remarks.¹

2 Language Production as a Window into Mental Representation

The present study builds on psycholinguistic models of language production which assume that linguistic knowledge is represented mentally in an organised and structured manner, and that language use provides a means of investigating these underlying representations. According to Levelt's (1999) *Blueprint of the Speaker*, utterance production proceeds through three successive stages: conceptualisation, formulation, and articulation. During conceptualisation, speakers generate a pre-verbal message based on communicative intentions, contextual information, and pragmatic knowledge. This message is subsequently transformed into linguistic form during formulation, which encompasses both grammatical and phonological encoding, before finally being externalised through articulation. Crucially, this model assumes that language production involves the retrieval and manipulation of abstract linguistic representations rather than the direct retrieval of fully specified word forms.

More specifically, the theoretical underpinning of this study is the activation-based account of lexical access and sentence production. Bock and Levelt (1994) proposed that linguistic information is organised within a network of interconnected nodes among which activation spreads during language production. Within this framework, lexical representations are distributed across different levels, including conceptual, lemma, and lexeme strata. The lemma level occupies a central role, as it mediates between conceptual information and phonological form and contains semantic and morphosyntactic information required for grammatical encoding.

Pickering and Branigan (1998) further developed this network model by proposing that the lemma stratum contains three types of nodes: syntactic category nodes, feature nodes, and combinatorial nodes. Category nodes encode information relating to word class and receive inherent activation whenever the corresponding lexical item is selected. By contrast, feature nodes and combinatorial nodes are contextually activated, such that only those corresponding to the specific morphological form and syntactic structure employed in a

¹ This article is based on the first author's Master's thesis, titled "Syntactic Priming of Passives in Late Bilinguals: Evidence from Italian L1-Spanish L2 Speakers" (Micheletti 2025), defended at Ca' Foscari University of Venice.

given utterance become active, while alternative representations remain inactive. Thus, the production of different syntactic realisations of the same lexical item selectively activates different combinatorial nodes associated with those constructions.

The notion of selective activation, together with the related concept of residual activation, has been particularly influential in explaining syntactic priming. Within activation-based accounts, in fact, this phenomenon arises because the combinatorial nodes associated with a previously produced structure retain residual activation, increasing the likelihood that the same representation will be selected again. Because syntactic priming reflects the temporary activation of abstract structural representations during language production, it offers a valuable window into the organisation of the mental lexicon and the nature of speakers' underlying grammatical knowledge.

2.1 Bilingual Activation Models

Hartsuiker, Pickering and Veltkamp (2004) advanced two opposing hypotheses for bilingual lexical-syntactic representation: the 'separate-syntax' account and the 'shared-syntax' (also called 'integrated') account. The former posits that bilingual minds distinguish syntactic representations for each language, whereas the latter theorises a common syntactic store, allowing structures to be shared across languages.

The separate-syntax model claims that language-specific stores – i.e., distinct syntactic representations associated with each language – facilitate efficient processing, as they allow bilinguals to focus on one language at a time, therefore limiting the number of structures to consider. However, this also implies that some information – namely, equivalent structures across languages – is inevitably represented twice. Such redundancy is avoided in the integrated account, where similar syntactic structures in different languages are only represented once, in a shared store. This would also facilitate code-switching and interference processes (Hartsuiker, Pickering, Veltkamp 2004, 413).

Figure 1 illustrates the shared-syntax framework using the verbs *colpire/golpear* ('hit') and *inseguire/perseguir* ('chase') in an Italian-Spanish bilingual. In this model, each lemma node (e.g. COLPIRE, GOLPEAR) is linked to a language-specific node (denoted by an Italian or Spanish flag) and a series of shared nodes: a conceptual node (HIT (X, Y)), a category node (Verb), and relevant combinatorial nodes (Active and Passive). In contrast, the separate-syntax account assumes independent syntactic representation for each language.

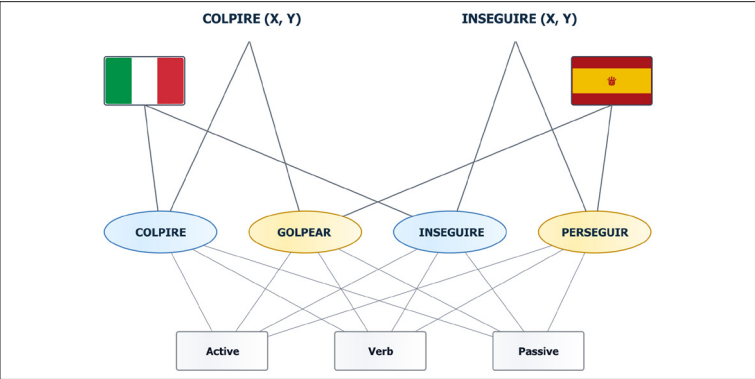


Figure 1 Example of lexical entries for the verbs ‘hit’ and ‘chase’ in an integrated (shared lexicon, shared syntax) account of Italian-Spanish bilingual language representation (adapted from Hartsuiker, Pickering, Veltkamp 2004, 413)

Bernolet, Hartsuiker and Pickering (2013) proposed an alternative solution for late bilinguals to the separate-versus-shared syntax debate, suggesting that L2 proficiency modulates storing strategies. The authors considered two possibilities: either (i) late learners immediately collapse their syntactic representations for the languages they know, or (ii) they initially store them separately (‘separate-to-shared syntax’). These scenarios are represented in Figure 2 and 3 respectively.

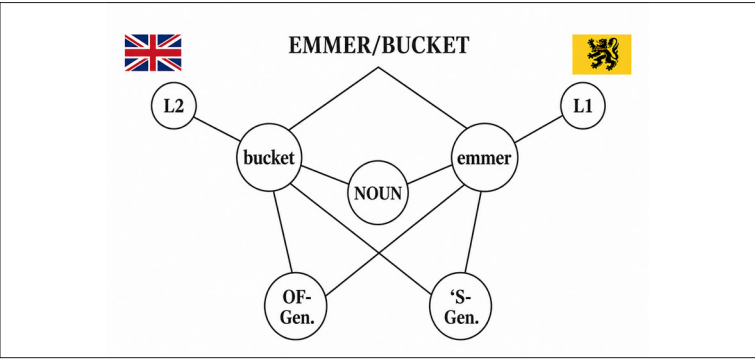


Figure 2 Representation of a model in which Dutch (Flemish) and English genitives are shared from the outset (adapted from Bernolet, Hartsuiker, Pickering 2013, 291)

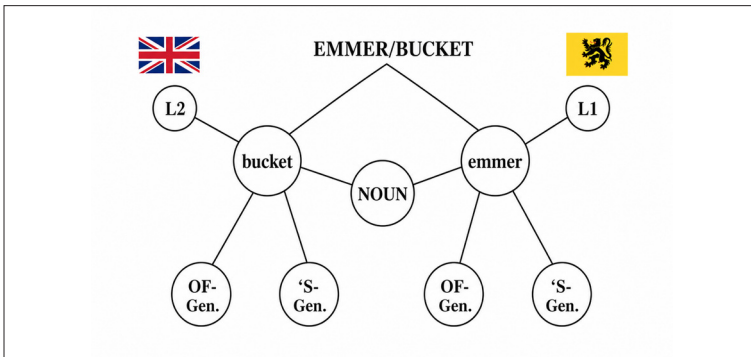


Figure 3 Representation of a model in which Dutch (Flemish) and English genitives are initially kept separate (adapted from Bernolet, Hartsuiker, Pickering 2013, 291)

Under the ‘separate-to-shared syntax’ hypothesis, lower-proficiency learners initially represent L2 syntactic structures separately from their L1 counterparts. As proficiency increases, however, structurally equivalent L1 and L2 representations are gradually integrated into a shared syntactic store. Bernolet and colleagues (2013) propose this model specifically for late bilingualism, as it implies that learners already know one syntax when they come into contact with the structure of a second language; from this perspective, the theorised initial separation would serve to reduce the risk of errors: when learners first encounter a structure (e.g. the Spanish prepositional dative in 1a) they do not form an abstract phrasal category. Instead, they link the configuration lexically to the specific verb with which it appeared (e.g. *dar*, ‘to give’, 1b). Only after sufficient exposure across a diverse vocabulary do speakers generalise the L2 structure (1c):

- (1) a. Juan dio un libro a María.
Juan gave a book to María.
b. [*dar*] + [direct object] + [*a*] + [recipient]
c. [verb] + [direct object] + [indirect object preposition ‘*a*’] + [recipient]

At this point, speakers recognise that the L2 configuration maps onto an equivalent structural template in their L1, such as the English prepositional dative in (2). Once this cross-linguistic equivalence is detected, the isolated L2 node is dissolved, and the representation is incorporated into a shared, abstract syntactic store (3).

- (2) a. John gave a book to Mary.
b. [verb] + [direct object] + [indirect object preposition ‘*to*’] + [recipient]
- (3) [verb] + [direct object] + [indirect object preposition] + [recipient]

This proficiency-driven shift in representational organisation parallels the developmental trajectory proposed in Ullman's (2001) declarative/procedural model of bilingualism, which proposes that L2 learners rely strongly on declarative memory when storing grammatical information, as opposed to L1 speakers, who rely primarily on procedural memory. However, Ullman also argues that L2 practice results in "better learning of grammatical rules in procedural memory" (2001, 118). As learners gain experience, both their memory strategies and syntactic representations progressively reorganise, moving from initial, explicit approaches toward integrated, procedural L2 structures.

Notably, the separate-or-shared syntax debate also expanded to foreign language learning beyond an L2, with empirical studies employing cross-linguistic structural priming paradigms (among many: Hartsuiker et al. 2016; Facipieri 2022) suggesting that syntactic information can indeed be shared across native and non-native languages.

2.2 Cross-Linguistic Priming: Testing Hypotheses of Multilingual Representation

Although several studies on the bilingual lexicon (comprehension: Spivey, Marian 1999; Van Heuven, Dijkstra, Grainger 1998; production: Colomé 2001; Costa, Miozzo, Caramazza 1999) demonstrate that accessing a word in one language activates related words in the other – indicating that at least some information is shared across languages – this does not solve the antithesis between the separate- and shared- syntax hypotheses. Theories of sentence production, in fact, posit a separation between lexical and syntactic selection during grammatical encoding, a framework which is compatible with a shared lexicon and the two alternative syntactic accounts.

Structural priming has been widely employed as a methodological tool for testing the two competing models. The shared-syntax account, in fact, assumes that combinatorial information is represented jointly across a bilingual's two languages, facilitating cross-linguistic priming. Consequently, exposure to a passive sentence such as *El camión es perseguido por el taxi* 'The truck is chased by the taxi' activates not only the lemma node for the Spanish verb *perseguir* but also that of its English equivalent *chase*, via activation of the shared passive combinatorial node (Hartsuiker, Pickering, Veltkamp 2004; [fig. 1]). Such activation would enhance the probability of subsequent production of a passive sentence in English. In contrast, the separate-syntax account assumes independent syntactic representations for each language which impede the spread of structural activation

across languages and therefore it does not predict cross-linguistic structural priming.

To answer the question “Is syntax separate or shared between languages?” Hartsuiker and colleagues (2004) conducted a cross-linguistic priming experiment with native speakers of Spanish who spoke English as an L2. Priming in bilinguals (henceforth: bilingual priming) can be tested in three combinations: (a) within a second language; (b) from a first language to a second language; (c) from a second language to a first language. Hartsuiker and colleagues (2004) specifically investigated Spanish-L1 to English-L2 cross-linguistic priming, in which prime structures produced in Spanish were intended to influence target productions in English.

The experiment employed a confederate scripting technique – first introduced by Branigan, Pickering and Cleland (2000) – in which naïve participants interacted with an experimenter confederate who pretended to be their conversational partner. The confederate would speak Spanish, whereas the participant spoke English. The participants and the confederate alternated in describing pictures (picture description task) and declaring whether they had encountered them before (yes/no decision task, included as a distractor).

All pictures depicted transitive events (e.g. a bottle being hit by a bullet). Participants were instructed to describe them using the verb printed at the bottom of each card (e.g. HIT). Prime and target verbs were always different (e.g. PERSEGUIR and HIT). On each trial, the confederate first described a picture using a scripted sentence that could contain one of four syntactic structures: active, passive, intransitive, or object-verb-subject (OVS). In the passive prime condition, the confederate’s description provided a passive syntactic structure (e.g. *El camión es perseguido por el taxi*, ‘The truck is chased by the taxi’), after which participants described their own target picture using a different verb. Participants’ target descriptions were then analysed to determine whether exposure to the confederate’s syntactic structure influenced their choice of sentence structure.

The authors found a 22% passive priming effect, extending previous evidence from cross-linguistic structural priming experiments. Loebell and Bock (2003), for instance, had already tested syntactic priming between German and English in a picture-description task, finding a priming effect for dative structures, regardless of language direction. They did not find, however, cross-linguistic priming between English actives and passives and their German equivalents – possibly because of word order differences. Crucially, these studies (Loebell, Bock 2003; Hartsuiker, Pickering, Veltkamp 2004) provided evidence for the shared-syntax account of the bilingual mind.

Bernolet and colleagues (2013) further elaborated the model, suggesting that shared syntactic representations only emerge at later stages of L2 learning. They drew these conclusions from two priming experiments conducted with native Dutch speakers who knew English as a second language.² The first experiment investigated cross-linguistic priming of genitive structures from Dutch to English, while the second experiment was performed entirely in English. The authors employed a picture-description task with a confederate to elicit genitive production, manipulating conditions where the prime and target head nouns either matched or mismatched.

The experiment employed a 2×2 design crossing genitive structure (of-genitive, e.g. 'The egg of the nurse', vs. 's-genitive, e.g. 'The nurse's egg') with lexical overlap (match vs. mismatch of the head noun between the prime and target). The authors tested whether syntactic representations are shared across languages from the outset or progressively integrated as proficiency increases. These two hypotheses generate different predictions as to cross-linguistic priming: if L1 and L2 syntactic representations are linked since the earliest stages of language learning, then between-language priming should occur for all participants, regardless of L2 proficiency. If representations are initially kept separate, then cross-linguistic priming should emerge only for more proficient bilinguals. Results indicated significant between-language genitive priming, as well as a translation equivalence boost: priming was stronger when the prime and target head nouns were translations of each other. Furthermore, the priming effect occurred only in more proficient bilinguals, but not in less proficient participants, supporting the separate-to-shared syntax account.

To further examine how L2 proficiency and lexical overlap relate to structural priming, the authors tested within-L2 priming in Experiment 2. Again, L2 proficiency modulated priming: less proficient bilinguals exhibited a lexical boost effect, showing strong L2-L2 priming only when prime and target head nouns matched, but no priming in the different-head-noun condition was found. In contrast, more proficient bilinguals showed robust priming regardless of whether the prime and target head nouns were the same or differed.

These results imply that at early stages of L2 learning, speakers rely on L1 representations (translating them directly into the L2) or imitate recently heard L2 structures, drawing primarily on explicit memory. Accordingly, 'immediate' priming in less proficient speakers can be attributed to language-specific explicit memory traces of the

2 Participants had at least 5 (Experiment 1) and 8 (Experiment 2) years of experience with English as an L2.

prime sentence. 'Abstract' priming, instead, arises in more proficient speakers from the activation of abstract syntactic representations which are shared across languages.

Hartsuiker and colleagues (2016) further investigated multilingual representations by examining priming between two non-native languages. They compared priming between two second languages (English and French) with priming between a first (Dutch) and second language (English, French) to test, once again, the separate- and shared- syntax accounts. Using a written sentence completion paradigm, they ran three priming experiments on relative clauses: in the 'high attachment' condition (e.g. 'Claire visited the students of the professor who were ...'), the relative clause was formed on the first noun of a complex NP; in the 'low attachment' condition (e.g. 'Claire visited the students of the professor who was ...'), it was formed on the second noun. Additionally, they conducted a fourth experiment on datives. Their results confirmed that the shared-syntax account may be extended to foreign language learning beyond an L2: priming effects were found across experimental conditions. This demonstrates that syntactic representations are shared among multiple languages, and they can activate one another with equal strength.

More recently, Facipieri (2022) – whose study is the starting point of this work – further demonstrated that passive priming can occur cross-linguistically between non-native languages (in their case, Spanish and English), provided that speakers possess sufficiently high proficiency in their L2 and L3. Moreover, her results indicated that patient animacy contributed to passive target production, leading to the conclusion that conceptual and syntactic information can both influence non-native speakers' choice of syntactic structure.

2.3 Syntax and Semantics in Structural Priming

Considering Levelt's (1999) model of language production, the stage of grammatical encoding maps conceptual information onto sentence structure, thereby organising semantic representations into syntax. A central question in research on structural priming is whether semantic and syntactic information interact during this process, or whether they influence sentence processing and production through independent mechanisms.

Sánchez-Walker (2024) identifies animacy as one of the semantic properties that can guide the interpretation of passive constructions, alongside reversibility and event plausibility. Animacy may therefore influence how the grammatical roles of NPs are represented, making it a potentially relevant factor in examining whether semantic properties also affect passive production.

Indeed, animacy has been repeatedly shown to modulate speakers' syntactic choices (Gámez, Valisyeva 2015; Ziegler, Snedeker 2018) including the production of passive structures in priming (Facipieri 2022). Unlike thematic roles, which have not consistently been found to interact with structural priming effects, animacy is a property of individual entities and is closely linked to conceptual accessibility. Speakers tend to assign prominent syntactic positions (e.g. subjecthood) to animate entities, which are generally more accessible than inanimate ones since they can establish a higher number of conceptual relations with other entities (Prat-Sala, Branigan 2000). Animacy may therefore remain active beyond functional processing and influence positional processing directly, in addition to any effects of structural priming.

Gámez and Valisyeva (2015) found that animacy features intervene in structural planning especially in immature grammars. They theorised a developmental shift in L1 acquisition, from semantic sensitivity in primed grammatical encoding in childhood to a more defined split between semantics and syntax in adulthood.

A similar contrast can be made between native and non-native production. Native processing is generally assumed to be *incremental*, meaning that words are encoded one by one (Bock, Levelt 1994); because animate entities are typically more easily accessible, they are retrieved more readily and therefore more likely to be encoded in the subject position. Syntactic priming, instead, elicits *hierarchical* processing, whereby the predicate-argument structure of the verb is specified before other elements are integrated. In non-native speakers, production tends to be hierarchical at early stages of language learning and becomes more native-like (incremental) in more proficient speakers (Branigan, Pickering, Cleland 2000). As production becomes more incremental with increasing L2 proficiency, conceptual accessibility may exert a greater influence during positional processing, potentially strengthening the role of animacy in structural choice. Taken together, these findings suggest that both native versus non-native status and L2 proficiency may modulate animacy effects on sentence planning and interact with syntactic priming.

2.4 Priming Magnitude Within and Across Languages

According to Hartsuiker and colleagues' (2004) shared-syntax model, cross-linguistic priming should be equally strong as within-language priming, because syntactic representations are assumed to be fully integrated. Bernolet, Hartsuiker and Pickering's (2013) revisitation of Hartsuiker's theory, instead, predicts stronger cross-linguistic priming in more proficient bilinguals, since representations only

become shared as L2 proficiency increases.

In a meta-analysis of 73 syntactic priming studies, Mahowald et al. (2016) found no significant difference between classic (L1-L1) priming and bilingual (L1-L2, L2-L1, or L2-L2) priming. Nevertheless, within-language priming effects tended to be numerically stronger than between-language ones. Similar patterns were also reported in other studies (Schoonbaert, Hartsuiker, Pickering 2007; Hartsuiker, Bernolet 2017) and can be explained in terms of node activation.

If syntactic priming is interpreted as the result of residual activation of a combinatorial node, which in a proficient bilingual is connected to L1 and L2 lemma and language nodes, cross-linguistic priming requires activation to spread from one language to the other. Within-language priming (L1-L1, L2-L2), on the other hand, involves shorter activation pathways and therefore requires lower processing efforts. This difference can increase the magnitude of within-language priming but does not prevent syntactic priming to occur across languages.

3 Syntactic Priming of Passives in Late Bilinguals: Our Experiment

3.1 Aim of the Study and Research Questions

The present investigation tests the bilingual separate-to-shared-syntax account (Boyle, Hartsuiker, Pickering 2013) through a passive sentence priming experiment. It aims to determine the extent to which syntax and semantics interact in structural choices in production and to assess the degree of integration between L1 and L2 syntactic representations, as a function of speakers' L2 proficiency. Specifically, the research questions are:

RQ1: Does a priming effect of the passive occur in native speakers of Italian (L1) who know Spanish as a second language (L2)?

RQ2: Can patient animacy affect the magnitude of the priming effect?

RQ3: Does L2 proficiency influence the magnitude of the priming effect?

RQ4: Given that L1-L2 cross-linguistic priming tends to be weaker than L1-L1 within-language priming, does it similarly show weaker effects compared to L2-L2 within-language priming?

We hypothesise that target responses (i.e. passive sentences) will be influenced by both structural priming and patient animacy. Specifically, participants are expected to produce more passive responses after passive primes than after active primes, and primes

with animate patients are expected to elicit more passive responses than primes with inanimate patients. We further predict that the effect of animacy will be stronger in more proficient L2 speakers, reflecting a greater influence of conceptual accessibility – that is, the ease with which entities can be mentally accessed and retrieved for linguistic encoding – during positional processing. L2 proficiency will also modulate the priming effect in the cross-linguistic priming condition, since highly proficient bilinguals are assumed to possess more strongly integrated representations across languages.

Finally, drawing on the considerations made about monolingual and bilingual priming, the present investigation predicts that (I) generally, L2-L2 within-language priming will be stronger than L1-L2 between-language priming and (II) greater Italian-to-Spanish passive priming effects will be found in highly proficient speakers of Spanish. To our knowledge, no previous studies have employed these two languages under a priming paradigm, nor has the L2-L2 direction of priming extensively been compared to L1-L2 priming effects.

The experimental design is modelled on that of Facipieri (2022), with adaptations due to differences in research questions, linguistic combinations, and proficiency profiles of the participant sample.

3.2 Materials

Norming phase. Experimental stimuli were selected through a norming phase. A total of 98 candidate prime sentences and 49 target pictures were evaluated through six questionnaires comprising acceptability judgment tasks (adopting a 0-6 Likert scale) and picture description tasks.

Prime sentences were subject to a numerical exclusion criterion ($M < 4$), although the final set was subsequently adjusted to achieve a balanced distribution of animacy conditions. Additionally, participants' comments revealed a preference for *venire*-passives over *essere*-passives. Therefore, all selected Italian passive primes were adapted to employ *venire*-passive constructions (Patient + Aux_{venire} + past participle + *da*-phrase + Agent). Target pictures were excluded if they were unclear, elicited unexpected thematic role assignments, or systematically encouraged alternative argument structures, including frequent intransitive realisations of target unaccusative verbs.

The norming phase also provided a preliminary empirical assessment of the markedness of the passive construction, revealing that Italian and Spanish native speakers produced canonical passives less frequently than active sentences in semi-spontaneous contexts.

Experimental items. The norming phase resulted in two sets of items, each comprising 30 prime sentences and 30 target

pictures. In one set, primes were in Spanish; in the other set, primes were in Italian. Example prime sentences are provided in Table 1. Target pictures were identical across the two sets. Half depicted an animate agent acting on an animate patient (*AnAn* condition), and the other half had an inanimate patient (*AnIn* condition). Each picture was accompanied by three linguistic elements: a verb and two noun phrases (NPs) corresponding to the depicted action, agent, and patient. While the verb always appeared first in the array, the order of agent and patient was counterbalanced across trials to prevent sequence effects in the target description. An example picture is shown in Figure 4. Each prime-target pair constituted an experimental trial and coincided in animacy features. Diathesis and patient animacy conditions were balanced across trials.

Furthermore, a total of 30 filler items – sentences and pictures – describing intransitive events involving two animate agents were also included. In the IT-ESP condition, filler sentences were presented in Italian; in the ESP-ESP condition, filler sentences were presented in Spanish.

Table 1 Spreadsheet examples for primes

Prime example	Language	Condition
Il contadino lega l'asino. 'The farmer ties the donkey.'	Italian	Active <i>AnAn</i>
Il soldato lancia la granata. 'The soldier throws the grenade.'	Italian	Active <i>AnIn</i>
Il topo viene inseguito dal gatto. 'The mouse is chased by the cat.'	Italian	Passiv <i>eAnAn</i>
La cena viene cucinata dallo chef. 'The dinner is cooked by the chef.'	Italian	Passive <i>AnIn</i>
El hijo contagia a la madre. 'The son infects the mother.'	Spanish	Active <i>AnAn</i>
El bombero apaga el incendio. 'The firefighter puts out the fire.'	Spanish	Active <i>AnIn</i>
El cordero es atacado por el lobo. 'The lamb is attacked by the wolf.'	Spanish	Passive <i>AnAn</i>
El paquete es embalado por el repartidor. 'The package is packed by the delivery person.'	Spanish	Passive <i>AnIn</i>



Figure 4 Target picture example

Finally, language background information was collected through the Bilingual Language Profile (BLP) questionnaire,³ which comprises 19 items per language and is divided into four sections: Language History, Language Use, Language Proficiency, and Language Attitudes. The questionnaire was used to derive two measures. First, a Language Dominance Index (BLP score) was calculated for each participant based on their responses across the two languages, following the procedure described by Birdsong et al. (2012). Second, responses from the Spanish Language Proficiency section were used to calculate Spanish Skills Average (SSA) values. Coding procedures are described in Section 3.6, while the relevant scoring details are reported in Appendixes A and B.

3.3 Participants

Prior to the experiment, a separate group of participants ($N = 44$) took part in the material norming phase. Picture norming was completed by 20 participants (10 native Italian and 10 native Spanish speakers), while sentence norming was completed by 24 participants (12 native Italian and 12 native Spanish speakers). The native Italian- and Spanish-speaking participants came from a range of regions and countries, including both Europe and Latin America, thus representing a variety of geographical backgrounds within the respective language groups.

The main experiment was carried out with 64 participants. The target sample consisted of native speakers of Italian who had acquired

3 The BLP questionnaire is an open-access self-report instrument designed to assess language dominance in bilinguals. Its sections can be employed to yield a composite dominance score or used as separate modules to address more specific questions (Birdsong et al. 2012).

Spanish as a second language. Five participants were excluded from the analyses as they did not complete the task correctly. The final sample comprised 59 participants, with 27 in the Italian-Spanish condition and 32 in the within-Spanish version of the experiment. They were recruited through personal contacts and social media (Instagram, Facebook, LinkedIn).

Participants reported varying educational backgrounds, which were recorded as part of the background questionnaire (BLP, Birdsong et al. 2012). Most participants (68%; $N = 40$) had completed or were enrolled in university-level education, while 26% ($N = 15$) had completed secondary education. The remaining participants had either withdrawn from university (3%; $N = 2$) or obtained a postgraduate degree (3%; $N = 2$). Participants reported a mean age of acquisition of Spanish of 13.61 years ($SD = 4.43$, range = 5-20+), had spent an average of 5.78 years in education in Spanish ($SD = 4.12$, range = 0-20+), and had lived in a Spanish-speaking country for an average of 1.73 years ($SD = 4.71$, range = 0-20+).

3.4 Design

Prime Type (*active* or *passive*) and Patient Animacy (*AnAn* or *AnIn*) were treated as within-participants variables, while Spanish Proficiency Level, indexed by Bilingual Language Profile (BLP) and Spanish Skills Average (SSA) scores, and Priming Direction (*IT-ESP* or *ESP-ESP*) were treated as between-participant variables. Spanish proficiency was entered as a continuous predictor in the analyses.

3.5 Procedure

Participants accessed the experiment via a direct link to the Gorilla Experiment Builder platform.⁴ Data were collected between December 22nd, 2025 and February 3rd, 2026. Before starting the experiment, each prospective participant read and accepted an informed consent, in compliance with the regulation (EU) 2016/679. The study received approval from the Ethics Committee of Ca' Foscari University of Venice. Participants then completed the BLP questionnaire to determine their language dominance. The BLP was followed by the priming task.

Participants were assigned to either the cross-linguistic (IT-ESP) or the within-language (ESP-ESP) version of the experiment. They first completed a familiarisation trial and then the main task. In each trial,

⁴ <http://www.gorilla.sc/>.

participants were first presented with a fixation cross (1.5s), after which a prime sentence was displayed for 4.5 seconds. Participants were instructed to read the sentence and repeat it out loud. Once the prime disappeared, the target picture was presented along with the target verb and two nouns (target agent and patient). These were always in Spanish. Participants were required to combine the given words to construct a sentence in Spanish describing the target picture and then press 'Adelante' (Next) to proceed to the following trial. An example experimental trial is displayed in Figure 5.

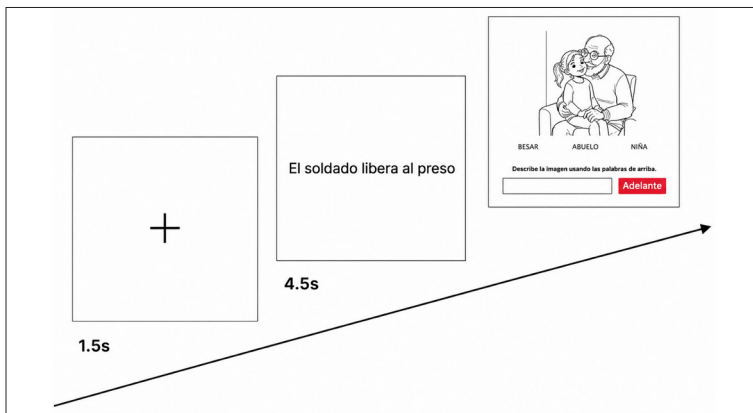


Figure 5 Visual example of an experimental trial, composed of the fixation cross, the prime sentence, and the target elements

Experimental and filler trials were pseudorandomised for each participant such that total trials were divided into three 20-trial blocks and randomised within each block. Blocks were separated by rest breaks to reduce fatigue and maintain attention. At the end of the experiment, participants were thanked for their participation and invited to press 'End' to save their responses.

3.6 Coding

Participants' responses to the entirety of the BLP questionnaire were employed to compute a Language Dominance Index (BLP score). Scores for each language were coded, summed and balanced, and the final score was obtained by subtracting the Spanish total from the Italian total (Birdsong et al. 2012). The scoring procedure and a worked example are reported in Appendix A.

For Spanish proficiency, the BLP Proficiency section, which comprises self-reported ratings of (i) speaking, (ii) comprehension,

(iii) reading, and (iv) writing abilities on a 0-6 Likert scale, was isolated and used to calculate a Spanish Skills Average (SSA) for each participant by averaging the four (i-iv) ratings. The items and scoring procedure are reported in Appendix B.

Task responses were coded according to the scoring scheme reported in Table 2. Descriptions were coded as Passive when the patient occupied the subject position, followed by the auxiliary *ser* ('be'), the past participle of the verb, and a *por*-phrase containing the agent. Cases involving an incorrect auxiliary (*estar* instead of *ser*) or an alternative preposition (*de/desde* instead of *por*) were nevertheless coded as Passive, as these deviations did not affect the intended argument structure.

Canonical SVO descriptions were coded as Active. Active responses also included cases involving omission of the preposition *a* before an animate patient, verb morphology errors, and instances where the preposition *a* preceded an inanimate patient. Reflexive uses of the target verb were likewise included in the Active category.

Ungrammatical sentences, responses in which thematic roles (Agent and Patient) were reversed, a non-target verb or patient was produced, or the target verb was used intransitively were coded as Other.

Table 2 Scoring criteria, updated for the main experiment

Label	Structure	Example
Active	NP _{agent} + verb + NP _{inanimate patient}	<i>El aficionado ondea la bandera.</i>
	NP _{agent} + verb + <i>a</i> + NP _{animate patient}	<i>El abuelo besa a la niña.</i>
	Lack of preposition ' <i>a</i> ' before animate patient	<i>El niño mima la cabra.</i>
	Extra preposition ' <i>a</i> ' before inanimate patient	<i>El niño chuta al balón.</i>
	Wrong verb morphology	<i>El hombre vee la televisión.</i>
	Reflexive use of target verb	<i>La niña se come una manzana.</i>
Passive	NP _{patient} + <i>ser</i> _{aux} + past participle + <i>por</i> + NP _{agent}	<i>La novia es acompañada por su padre.</i>
	Wrong auxiliary	<i>La chimenea está encendida por el señor.</i>
		<i>El perro viene enjabonado por su dueño.</i>
	Wrong preposition for <i>by</i> -phrase	<i>La pizarra es borrada de la maestra.</i> <i>La novia es acompañada desde su padre.</i>
Other	Reversed theta-roles	<i>El alumno calla a la profesora.</i>
	Non-target verb	<i>El aficionado está moviendo la bandera.</i>
	Non-target patient	<i>El jardinero corta la hierba con el césped.</i>
	Intransitive use of target verb	<i>La chica firma.</i>
	Relative clause	<i>Hay un joven que ayuda a un anciano.</i>
	Ungrammatical sentence	<i>La maestra borra en la pizarra.</i>

3.7 Statistical Analysis

To examine which factors influence the production of passive responses, two mixed-effects logistic regression models were fitted to the data. Statistical analyses were conducted in R (v4.5.2; R Core Team 2025). The models were fitted using generalised linear mixed-effects modelling with the lme4 package (Bates et al. 2015). Estimated marginal means and post-hoc comparisons were computed using emmeans (Lenth 2026; version 2.0.1).

The first model examined predictors of passive target production. Passive target production was treated as a binary outcome, with responses coded as passive or non-passive. Fixed effects included prime type, animacy, and proficiency. The SSA scores were standardised to z-scores (zSSA) and entered as a continuous predictor. To assess whether the effect of animacy varied across proficiency levels, an interaction between animacy and proficiency was included. Random intercepts were specified for participants and items to account for participant- and item-level variability.

The second model examined predictors of priming magnitude. Priming magnitude was operationalised as the probability of producing a passive description following a passive prime. Fixed effects included priming direction and proficiency, together with their interaction, in order to assess whether cross-linguistic and within-language priming patterns varied across proficiency levels. Random intercepts for participants and items were again included to account for participant- and item-level variability.

For both models, odds ratios (OR), standard errors (SE), confidence intervals (CI), and p-values are reported for fixed effects.

3.8 Results

BLP scores. Figures 6 and 7 illustrate the distribution of BLP scores ($M = 111.43$, $SD = 47.67$) and SSA values ($M = 4.10$, $SD = 1.17$) across the sample ($N = 59$). Overall, both measures showed a tendency for scores to cluster around the mean, indicating medium-to-high levels of proficiency across participants. On a scale ranging from 0 to 6, an SSA mean of 4.10 reflects a relatively high level of self-reported ability.

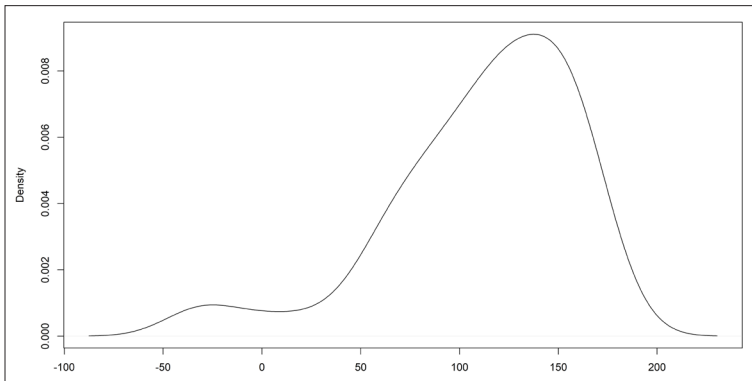


Figure 6 Density plot of BLP scores

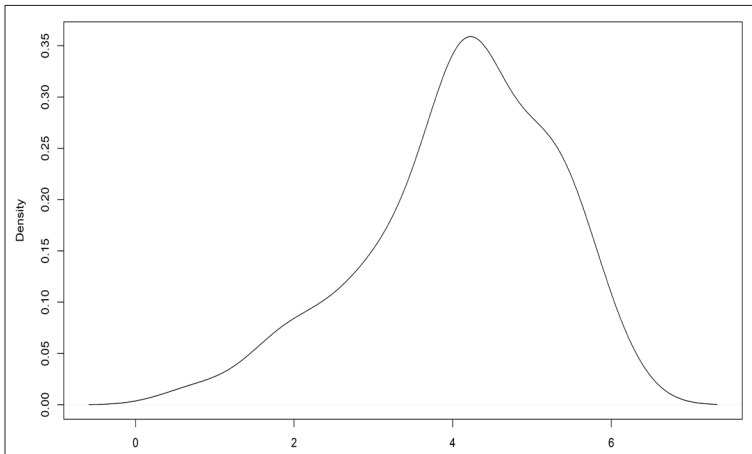


Figure 7 Density plot of SSA scores

Picture-Description Task. Coded responses from the picture-description tasks ($N = 59$) were analysed to examine the distribution of target description types across conditions. Active descriptions constituted 91% of total responses ($n = 1606$), while passive sentences accounted for 6% of observations ($n = 112$). Other responses represented 2% of the data ($n = 38$), and a small proportion of descriptions (1%, $n = 14$) was not given.

Table 3 illustrates total counts and ratios of target description types across prime type conditions. Although active sentences were considerably more frequent than passive sentences, passive constructions were produced more often following a passive prime (10%) than an active prime (3%), yielding a 7% passive priming effect.

Table 3 Total counts (n) and proportions (ratio) of target description types by prime type

Prime type	Target descriptions							
	Active		Passive		Other		Missing	
	n	ratio	n	ratio	n	ratio	n	ratio
Active	837	.95	23	.03	18	.02	7	.01
Passive	769	.87	89	.10	20	.02	7	.01

Note Ratios represent the number of responses of each type divided by the total responses for that prime type.

Breaking down the data by priming direction allowed comparison between the Italian-to-Spanish ($N = 27$) and Spanish-to-Spanish ($N = 32$) conditions. Results revealed a 4% passive priming effect in the cross-linguistic task and a 9% effect in the within-language task, indicating that Spanish passive primes elicited Spanish passive descriptions more frequently than Italian primes.

Table 4 Counts and proportions of passive target descriptions by prime type and priming direction

Prime type	Passive target descriptions			
	IT-ESP		ESP-ESP	
	n	ratio	n	ratio
Active	4	.01	19	.04
Passive	19	.05	70	.15

Target response types were also examined by animacy condition, with analyses reported in Table 5. Passive responses varied across animacy conditions: 65% occurred in the animate-agent animate-patient (*AnAn*) condition, whereas 35% occurred in the animate-agent inanimate-patient (*AnIn*) condition.

Table 5 Total counts and proportions of target description types by animacy condition

Animacy	Target descriptions							
	Active		Passive		Other		Missing	
	n	ratio	n	ratio	n	ratio	n	ratio
AnAn	783	.88	73	.08	22	.02	7	.01
AnIn	823	.93	39	.04	16	.02	7	.01

Note Ratios represent the number of responses of each type divided by the total responses for that animacy condition.

Similar patterns were observed in both versions of the task (IT-ESP and ESP-ESP). In the Italian-to-Spanish task, 70% of passive responses occurred in the *AnAn* condition ($n = 16$), whereas 30% occurred in the *AnIn* condition ($n = 7$). In the Spanish-to-Spanish task, the corresponding proportions were 64% ($n = 57$) and 36% ($n = 32$).

Table 6 Counts and proportions of passive target descriptions by animacy and priming direction

	Passive target descriptions			
	IT-ESP		ESP-ESP	
Animacy	n	ratio	n	ratio
<i>AnAn</i>	16	.12	57	.04
<i>AnIn</i>	7	.07	32	.02

Overall, descriptive measures indicated that passive responses increased following passive primes and were more frequent following Spanish primes than Italian primes. Finally, passive target productions predominantly described transitive events with an animate agent and patient, regardless of priming direction.

Results of the first mixed-effects logistic regression are presented in Table 7. The regression revealed that, overall, passive responses were significantly more likely following passive primes than active primes ($OR = 5.32$, $CI [2.78, 10.20]$, $p < .001$). Animacy also significantly influenced passive production ($OR = 0.49$, $CI [0.27, 0.90]$, $p = .021$), with fewer passives occurring when the patient was inanimate. Proficiency did not significantly predict passive production ($p = .386$), nor was the interaction between animacy and proficiency significant ($p = .781$).

Table 7 Summary of the mixed-effects logistic regression predicting passive target responses

Predictors	Passive Target Descriptions			
	OR	SE	CI	p
(Intercept)	0.01	0.00	[0.00, 0.02]	<.001
prime type [passive]	5.32	1.77	[2.78, 10.20]	<.001
animacy [<i>AnIn</i>]	0.49	0.15	[0.27, 0.90]	.021
zSSA	1.30	0.40	[0.72, 2.37]	.386
animacy [<i>AnIn</i>] x zSSA	0.95	0.19	[0.64, 1.40]	.781
Observations	1770			
Marginal R^2 / Conditional R^2	0.118 / 0.579			

Figure 8 illustrates the effect of prime type on passive production, showing that passive primes significantly increased the predicted probability of producing a passive response compared to active primes, confirming robust structural priming.

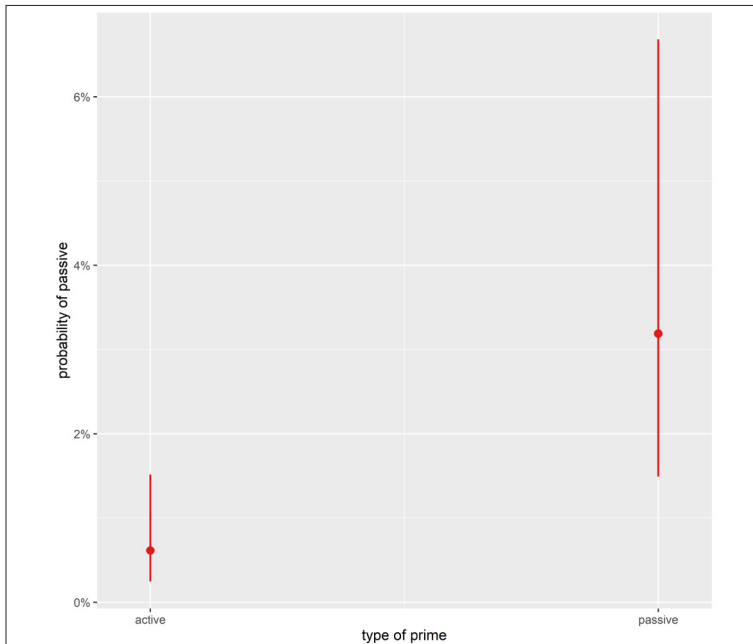


Figure 8 Predicted probability of producing a passive response by prime type, based on the mixed-effects logistic regression

Similarly, Figure 9 presents predicted passive production probabilities across animacy and proficiency conditions, showing a higher likelihood of passive constructions with animate rather than inanimate patients. The figure further indicates an increase in passive production as proficiency rises in both animacy conditions. The *AnAn* condition also shows a somewhat steeper increase than the *AnIn* condition, suggesting a potential proficiency-by-animacy pattern that merits further investigation. However, given the non-significant interaction ($p = .781$), this observation should be treated cautiously and requires replication within a larger sample.

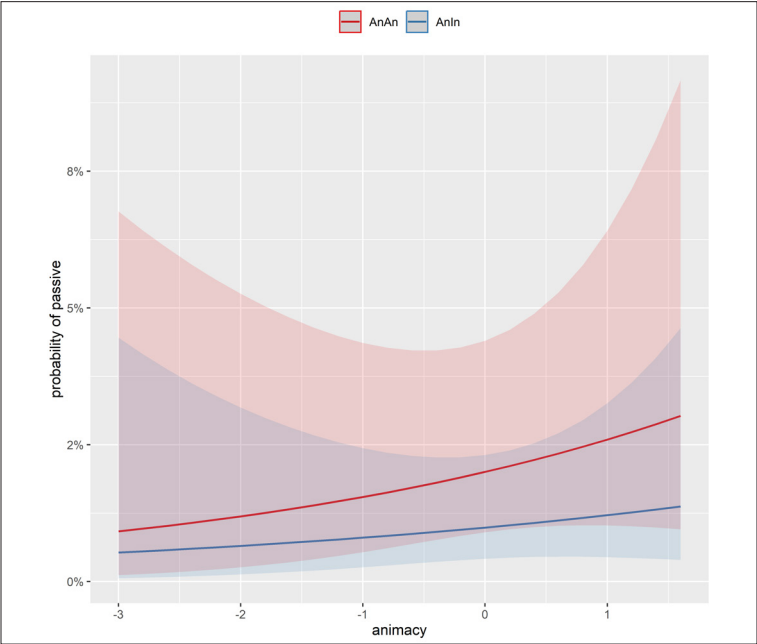


Figure 9 Predicted probability of producing a passive response by animacy and proficiency, based on the mixed-effects logistic regression. *Note* Shaded areas represent 95% confidence intervals. Proficiency is standardised (zSSA).

Results of the second mixed-effects logistic regression are presented in Table 8. Priming direction significantly affected passive priming ($OR = 0.10$, $CI [0.02, 0.48]$, $p = .004$), with the odds of producing a passive response in the Italian-to-Spanish condition approximately 90% lower than in the Spanish-to-Spanish condition. Proficiency and its interaction with priming direction, instead, did not reach significance ($p_s > .05$). Results are further illustrated in Figure 10.

Table 8 Summary of the mixed-effects logistic regression predicting passive priming

Primed Passive Descriptions				
Predictors	OR	SE	CI	p
(Intercept)	0.01	0.00	[0.00, 0.03]	<.001
priming direction [IT-ESP]	0.10	0.08	[0.02, 0.48]	.004
zSSA	1.29	0.51	[0.60, 2.78]	.516
priming direction x zSSA	2.37	1.86	[0.51, 11.05]	.270
Observations	1770			
Marginal R ² / Conditional R ²	0.101 / 0.770			

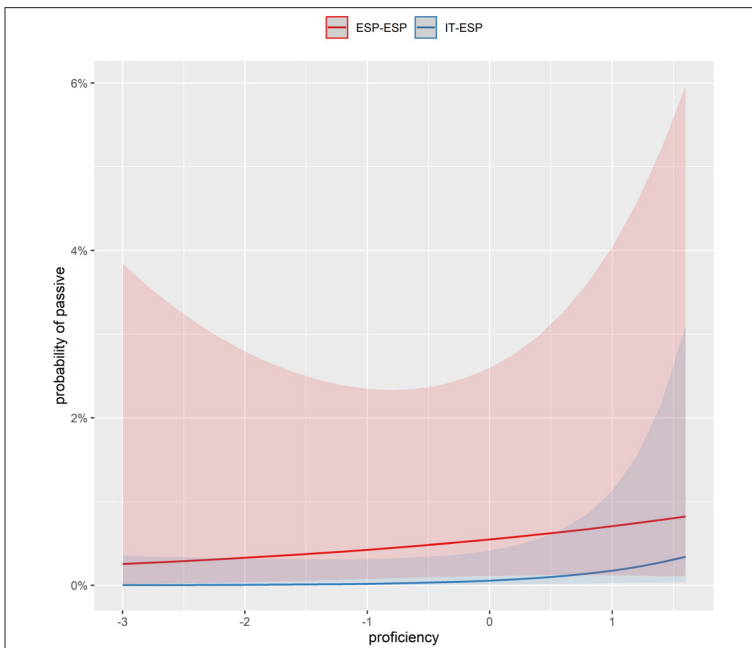


Figure 10 Predicted probability of producing a primed passive description by priming direction and proficiency (zSSA)

The plot shows the probability of producing a passive response following a passive prime across the proficiency continuum for both priming directions. Consistent with the model estimates, there is a clear main effect of priming direction, with within-language priming (ESP-ESP) consistently yielding higher priming probabilities. Although the interaction between proficiency and priming direction was not statistically significant ($OR = 2.37$, $CI [0.51, 11.05]$, $p = .270$), the trajectories in Figure 10 appear to differ descriptively across the proficiency continuum. In particular, the ESP-ESP condition shows a relatively gradual increase, whereas the IT-ESP condition appears comparatively flat at lower proficiency levels and somewhat higher at proficiency levels above the mean ($z > 0$). Given the non-significant interaction, however, these differences should be interpreted as exploratory visual patterns rather than evidence of a reliable proficiency-by-priming-direction interaction and would benefit from replication with a larger sample.

4 Discussion

Overall, the descriptive measures revealed a 7% increase in passive production following a passive prime, and the mixed-effects linear regression confirmed a significant effect of prime type on the production of passive responses ($p < .001$) (RQ1). This pattern aligns closely with the residual activation framework proposed by Pickering and Branigan (1998), according to which recently activated combinatorial nodes remain temporarily more accessible and bias subsequent structural choices. The increased likelihood of passive production following passive primes supports the prediction that syntactic representations remain activated across prime-target pairs facilitating structural persistence.

Furthermore, primes containing animate patients elicited a higher proportion of passive responses than those containing inanimate patients ($p = .020$) (RQ2). The additive effect of animacy observed in the present study is consistent with the broader view that semantic properties of noun phrases contribute to passive processing. In particular, Sánchez-Walker (2024) identifies animacy as a cue that favours specific interpretations of the agent and patient roles in passive constructions. The present findings extend this perspective to passive production by showing that animacy affects the likelihood of producing a passive, suggesting that this semantic information may also influence structural encoding, with animate patients being more likely to be selected as the prominent subject of a passive. Animacy was also expected to interact with proficiency, reflecting the increasing role of conceptual accessibility during incremental positional encoding as proficiency increases (RQ3). While such interaction was not statistically significant, analyses suggest a trend consistent with the predicted pattern [fig. 10].

As far as priming direction is concerned, stronger priming was expected in the Spanish-to-Spanish version of the task (RQ4). Indeed, a smaller passive effect was found in the cross-linguistic task (4%) than in the within-language task (9%). This significant difference ($p = .004$) can be attributed to the fact that cross-linguistic priming requires activation to spread across language-specific nodes, whereas within-language priming involves shorter activation routes. This pattern is coherent with previous findings reported by Schoonbaert, Hartsuiker and Pickering (2007, 164-7).

Larger Italian-to-Spanish passive priming effects were expected especially among highly proficient speakers of Spanish (RQ3). Although the interaction between L2 proficiency and priming direction did not reach statistical significance ($p = .270$), results suggest that cross-linguistic priming increases as learners reach advanced levels ($z > 0.5$) of Spanish [fig. 10]. In other words, once learners obtain a certain threshold of proficiency, Italian primes appear more effective

at triggering Spanish passive constructions. This pattern aligns with the separate-to-shared syntax account proposed by Bernolet and colleagues (2013), which posits that highly proficient bilinguals develop more strongly integrated syntactic representations across their languages.

5 Conclusions

The present study was designed with the aim of shedding light on the functioning of the multilingual mind: do the languages we speak reside in separate compartments in our brains, or does all linguistic information go into one general storage? What happens when a speaker is temporarily unable to retrieve a word in the language currently in use, yet can readily access its equivalent in another language? At the same time, what enables multilingual speakers to produce fluent speech in one language without constant unintended influence from another? In this context, cross-linguistic priming represents a valuable window into the nature of bilingual mental representation.

After preparing and norming materials, as well as piloting the experiment, we administered a syntactic priming study targeting passive production in Italian-Spanish late bilinguals. Participants anonymously answered a questionnaire on their linguistic profile (BLP, Birdsong et al. 2012) and completed a task where they alternated reading sentences out loud (prime) and describing pictures using provided words (target). Part of the sample read sentences in Italian, while the rest read sentences in Spanish; pictures were always described in Spanish.

Our findings indicate that structural nodes activated by recent exposure bias subsequent production, while semantic features like animacy shape encoding in both L2-to-L2 and L1-to-L2 tasks. Cross-linguistic priming was weaker than within-language priming but tended to strengthen with higher L2 proficiency, indicating that residual activation can spread along both language-specific and shared syntactic representations, especially in highly proficient learners.

In line with the network model of language representation proposed by Bock and Levelt (1994), the activation account of priming proposed by Pickering and Branigan (1998), and the separate-to-shared syntax model developed by Bernolet, Hartsuiker and Pickering (2013), the findings of our study show that bilingual syntactic representations are flexible and hierarchically organised. Overall, bilingual sentence production reflects an interplay of structural activation, semantic salience, and potential proficiency-driven integration of L1 and L2 syntactic representations.

Our findings should be interpreted in light of a series of methodological constraints. First, passive responses were relatively infrequent overall, accounting for only 6% of all target descriptions. This low base rate may have limited our ability to detect interactions and subgroup effects in some of the more fine-grained analyses (namely, proficiency $\times$ animacy and proficiency $\times$ priming-direction). The absence of significant proficiency-related interactions may therefore reflect limited statistical power, rather than necessarily indicating an absence of proficiency modulation. Notably, the interaction plots [figs 9-10] show trends consistent with our predictions, suggesting a promising foundation for future, better-powered experiments.

Additionally, although the Italian-to-Spanish and Spanish-to-Spanish conditions differed substantially in priming magnitude ($OR = 0.10$), this asymmetry may partly reflect pre-existing differences between the participant groups rather than priming direction per se. In particular, participants' L2 proficiency and acquisition histories may have differed across conditions in ways that are not fully captured by self-reported proficiency measures. A within-participants, counterbalanced design would allow a more direct comparison of priming across directions while controlling for between-participant variability.

Finally, conducting the experiment online facilitated data collection but prevented verification that participants consistently read sentences aloud, potentially attenuating priming effects. Future replications could therefore benefit from in-person testing or incorporating video recordings to ensure compliance with task instructions.

Future research could extend our findings in several directions. Applying the paradigm to more distant language pairs would help clarify the generality of our findings and the role of cross-linguistic influence in bilingual sentence production. Reversing L1-L2 profiles – targeting native speakers of Spanish who know Italian as a second language – would contribute to investigating how directionality shapes bilingual syntactic processing. Well-powered replications, ideally conducted in person or with video monitoring, could verify instruction compliance and strengthen the reliability of observed effects. Overall, this study contributes to a more nuanced understanding of bilingual sentence production, illustrating how interconnected and flexible syntactic representations allow multiple languages to coexist and interact in the multilingual mind.

Appendix A: BLP scoring

Table A1 BLP module-level scoring procedures

BLP module	N. of items	Response range	Scoring
Language history	6	0-20	Numerical response value, with specified reverse-scored items and exceptions
Language use	5	0-10	Numerical response value
Language proficiency	4	0-6	Numerical response value
Language attitudes	4	0-6	Numerical response value

Note Responses to the BLP questionnaire were scored separately for Italian and Spanish. Items within each module were assigned numerical scores based on the response provided. The obtained numerical scores were then summed to calculate module scores. For the complete scoring procedure, including item-specific scoring rules and exceptions, see Birdsong et al. (2012).

Table A2 BLP module adjustment factors

BLP Module	Adjustment factor
Language history	0.454
Language use	1.09
Language proficiency	2.27
Language attitudes	2.27

Note Calculated module scores were multiplied by the corresponding adjustment factor. The adjusted module scores were then summed to obtain a global score for each language, with a maximum possible score of 218.

Table A3 Calculation of the BLP score: worked example

BLP module	Module score		Adjusted score	
	IT	ESP	IT	ESP
Language history	102	24	46.308	10.896
Language use	50	24	54.5	26.16
Language proficiency	24	23	54.48	52.21
Language attitudes	24	21	54.48	47.67
Language score	-	-	209.768	136.936
BLP score			72.832	

Note The example illustrates the calculation from module scores to the final BLP score for one participant. Module scores were obtained following the scoring procedures described in Table A1. Adjusted module scores were obtained by multiplying each module score by the corresponding adjustment factor reported in Table A2. The adjusted module scores were then summed to obtain a global score for each language. The BLP score was calculated by subtracting the Spanish language score (less dominant language) from the Italian language score (dominant language).

Appendix B: SSA scoring

Table B1 SSA items and scoring

BLP item	Skill	Response range	Scoring
12. How well do you speak Spanish?	Speaking	0-6	Numerical response value
13. How well do you understand Spanish?	Comprehension	0-6	Numerical response value
14. How well do you read Spanish?	Reading	0-6	Numerical response value
15. How well do you write Spanish?	Writing	0-6	Numerical response value

Note The SSA score was calculated as the mean of the Language proficiency module items, comprising four self-reported Spanish proficiency ratings: speaking, comprehension, reading, and writing.

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