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First Language Attrition in Late Bilingualism:

Lexical, Syntactic and Prosodic Changes in English-Italian Bilinguals

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Abstract

Among the most notable findings in recent bilingualism research is that the two languages are constantly active, thus giving rise to complex interactions, in the bilingual mind. One of the natural consequences of these interactions is the non-pathological attrition of the firstly acquired language, which is here understood as the manifestation of selective and reversible changes in the way the first language is processed and produced by speakers of a second language. In the last forty years, these changes have been investigated mainly in long-term residents immersed in a second language environment (usually anglophone countries) rather narrowly, by focusing only on a single domain in the first language. What happens to other types of late (i.e., post-puberty) bilingual speakers in different language domains at the same time, alongside what happens to their second language, is mostly underexamined.

Hence, this thesis aims to fill the aforementioned research gaps by investigating the attrition of a firstly acquired language (English) in three different language domains (the lexicon, syntactic interfaces and prosody) of two types of late bilingual speakers (British classroom-based learners of Italian at UK universities as well as British long-term residents in Italy), by also considering what happens in their second language (Italian) within the same domains. The results of this research show, firstly, that similar types of lexical retrieval interference are experienced by both classroom learners and long-term residents, with only a slightly higher degree of interference being experienced by long-term residents. Secondly, syntactic interface structures are selectively affected by first language attrition only for long-term residents, even though both bilingual groups resolve syntactic ambiguities in the second language similar to a control group of first language speakers of Italian

(despite some processing delays). Thirdly, while prosodic changes in the first language are not reported for either bilingual group – at least in initial confirmatory analyses – both groups do seem to have acquired the prosodic patterns of their second language, with long-term residents being virtually indistinguishable from Italian controls.

Taken together, the findings of this thesis lend support to the idea that non-pathological attrition of a first language is a natural by-product of bilingualism, as it is found to affect the processing and production of different first language domains for both late bilingual groups examined. Crucially, these research findings reveal that the extent to which attrition is experienced varies according to the language domain and the specific structure under investigation. Interestingly, an inverse relationship between the second language and the first language is found for some bilingual speakers in certain areas, but not conclusively in others (e.g., for long-term residents in some aspects of the lexicon and syntax, but whether this is also the case for their prosody is not yet clear). This work thus points to the need for further research into first language attrition and second language acquisition, to fully understand the complex relationship between the two languages in the bilingual mind.

Lay Summary

Recent research on bilingualism, broadly understood as the use of more than one language, found that both languages are always active and interact in the mind of bilingual speakers. One of the consequences of the interaction of the two languages for bilinguals is that localised, non-permanent changes can be experienced in the comprehension and production of their language acquired first in life – a phenomenon known as first language ‘attrition’. Usually, first language attrition has been examined in isolation, by focusing on bilingual speakers who have long been immersed in their second language abroad (usually in English-speaking countries), mainly looking at only one area of their first language. What has been overlooked, on the other hand, is whether other speakers who learn a second language after puberty, also referred to as ‘late’ bilinguals, experience attrition in different areas of their first language as well, and whether these changes may happen in parallel to the development of their second language.

Therefore, this thesis aims to answer the above questions by examining the attrition of a firstly acquired language (English) in three different areas of language (vocabulary, grammar and pronunciation) for two types of late bilingual speakers (British learners of Italian at UK universities as well as British residents who have been living in Italy for a long time), by also considering what happens in their second language (Italian) within the same language areas. The results of this research show, to begin with, that both bilingual groups experience similar types of interference in the way they access words in their mental vocabulary, with only a slightly higher degree of interference being experienced by long-term residents. Secondly, some grammatical structures (for example pronouns, such as ‘he’ or ‘she’) are affected by first

language attrition only in long-term residents, even though both bilingual groups understand potentially ambiguous forms in the second language similar to Italian speakers who do not speak other languages fluently (despite some delays in their understanding). Thirdly, while changes in pronunciation in the first language are not reported for either bilingual group – at least in the analyses carried out to confirm the initial predictions of the study – both groups do seem to pronounce words in their second language similar to Italians, with long-term residents being virtually indistinguishable from Italians.

In sum, the findings of this thesis support the idea that attrition in a first language is a natural consequence of bilingualism, given that changes in the comprehension and production of a first language are found for both bilingual groups, in different areas of language, in the present study. Importantly, these findings reveal that the degree of attrition experienced depends on the language area and the specific linguistic phenomenon under investigation. Interestingly, an inverse relationship between the second language and the first language is found for some bilingual speakers in certain areas, but not conclusively in others (e.g., for long-term residents in some aspects of their vocabulary and grammar, but whether this is also the case for their pronunciation is not entirely clear). Thus, this work emphasises the need for further research into changes in the first language and the acquisition of a second language, to fully understand the complex relationship between the two languages in the bilingual mind.

Riassunto

La ricerca recente sul bilinguismo, qui intenso in maniera ampia come l'uso di più di una lingua, ha scoperto che le due lingue sono costantemente attive e interagiscono nella mente bilingue. Una delle conseguenze dell'interazione delle due lingue per i bilingui è che alcuni cambiamenti, localizzati e non permanenti, possono verificarsi nella comprensione e nella produzione della loro prima lingua acquisita; tal fenomeno è noto con il nome di "attrito" della prima lingua. Generalmente, l'attrito linguistico viene esaminato in maniera isolata, concentrandosi sui parlanti bilingui che sono stati immersi per lungo tempo nella loro seconda lingua all'estero (di solito in paesi di lingua inglese), analizzando principalmente solo un'area della loro prima lingua. Viene trascurato, invece, se anche gli altri parlanti che imparano una seconda lingua dopo la pubertà, detti anche bilingui "tardivi", sperimentano cambiamenti in diverse aree della loro prima lingua, e se questi cambiamenti si verificano parallelamente allo sviluppo della loro seconda lingua.

Pertanto, questa tesi mira a rispondere alle domande sopracitate, esaminando l'attrito di una lingua acquisita per prima (l'inglese) in tre aree linguistiche diverse (il lessico, la grammatica e la pronuncia) per due tipi di parlanti bilingui tardivi (gli studenti britannici che apprendono l'italiano nelle università del Regno Unito e i britannici residenti in Italia da molto tempo), considerando anche quanto accade nella loro seconda lingua (l'italiano) all'interno delle stesse aree linguistiche. I risultati di questa ricerca mostrano, per cominciare, che entrambi i gruppi bilingui sperimentano tipi simili di interferenza nel modo in cui accedono alle parole nel loro lessico mentale, con un grado di interferenza solo leggermente maggiore nel caso dei residenti in Italia. In secondo luogo, alcune strutture grammaticali (ad

esempio i pronomi, come "lui" o "lei") sono influenzate dall'attrito della prima lingua unicamente nei residenti a lungo termine, anche se nella seconda lingua entrambi i gruppi bilingui comprendono strutture grammaticali potenzialmente ambigue in maniera simile ai parlanti italiani che non parlano altre lingue in maniera fluente (nonostante alcuni ritardi nell'interpretazione). In terzo luogo, sebbene non siano rilevati cambiamenti nella pronuncia della prima lingua per nessuno dei due gruppi bilingui (almeno nelle analisi effettuate per confermare le previsioni iniziali dello studio), entrambi i gruppi sembrano pronunciare le parole nella loro seconda lingua in maniera simile agli italiani, con i residenti in Italia che risultano praticamente indistinguibili dagli italiani.

In breve, i risultati di questa tesi supportano l'idea che l'attrito in una prima lingua sia una conseguenza naturale del bilinguismo, dato che i cambiamenti nella comprensione e nella produzione di una prima lingua vengono riscontrati, in questo studio, in diverse aree del linguaggio dei due gruppi bilingui. È importante sottolineare che questi risultati rivelano che il grado di attrito sperimentato dipende dall'area linguistica e dal fenomeno linguistico esaminato nello specifico. È interessante notare, inoltre, che esiste una relazione inversa tra la seconda lingua e la prima lingua, per alcuni parlanti bilingui, in alcune aree linguistiche ma non in maniera conclusiva in altre (ad esempio, per i residenti in Italia, in alcuni aspetti del lessico e della grammatica, ma non è interamente chiaro se ciò accada anche nella pronuncia). Dunque, questo studio sottolinea la necessità di ulteriori ricerche sui cambiamenti nella prima lingua e sull'acquisizione di una seconda lingua, per comprendere appieno la complessa relazione fra le due nella mente bilingue.

Signed Declaration

I declare that this thesis has been composed by myself and that the research reported here has been carried out by myself, except where due acknowledgment is made. I also confirm that the work presented hereafter has not been submitted for any other degree or professional qualification. Following the *viva voce* examination, parts of all chapters are intended to be submitted for publication with co-authors Vasiliki Chondrogianni, D. Robert Ladd and Antonella Sorace.

A handwritten signature in black ink, reading "Mattia Zingaretti". The signature is written in a cursive style with a horizontal line underneath it.

Mattia Zingaretti

31 October 2022

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Perché non mi sento più a casa in inglese? Come mai non mi rincuora la lingua in cui ho imparato a leggere, a scrivere? Cosa è successo, e cosa significa? Lo straniamento, il disincanto che provo mi confonde, mi turba.

Why don't I feel more at home in English? How is it that the language I learnt to read and write in doesn't comfort me? What happened, and what does it mean? The estrangement, the disenchantment confuses, disturbs me.

—Jhumpa Lahiri, *In Altre Parole*

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Introduction

As pointed out by Schmid (2016, 186), the phenomenon of language attrition has increasingly received attention for over forty years now. In particular, attrition research has become more neatly defined and theoretically grounded since the initial publications on a wide variety of topics, such as the non-pathological loss of a fully acquired first language (L1) or second language (L2), incomplete acquisition, language contact and death, dialect change and death, and pathological language loss. The specific focus of this thesis is on late bilinguals' non-pathological L1 attrition, also referred to as 'attrition proper' (Schmid 2016, 186; Köpke and Schmid 2004, 5). In this work, the term attrition is used to denote the manifestation of *selective changes* (cf. Chamorro, Sorace and Sturt 2016; Chamorro, Sturt and Sorace 2016; as detailed in §§ 1.1.2.2-1.1.2.3) in the *online* comprehension and production of different L1 domains, mainly - though *not exclusively* - due to cross-linguistic influence from the L2 (cf. § 1.1.3.2) and/or cognitive effects of bilingualism (cf. § 1.1.3.3). Precisely, this thesis analyses the lexical, syntactic and prosodic changes that may occur in the online comprehension and production of the L1 (i.e., English) of two groups of late L2 (i.e., Italian) speakers: namely, British long-term residents in Italy and British students of Italian at UK Universities.

Thus, before delving into the details of the research carried out in each of the three language domains aforementioned, this chapter sets the scene by presenting the most relevant findings of research into L1 attrition to date and some of the open questions in the field addressed by this thesis. The following sections provide an overview of (1) the emergence of non-pathological L1 attrition in late L2 acquisition, (2) the different L1 domains and structures where attrition manifests, and (3) the causes underlying L1 attrition.

1.1 Main Findings and Open Questions in L1 Attrition

1.1.1 *Late Bilingualism/L2 Acquisition and L1 Attrition*

Before examining the occurrence of L1 attrition, with specific reference to late bilingualism/L2 acquisition, it is necessary to explain what is understood as bilingualism in the first place. Over a decade ago, Grosjean (2010) begins his chapter ‘Describing Bilinguals’ by reporting the following anecdote:

One day, I was sitting at an outdoor café and overheard three people talking about what it means to be bilingual. [...] One of them insisted that being bilingual meant being totally fluent in two languages; another agreed and added that the bilingual person also had to have grown up with both languages. The third person was less assertive and mentioned simply the regular use of two languages. “After all,” she asked, “someone might know two languages fluently but almost never use one of them; does that make him bilingual? What about the person who doesn’t know the two languages to the same level but who uses them regularly? Isn’t she bilingual?”. (Grosjean 2010, 18).

Such contrasting and unclear views on what bilingualism is are still widely diffused today – suffice to say, even the online Cambridge English dictionary currently defines ‘bilingual’ as ‘able to use two languages *equally well*’ (Cambridge University Press 2022; emphasis added). In reality, these views are all representative of the wide range of experiences that bilingualism entails, as explained in the following section.

1.1.1.1 The Bilingual Continuum

Indeed, departing from Bloomfield’s (1933, 56) initial descriptions of bilinguals as necessarily native-like speakers in both of their languages, more recent scholars define bilingualism as a ‘continuum’ of experiences (Luk and Bialystok 2013; Bak 2016; Bonfieni 2018), which span from low-proficiency L2 speakers immersed in their L1 environment, to multilingual speakers using

more than two languages (or dialects; Grosjean 2010, 22) every day in the course of their lives. For instance, Valdés (2005, 414), points out that bilinguals fall along different points of the continuum as they manifest different strengths in their two languages. In her visual representation of the continuum, reported in Figure 1, she notes that a recently arrived immigrant with dominance in the immigrant language (i.e., 'A') and in early stages of acquiring an L2 (e.g., English; 'B') might be represented as 'Ab', while a fourth-generation (i.e., heritage) speaker may be represented as 'Ba', being dominant in English, the language acquired as an L1, and still retaining some L2 proficiency in the immigrant language. In this light, the continuum can refer to both individual bilingual speakers as well as different generations of bilingual speakers, depending on how the continuum is viewed.

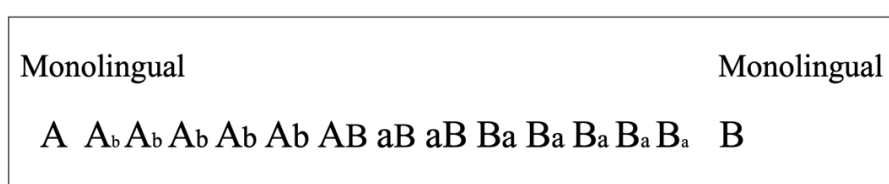


Figure 1. Valdés' continuum of L1/L2 users, ranging from monolingual proficiency in language A to monolingual proficiency in language B, from Valdés (2005, 414).

From this perspective, the focus in defining bilingualism shifts from language proficiency to language use, highlighting a great diversity among bilingual speakers in terms of purposes and domains of language use, and people with whom bilinguals use their different languages. In fact, seeing bilingualism as a continuum of experiences means acknowledging that bilinguals are rarely equally fluent in their languages, thus rejecting the misconceived idea that a bilingual is the sum of two monolinguals (cf. Grosjean 1989). In the research carried out for the purposes of this thesis, the focus is on L1 attrition in different kinds of *late* bilingual speakers (cf. Hoffmann 1991, 34) – namely,

learners of an L2 in adulthood, or, in other words, after the age of puberty (i.e., from fifteen/sixteen years of age onwards). Late bilinguals have thus fully acquired their L1, and they acquire their L2 either spontaneously (e.g., after migrating to an L2-speaking country) or through formal instruction.

1.1.1.2 Emergence of L1 Attrition in Late Bilingualism

To describe the emergence of L1 attrition in the late bilingual population, it is useful to consider Cherciov's (2011) integrated view of L2 acquisition, bilingualism, and L1 attrition, illustrated in Figure 2.

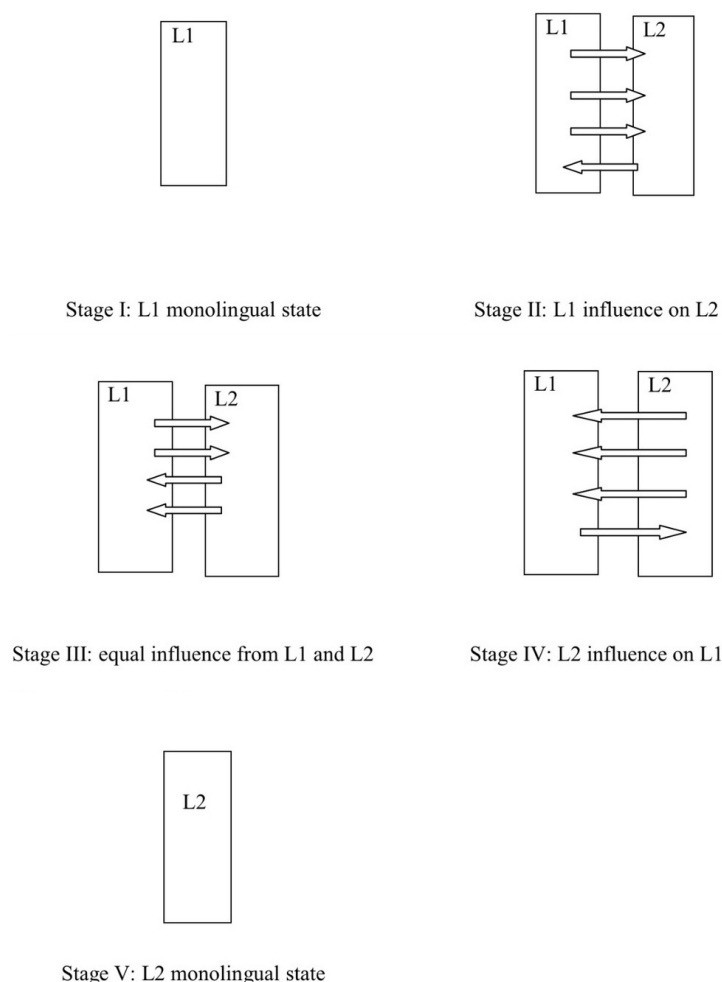


Figure 2. Five stages of Cherciov's integrated view of L2 acquisition, bilingualism, and L1 attrition, from an L1 monolingual state to an L2 monolingual state, from Cherciov (2011, 13).

According to Cherciov (2011, 14), stage I corresponds to an (L1) monolingual state, presumably before any L2 learning has taken place. As soon as the speaker engages in the L2 learning process, stage II begins. This is the earliest stage of bilingualism where crosslinguistic influence (CLI) arises – here intended (mostly) as transfer effects from the L1 to the L2, although target language effects on L2 development or L2-to-L1 effects may also be possible manifestations of CLI (see Chondrogianni and Vasić 2016).

Cherciov further (2011, 14) postulates, in line with Schmid and Köpcke's (2007) 'crosslinguistic traffic' notion, that some form of CLI in the other direction (i.e., from the L2 to the L1) is also possible in stage II (however, cf. § 1.1.3.2 on CLI as only *one* of the possible causes of L1 attrition). The presence of L2-to-L1 effects early on in (late) L2 acquisition is in opposition to previous models of bilingualism, such as Seliger and Vago's (1991, 5) model, reported in Figure 3. In their first stage of L2 learning (i.e., 'compound I bilingualism'), it is only the L1, together with Universal Grammar (UG) principles, that affects the L2. The L2 only comes to affect the L1 in their latest stage of L2 learning (i.e., 'compound II bilingualism', following the intermediate 'coordinate bilingualism' stage).

<i>Compound I bilingualism</i>	<i>Coordinate bilingualism</i>	<i>Compound II bilingualism</i>
L1 → L2	L1 → L2	L2 → L1
UG → L2	L2 → L2	L2 → L2
	UG → L2	L1 → L2
		UG → L2?
		UG → L1

Figure 3. Seliger and Vago's three stages of bilingualism (compound I bilingualism, coordinate bilingualism and compound II bilingualism), from Seliger and Vago (1991, 5).

In this sense, Cherciov's model is more in line with recent proposals deeming every bilingual speaker also an 'attriter', even early on during the L2 learning

process, to a certain degree (cf. Schmid and Köpke 2017a). However, interestingly, despite acknowledging that ‘attrition is a question of degree’ (Cherciov 2011, 19), in her research Cherciov narrowly defines as attriters *only* those participants who experience communication problems and whose L1 intelligibility is affected.

The increasing influence of the L2 on the L1 becomes even more established in Cherciov’s (2011, 14) stage III, where the linguistic knowledge of a bilingual is ideally ‘balanced’, and equal bidirectional effects are experienced. Stage IV, then, marks the beginning of language restructuring, whereby the L2 gets activated significantly when speaking the L1, while the opposite activation (i.e., that of the L1 when speaking the L2) is minimal (Cherciov 2011, 14-15). Conclusively, in stage V the bilingual speaker has become fully L2 dominant, and *de facto* monolingual in their L2. Cherciov (2011, 15) notes that such an extreme case (i.e., the complete loss of an L1) remains the theoretically possible end point of the attrition process despite not having been attested in the literature. As the research reviewed in this introductory chapter shows, the assumption that L1 attrition is cumulative and can therefore lead to complete L1 loss is highly unlikely, given that studies on L1 attrition in long-term migrants suggest that underlying L1 knowledge remains intact even after sixty years of migration to an L2-speaking country (e.g., Schmid 2002) and that there is also evidence in favour of L1 attrition reversal (e.g., Chamorro, Sorace and Sturt 2016) – see § 1.1.2.¹

Nevertheless, Cherciov’s integrated model raises important issues for the present thesis, and for research on L1 attrition in late bilingualism more

¹ Although beyond the scope of the research carried out for the present thesis, it needs to be pointed out that some recent research has also found evidence of attrition *without* L2 acquisition (cf. Baladzhaeva and Laufer 2018).

generally. Specifically, the kind of L2-to-L1 effects one might expect to see (e.g., lexical, grammatical, and/or phonological effects?) in the early stages of L2 acquisition/L1 attrition (i.e., stage II), and whether these effects only differ in quantity or also quality (e.g., L1 knowledge representations being affected *as well as* processing difficulties?) in later stages of L2 acquisition/L1 attrition (i.e., stages III and IV). By comparing two separate groups of late bilingual speakers (i.e., British long-term residents in Italy vs. British students of Italian at UK Universities) in lexical, syntactic and prosodic studies, this thesis addresses precisely these questions, and the final discussion of results across studies (Chapter 5) provides some answers to these issues.

For the aim of this introduction, it is also important to note that the above model is a useful illustration of the mutual interactions of the L1 and the L2 occurring to different extents, as the two languages co-exist and draw from a limited quantity of memory and processing space in the bilingual mind (Seliger and Vago 1991, 4). Indeed, as reported by Kroll *et al.* (2012, 231-232), one of the most striking research findings in recent years is that the two languages are always active in the bilingual mind, causing cross-language activity for bilinguals of all proficiencies, bilinguals with languages different in script (i.e., Hoshino and Kroll 2008) and bimodal bilinguals alike (i.e., Emmorey *et al.* 2008; Morford *et al.* 2011). Bilinguals of different kinds, then, all need to constantly inhibit the language not in use (see, e.g., Abutalebi and Green 2007). Some attrition scholars therefore suggest that these memory and processing demands give rise to a trade-off between languages (Opitz 2011), and that L1 attrition may indeed be the direct consequence of inhibiting the L2 with increasing difficulty when using the L1 (Schmid 2007) – see later discussion in § 1.1.3.3.

Since the cross-language interactions mentioned above are reported to occur at different levels of language processing (i.e., in the lexicon, grammar, and phonology; Kroll *et al.* 2012, 232), the following paragraphs illustrate (a) how, over the years, attrition research has come to incorporate the concept of ‘attrition without loss’ (Schmid and Köpke 2017b, 768), as well as (b) the different language domains and structures where evidence of L1 attrition has been found, outlining the related issues addressed by this thesis.

1.1.2 Attrition over Time: from Loss to Change

1.1.2.1 Early Research on Attrition as Language Loss

When examining the reported instances of L1 attrition, it needs to be highlighted that it is only recently that studies have come to investigate attrition as a matter related to online language processing. Indeed, the initial studies on attrition only investigated what would nowadays be defined as ‘offline’ L1 preferences, usually by means of acceptability judgment tasks. An example among others is Seliger’s (1991) study of O., a bilingual speaker emigrated to Israel at the age of six, who was shown to accept ungrammatical word order and double object judgments in her L1 English under the influence of L2 Hebrew (cf. Zingaretti 2017, for a more detailed overview). Importantly, in these studies, a drastic reduction in L1 exposure and use following many years of emigration to an L2 country often happened before the age of puberty, thus before having acquired the L1 fully, leading to the association of L1 attrition with structural erosion and, ultimately, language loss.

In later research also examining long-term migrants (e.g., in Schmid 2002, sixty years of emigration for German Jew refugees in anglophone countries during the Second World War), emotionality and (negative) attitudes

fuelled by exceptional circumstances (i.e., persecution) were found to be an even more determining factor affecting the severity of attrition outcomes. At least two important points need to be made here. Firstly, while many people worldwide are forcibly displaced as a result of persecution, conflict and violence (the estimate was over 82 million people in 2020; United Nations High Commissioner for Refugees 2020), there are also many migrants 'by choice' (estimated at around 199 million in 2020; United Nations Department of Economic and Social Affairs, Population Division 2020). For the latter, L1 attrition is thus not necessarily exacerbated by trauma-related negative attitudes towards the L1, and it would be unlikely for them to experience severe change or permanent L1 loss – also thanks to today's ease of access to L1 media which facilitates L1 maintenance (Zingaretti and Spelozzi 2021, 8).

Secondly, even in Schmid (2002), where interference data revealed attrition effects in morphology and syntax with emigration date significantly influencing the degree of attrition, in the proficiency data no influence could be detected – leading to the conclusion that L1 attrition affects only the way morphosyntactic rules are accessed online rather than overall proficiency (Schmid 2002, 190). In other words, as also argued in Zingaretti (2017, 16), if bilingual speakers' L1 intuitions are intact (e.g., as shown by their results on an acceptability judgment task), and bilingual speakers produce standard forms and structures correctly at times (i.e., with the same semantic intentions as those of L1 monolingual speakers, and in environments where monolinguals would also use them), then no syntactic/semantic/pragmatic loss of properties has occurred, but what has ultimately been affected is how these properties are processed in real time (Sharwood Smith and van Buren 1991; Hulsen 2000). Indeed, if speakers are able to maintain intact underlying knowledge after sixty years of emigration, 'we have to consider the possibility

that a language once learned can easily survive close to a lifetime of non-use' (Schmid 2002, 190) even for those who do not migrate by choice.

1.1.2.2 Attrition without Loss and its Manifestations

More recent evidence of attrition at the processing level gathered from studies of short periods of L2 immersion (e.g., Dussias 2004; Dussias and Sagarra 2007; Linck, Kroll and Sunderman 2009; reviewed in detail in Chapters 2 and 3) points to the fact that the role of L1 disuse in L1 attrition may be secondary to L2 exposure, the interactivity of the two languages, and L1 inhibition via L2 immersion (Gallo *et al.* 2021, 3). Although the extent to which L1 disuse and L2 influence contribute to L1 attrition is still debated (see § 1.1.3), the evidence reviewed here points to the conclusion that attrition does not necessarily involve language loss – if at all – contrary to what the term itself may suggest. No negative connotation is implied by the term, either, as attrition can be seen as a natural outcome of bilingual development (also in light of the results of the present research, cf. § 5.3 Implications). Thus, in agreement with Schmid and Köpke (2017a, 638), the use of the term 'attrition' intended 'without loss' (Schmid and Köpke 2017b, 768) in the present thesis is to provide coherence, cohesiveness and, importantly, visibility, to a relatively recent field of research.

With this premise in mind, online instances of L1 attrition have been reported in different language domains (see, e.g., Schmid and Köpke 2019, for a comprehensive overview): the lexicon (e.g., Linck, Kroll and Sunderman 2009; Schmid and Jarvis 2014), morphology (e.g., Dussias 2004), syntax (e.g., Tsimpli *et al.* 2004; Chamorro, Sorace and Sturt 2016), semantics (e.g., Ben Rafael 2001), and phonology/phonetics (e.g., Mennen 2004; van Maastricht, Krahmer and Swerts 2016; de Leeuw, Tusha and Schmid 2018). Recent

research also suggests that the perception of emotions may be impacted by L1 attrition (Kim and Starks 2008; Zingaretti, Garraffa and Sorace, Forthcoming). Importantly, evidence of attrition has been found in both typologically similar language combinations (i.e., German and Dutch; see Ribbert and Kuiken 2010) and typologically different language pairs (e.g., Korean and French; see Ventureyra, Pallier and Yoo 2004). Given that an in-depth review of studies on lexical, syntactic and prosodic attrition is carried out in Chapters 3, 4 and 5 of the present thesis, the following paragraphs point to some of the related overarching issues that the thesis addresses.

1.1.2.3 Selectivity and Reversibility of L1 Attrition

Firstly, attrition has been defined as a highly selective process which does not affect all structures within the same domain to the same extent (Chamorro, Sturt and Sorace 2016). Indeed, the results of both online and offline tasks in Chamorro, Sturt and Sorace (2016) reveal that direct object marking (i.e., the obligatory use of a dative preposition to introduce animate and specific objects in Spanish – e.g., ‘*María vio al niño esta mañana*’, lit. ‘*María saw to+the kid this morning*’, for ‘the kid’) is *not* affected by attrition in a group of Spanish-English bilinguals residing in the UK for at least five years. This is in opposition to what the same researchers have found for pronoun resolution in the same bilingual speakers (Chamorro, Sorace and Sturt 2016; cf. also Tsimpli *et al.* 2004; both discussed in detail in Chapter 3).

The possible reasons why different structures may or may not be affected by attrition are introduced in § 1.1.3 below and, with regards to syntax, they are later reviewed thoroughly in Chapter 3. What is central to this introduction is that not many studies have investigated the effects of attrition on different structures within the same domain as Chamorro, Sturt and Sorace

(2016) did – and no study to date has attempted to investigate whether three separate domains are affected in parallel within the same bilingual individuals. The present thesis thus constitutes an attempt at answering these questions, by not only investigating two structures within the syntactic domain (i.e., the resolution of pronouns and relative clause attachment ambiguity), but importantly by also examining what happens in two other domains at the same time (i.e., the lexicon and prosody).

Further, Chamorro, Sorace and Sturt (2016) examine an important issue that has not received much attention in the attrition literature, but which is nonetheless central to how attrition is understood: that is, the effects of re-exposure to the L1, thus L1 attrition reversibility. In their study, Chamorro, Sorace and Sturt (2016) investigated whether the attrition effects found in the resolution of ambiguous pronouns for Spanish-English bilinguals in the UK could be reverted by means of a one-week (re-)immersion period in Spain (i.e., their L1 country) before testing. The group of re-immersed (i.e., ‘exposed’) bilinguals was compared to a monolingual group of Spanish speakers (with very limited knowledge of English) and to another group of Spanish-English bilinguals who had also been in the UK for at least five years, but not undergoing L1 re-exposure (i.e., ‘attriters’).

In the offline results for the naturalness judgment task no difference was found across groups, with subject antecedents preferred when interpreting null pronouns, following Carminati’s (2002) Position of Antecedent Strategy (PAS; more on this in Chapter 3). By contrast, significant differences were found in the online eye-tracking results, reported in Figure 4 for (a) first pass reading times (i.e., length of all fixations in a region, without any regression or return), (b) go-past times (i.e., length of all fixations in a region, with regressions and/or returns) and (c) total times in the critical region

(i.e., 'ella/*pro* cruzaba' – 'she/*pro* crossed'). Firstly, all groups took significantly longer to resolve sentences with overt pronouns than sentences with null pronouns. Further, pronoun mismatch in overt pronoun resolution (i.e., overt pronouns forcedly resolved as referring to the subject, rather than the more natural object antecedent) was significantly noticed by both the monolingual and exposed groups, but not by the attriters. Interestingly, significant differences were only found between monolinguals and attriters.

Chamorro, Sorace and Sturt's (2016, 530-531) conclusions are that a reduction of attrition effects as a result of L1 re-exposure is possible, but also that bilinguals undergoing L1 re-exposure set themselves between monolinguals and attriters – as significant differences were indeed only found between monolinguals and attriters). Therefore, while a reduction of attrition effects seems possible, the extent to which bilinguals may go back to a fully (L1) monolingual system is yet to be determined by further research.² These findings are important as they ultimately add crucial evidence in favour of the concept of 'attrition without loss' (cf. earlier § 1.1.2.2).

² The present thesis had initially wished to investigate the extent of attrition reversibility by examining the effects of a one-year study abroad period in an L2 country (i.e., Italy) on a group of British university students of Italian. Specifically, participants would have been tested before the beginning and right at the end of the immersion period, as well as six months after returning to their L1 country (i.e., the UK). However, the COVID-19 pandemic halted all study-abroad programmes, consequently forcing a complete reconfiguration of the original research proposal, thus preventing the exploration of the extent of attrition reversibility.

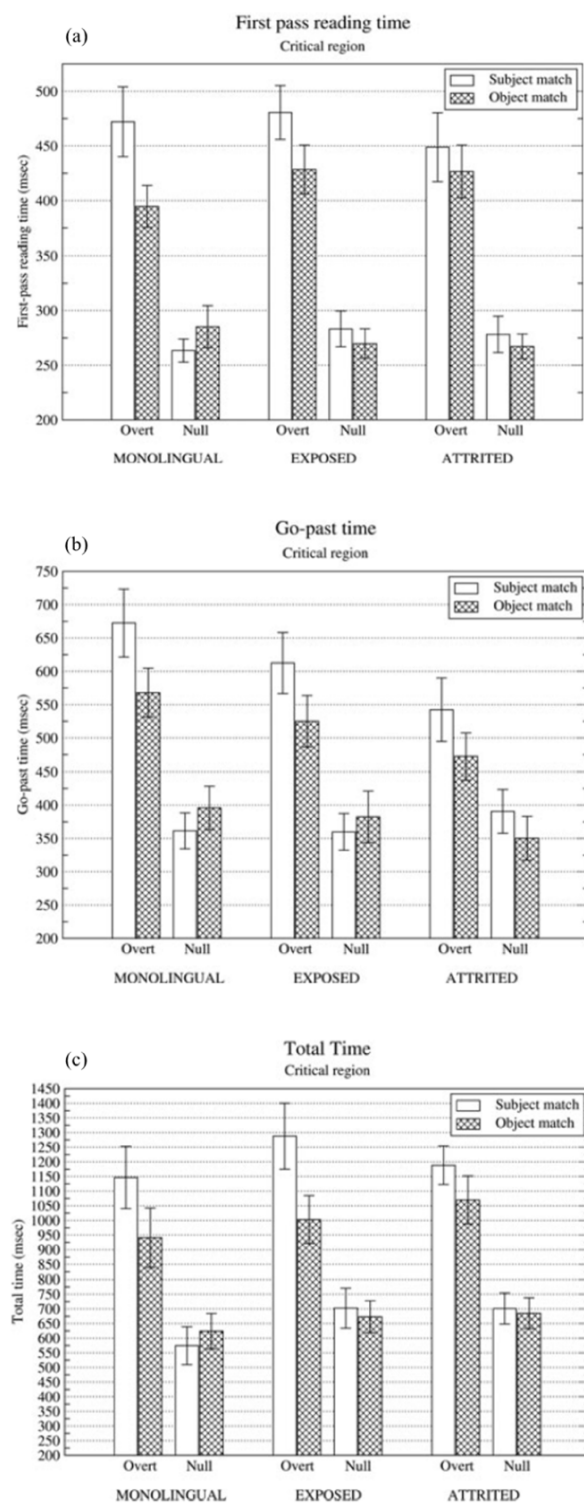


Figure 4. Eye-tracking results for (a) first pass reading times, (b) go-past times and (c) total times, comparing pronoun mismatch in overt and null-subject sentences across (1) 'monolingual' Spanish controls, (2) L1 re-exposed Spanish-English bilinguals, and (3) attrited Spanish-English bilinguals, from Chamorro, Sorace and Sturt (2016, 529).

Having clarified what has been considered attrition over the years, where evidence of attrition has been found, and some of the related issues addressed by this thesis, the following section draws this introduction to a close by highlighting the main causes that are thought to underlie L1 attrition and by explaining how this thesis contributes to the understanding of these causes.

1.1.3 The Cause(s) of L1 Attrition

In the lively debate on the causal mechanisms of L1 attrition, the three main factors reported are (1) the progressive disuse of the L1, (2) increasing CLI from the L2, and (3) competition in the allocation of cognitive resources. Each of these is discussed, in turn, below.

1.1.3.1 L1 Disuse

L1 disuse is one of the first factors that have been thought to be linked with L1 attrition, with the most convincing evidence coming from research on adopted children who, after leaving their L1 context, have been found to undergo drastic levels of L1 attrition (cf. Nicoladis and Grabois 2002; Pallier *et al.* 2003; Ventureyra, Pallier and Yoo 2004). Especially important for the focus of this thesis on attrition in late bilingualism are findings evidencing more severe attrition in adult participants whose contact with their L1 environment is weak (e.g., de Bot, Gommans and Rossing 1991; Köpke 1999).

On the other hand, less severe attrition has been found in bilinguals who use their L1 in formal contexts when compared to others who use the L1 with family and friends (e.g., Schmid 2007; Schmid and Dusseldorp 2010; Schmid and Mennen 2010; de Leeuw, Mennen and Scobbie 2012; de Leeuw, Yilmaz and Schmid 2012), suggesting that, alongside the amount of L1 use,

the context in which the L1 is used significantly affects the degree of attrition experienced in late bilinguals. Some have argued that those who use the L1 in a formal context experience less attrition because code-switching is often discouraged in such contexts, consequently limiting the amount of CLI which would otherwise be triggered by language co-activation – stimulating attrition (Grosjean and Py 1991; Green 2011; Green and Abutalebi 2013). However, empirical investigations have highlighted a lack of attrition in formal contexts where both languages are active, such as in the case of trainee and experienced translators (Miličević Petrović and Kraš 2017; Miličević Petrović, Kraš and Lisica 2019) – possibly because, in such cases, code-switching may actually facilitate L1 maintenance by allowing speakers to use and reinforce their L1 in a bilingual environment (also cf. § 2.2.2.2). Further research into the role of code-switching for L1 attrition in formal versus informal contexts therefore seems to be needed.

Ultimately, then, the degree of L1 attrition experienced may be determined by not only the amount of L1 exposure and use, but also by the context of L1 use and the amount of code-switching employed in daily interactions. Given that the research carried out for this thesis does not only employ an immersed group of L2 speakers with reduced L1 use (i.e., British residents in Italy), but also a group of L2 speakers in their L1 country with no reduction of L1 use (i.e., British students of Italian in the UK), finding evidence of L1 attrition in the latter group would disfavour seeing L1 disuse as the main causal mechanism underlying L1 attrition.

1.1.3.2 Crosslinguistic Interference

An alternative account used to explain the cause of L1 attrition is CLI from the L2 (for very recent overviews of crosslinguistic influence and its modulating

factors, in both bi/multilingual children and adults, cf. van Dijk *et al.* 2021; Degani, Prior and Wodniecka 2022). Indeed, L2-to-L1 effects have been reported in the literature for different language domains, such as at the morpholexical level (e.g., Pelc 2001), at the syntactic level (e.g., Dussias 2004), and at the phonological level (e.g., de Leeuw, Tusha and Schmid 2018).

Among different factors (cf. CLI overviews mentioned above), some scholars have tried to explain the occurrence of CLI by looking at language dominance – showing how CLI takes place from the dominant language to the non-dominant language (cf. Yip and Matthews 2000; Argyri and Sorace 2007). Other scholars have referred to the linguistic properties of the two languages – i.e., for a linguistic structure to be affected by CLI, it must involve more than one language domain (e.g., syntax and pragmatics), and it must be ambiguous. For instance, when language X has two options for a target structure, and language Y only has one, it is the ‘less restrictive’ language Y to affect language X and not vice versa (cf. Müller 1998; Hulk and Müller 2000; Müller and Hulk 2001). The predictions of Müller and Hulk’s hypothesis, for instance, have been tested amply in the distribution of pronominal forms, given that pronominal choice (e.g., between null and overt pronouns) is governed by pragmatic factors which vary across languages – e.g., Italian uses null pronouns to refer to topic antecedents and overt pronouns for non-topic antecedents, while English employs overt pronouns for both (more on this in Chapter 3).

Two CLI-related issues are central to the present introduction. Firstly, the fact that most attrition studies (both commented upon here and beyond) examine bilinguals whose L2 is English has led some to argue that the effects found may be mistaken as attrition due to L2-to-L1 transfer when, in reality, they are the consequence of L1 ‘internal’ factors (e.g., simplification or

generalisation, cf. Schmid 2002; Köpke and Schmid 2004). Indeed, as pointed out in Gallo et al. (2021, 4), English, being an ‘analytical language’, commonly relies on a limited repertoire of syntactic choices (given its simple lexical morphology and rigid word order). Since simplification and generalisation are both shifts to a simpler pattern that is common to both the L1 and L2, albeit less typical in the L1, and that simpler patterns are often found in (L2) English, the process could be thought of as reflecting L2 influence, when it may reflect L1 internal processes instead. However, although this view is supported by evidence from some studies (e.g., Isurin 2005; Laleko 2007), Gallo et al. (2021, 4) note that, even when simplification and generalisation are at play, they may not be operating in isolation, with the L2 possibly still influencing L1 processing.

The research carried out in this thesis hence attempts to shed further light on this matter, by examining late bilingual speakers whose L1 – not L2 – is English. Indeed, evidence of attrition in L1 English prompts taking into consideration factors that go beyond simplification and generalisation (given that English is already the simpler system), or even influence from the L2 (in this case Italian, the more complex system, as discussed in the coming chapters), when trying to explain the occurrence of attrition. A possibly complicating factor, however, is the status of English as today’s highly prestigious *lingua franca* (cf. Kahane and Kahane 1976; Francis and Ryan 1998), which makes it easier for L1 English bilinguals in an L2 country to access their L1 than for other bilinguals abroad, while also making it less necessary for L1 English speakers to learn an L2 – possibly lowering the degree of attrition found in L1 English.

1.1.3.3 Competition in the Allocation of Cognitive Resources

The other issue related to CLI relevant to this introduction is that the overextension of overt pronouns to contexts where null pronouns would be expected (i.e., topic continuation; cf. §§ 3.2.2.1-3.2.2.2) is not only found in the L1 of late bilinguals whose L2 is a non-null subject language (i.e., L2 English, as in Tsimpli *et al.* 2004), but also in speakers of two non-null subject languages, both bilingual adults (e.g., Bini 1993; Margaza and Bel 2006; Lozano 2006; Guido Mendes and Iribarren 2007; de Prada Pérez 2009) and children (e.g., Sorace *et al.* 2009; Michnowicz 2015; Rodríguez-Ordóñez and Sainzmaza-Lecanda 2018; Bonfieni *et al.* 2019). This evidence has led some scholars (e.g., Schmid 2007; Sorace 2011, 2014, 2016) to look for an alternative factor when explaining the cause of L1 attrition, which has been identified in the competition in cognitive resources allocation.

For instance, Sorace (2011, 2016) has expanded her initial ideas elaborated in the Interface Hypothesis (Sorace and Filiaci 2006), which previously located the source of difficulty for pronoun production and comprehension in the processing load related to referring to pragmatically appropriate antecedents. Precisely, given that bilingual speakers' languages are always active (Green 1998; cf. earlier § 1.1.1.2), and that bilinguals constantly need to inhibit the language not in use to avoid interference, the persistent need to separate the two languages may result in more competition for cognitive resources. In this light, the overextension of overt pronouns is an attempt, by the bilingual speaker, to solve this increasing cognitive competition – with overt³ pronouns, being explicit, used as a default form

³ It is to be noted that the overextension of overt – and not null – pronouns (often resulting in redundancy and, at times, ambiguity) is in line with the enhanced perspective-taking abilities found in bilingual speakers (e.g., Kovács 2009; Rubio-Fernández and Glucksberg 2012).

which relieves the processing demands of integrating pragmatic and/or contextual information in real time.

Interestingly, as also pointed out in Zingaretti (2017, 29), evidence in support of a cognitive resources account comes from studies that have found a greater degree of overt pronoun overextension in speakers of L2 Italian (e.g., Sorace and Filiaci 2006; Belletti, Bennati and Sorace 2007) in comparison to L1 Italian attriters (e.g., Tsimpli *et al.* 2004). This may be due to the fact that it is more costly to inhibit L1 English for L2 Italian speakers (as English is their dominant language), than it is for L1 Italian attriters to inhibit L2 English (as their secondary language). The very same fact that L1 attriters and L2 speakers seem to converge in the overextension of overt pronouns has led some to further suggest that changes in both quantity and quality of input may also affect processing abilities (Sorace 2011). Indeed, L1 attriters and L2 speakers receive input in their L1 and L2, respectively, that is quantitatively and qualitatively different from monolinguals of either language – resulting in fewer opportunities to coordinate information from different domains. Lastly, studies looking at bilingual children returnees (e.g., Kubota *et al.* 2020) also corroborate the cognitive resources account, as they find that CLI alone cannot account for the changes evidenced in returnees' performance on genitive preference, and that general processing difficulties are also at play. However, they also point to the need of defining degrees of processing difficulties, and not simply contrasting 'internal' and 'external' interfaces (as originally posited in Sorace and Filiaci 2006; see later § 3.2.1.2).

Therefore, while the discussion on the causal mechanisms of L1 attrition is very much open, it needs not be an either-or debate. L1 disuse, CLI, as well as cognitive processing demands may possibly (though not necessarily) work in tandem, giving rise to different degrees of L1 attrition, together with other

modulating factors – i.e., L1 attitudes (cf. Schmid 2002), crosslinguistic similarity, exposure, co-activation, and age of acquisition (cf. Schmid and Köpke 2017a), and changes in input quantity/quality (cf. Sorace 2011). The next section thus summarises the specific factors and questions that this thesis aims to address in the emergence of L1 attrition within late bilingualism, as well as giving an overview of the coming chapters in the thesis.

1.2 Aims and Structure of the Thesis

1.2.1 Research Questions, Hypotheses and Predictions

In the investigation of L1 attrition in late bilingualism, the present thesis aims to answer the following research questions (RQs):

1. Is evidence of L1 (i.e., English) attrition found in different groups of late L2 (i.e., Italian) speakers (i.e., British long-term residents in Italy and British students of Italian at UK universities)? If so, does attrition manifest itself differently in the two groups?
2. Does L1 attrition affect separate language domains (i.e., the lexicon, syntax and its interfaces, and prosody) simultaneously? And, within one of these domains (i.e., syntax), does L1 attrition affect the resolution of different structures (i.e., pronouns and relative clauses) similarly?
3. What is the relationship between late L2 acquisition and L1 attrition?

Given that, in this research, ‘attrition’ is interpreted in its wider meaning, thus hypothesised to subsume L1 changes in online processing (cf. ‘attrition without loss’ in Schmid and Köpke 2017b; see earlier § 1.1.2.2), the following predictions have been formulated:

1. Evidence of L1 English attrition is expected to be found in both groups of late bilingual speakers, albeit to different degrees, as ‘every bilingual is an attriter’ (Schmid and Köpke 2017b, 764). Specifically, long-term residents, further to the right on Valdés’ (2005) bilingual continuum, are expected to experience more attrition than university students, who are arguably more to the left of the continuum. Given their higher L2 proficiency, more frequent L2 use, and less frequent L1 use (with different people as well as in different contexts), long-term residents will show not only slower processing, but also lower accuracy and more different preferences from L1 ‘monolingual’⁴ controls, than university students in L1 comprehension/production. By contrast, attrition effects will be more limited for university students – e.g., showing only slower processing, but not necessarily lower accuracy or highly different preferences from L1 controls in comprehension and production tasks. However, the overall degree of L1 English attrition found is likely to be lower than that reported in previous research on L2 English speakers due to the prestige and lingua-franca status of English nowadays (Kahane 1986; Francis and Ryan 1998), which potentially allows long-term residents to access (and thus maintain) their L1 more easily, as well as making it less stimulating for university students to practice and better their L2 – than, for instance, bilinguals of other L1s (e.g., L1 Italian, Spanish, French, etc.) in anglophone countries or university students learning L2 English in their respective L1 countries.
2. L1 attrition is expected to be found in all of the domains under investigation, but not for all groups of speakers. Specifically, while long-

⁴ As explained in the methodology of the first study presented (§ 2.3.1), the participants chosen as English and Italian controls are ‘monolingual’ in the sense that they are not fluent in any language other than their L1. However, they may have studied foreign languages in school – highlighting an increasing difficulty in finding *fully* monolingual speakers nowadays.

term residents are expected to experience lexical, syntactic and prosodic attrition – as reported in the literature on L1 attrition in long-term residents for each of these domains (see specific predictions⁵ in each chapter) – university students are likely to undergo lexical attrition and, possibly, syntactic attrition, though to a lesser degree than long-term residents. It is also highly unlikely that students' L1 prosody will be affected (again, cf. predictions in each chapter). Due to the selectivity of L1 attrition (Chamorro, Sturt and Sorace 2016; see § 1.1.2.3 above), both the resolution of pronouns and that of relative clauses can undergo attrition, given that both structures involve the coordination of syntactic and discourse information. However, following the Interface Hypothesis (Sorace and Filiaci 2006), only the resolution of relative clauses is expected to undergo attrition in English – i.e., the more restrictive language, with 'of'-headed RCs usually attaching low and 'with'-headed RCs attaching high, while Italian RCs are always attached high – with no attrition being expected in the resolution of overt pronouns in English – i.e., the less restrictive language in this case, given the required use of overt subjects in English, whilst in Italian overt subjects are used more restrictively to signal topic shift, as opposed to null subjects (cf. predictions in Chapter 3).

3. In line with the view that higher degrees of L1 attrition are expected in more proficient L2 learners (cf. Cherciov 2011; see § 1.1.1.2), higher accuracy, more similar preferences to controls, and faster speed of

⁵ Prior to data collection, the predictions formulated for each domain were preregistered, along with sample size, variables and planned analyses, on the AsPredicted website (<https://aspredicted.org>). As parts of this thesis are intended to be submitted for publication following thesis submission, preregistration links are not provided here to maintain anonymity in the peer-review process. The links will be included in the article(s) published from this work. For the same reason, the full dataset and all analyses will also be made available on the Open Science Framework website (<https://osf.io>) following publication.

processing in an L2 domain (i.e., better L2 performance) are likely to correspond to lower accuracy, more dissimilar preferences from controls, and slower speed of processing in the respective L1 domain (i.e., a higher degree L1 attrition) for all bilingual speakers.

1.2.2 Structure of the Thesis and Chapters

Each of the next three chapters corresponds to the investigation of L1 attrition in L2 acquisition within a single domain. Specifically: Chapter 2 focuses on the lexicon; Chapter 3 examines syntax and its interfaces; finally, Chapter 4 explores prosody. Each chapter introduces the relevant background literature on L1 attrition and L2 acquisition, the structures under investigation as well as the RQs and predictions formulated for each study – pointing out possible differences from preregistered content where necessary. The methodology of each experiment is carefully examined to then report the results and an interim discussion thereof in each chapter.

In Chapter 5, the results of each individual study are discussed altogether in light of the overarching RQs and main predictions of the thesis (cf. § 1.2.1), whilst also accounting for the limitations of the present research. The thesis is thus brought to a close by summarising the main contributions of this research to the field(s) of L1 attrition and L2 acquisition/bilingualism, as well as suggesting possible avenues for future studies.

Lexical Attrition

2.1 Introduction

This chapter presents the first language domain under investigation – that is, the lexicon. To begin, the main findings of research into lexical attrition are reviewed, focusing on the different types of evidence widely used to suggest that the lexicon may be the first and most affected domain by attrition. Then, the hypotheses and factors providing possible accounts for the occurrence of lexical attrition are introduced. Specific evidence indicating the effects of L2 immersion on L1 word retrieval is thus discussed in relation to relevant models of bilingual lexical access. Having laid the basis for the experimental work on lexical attrition carried out for this thesis, the methodology and results of the study are presented and finally discussed.

2.2 Background

2.2.1 Instances of Lexical Attrition

As reported in Schmid and Köpke (2009, 211), the lexicon has often been described as the first and most ‘vulnerable’ or ‘sensitive’ domain of the linguistic system to undergo attrition (e.g., Weinreich 1953; Andersen 1982; Weltens and Grendel 1993; Köpke 2002). The scholars report at least two reasons why this assumption seems convincing: (1) the lexicon contains many more items (i.e., words) than, for instance, phonetic or morphological items; (2), the network of lexical items is much less interconnected than other networks (e.g., the phonological inventory), and it is thus better able to tolerate change than, for instance, the phonological or morphological systems

– where even minor changes can yield overall restructuring (Schmid and Köpke 2009, 211-212). However, as further pointed out, the lack of longitudinal data and of an agreed ‘measuring stick’ makes it difficult to compare the emergence of attrition over time in different linguistic systems (Schmid and Köpke 2009, 212).

Hence, the present thesis attempts to fill the gap in this direction by investigating lexical attrition alongside syntactic and prosodic attrition in two bilingual populations, and the issues related to operating a three-domain comparison are discussed in Chapter 5. Before delving into the details of the research carried out within the lexical domain, it is useful to consider what has been reported as evidence of lexical attrition in research throughout the years – specifically, both with regards to more severe instances of lexical attrition (i.e., vocabulary loss) and less severe cases thereof (i.e., effects in terms of fluency, accuracy and complexity).

2.2.1.1 Loss of Vocabulary

As Jarvis (2019, 241) notes, the complete loss of L1 vocabulary is the most severe case of lexical attrition. It is often found in speakers who begin acquiring a language in childhood, and end up losing the language following early-childhood adoption into a home or community where the language is not spoken. Usually, research into the loss or near-loss of a language learnt during childhood employs international adoptees – for instance, young children of seventeen months of age (e.g., Nicoladis and Grabois 2002) or even nine-year-olds (e.g., Isurin 2000). In particular, Isurin and Seidel’s (2015) case of TJ is the example of an adoptee born and raised in the US to a Russian-speaking mother, who was later adopted by another family in the US that only spoke American English to her, consequently causing her to lose Russian. TJ

even forgot that she had known some of the language, and discovered she could speak a few words of a language similar to Russian or Ukrainian only whilst undertaking psychotherapy as an adult. Isurin and Seidel (2015) later found evidence that she had indeed begun acquiring Russian during childhood as she showed an advantage in learning words she probably would have known at three years of age (i.e., when she was adopted) over words she probably would have not known (e.g., *igraj* 'play' over *klekta* 'cage').

From the evidence reported above, severe lexical attrition (i.e., L1 vocabulary loss) thus seems a likely outcome for those who, not having fully acquired their L1, are removed from the L1 community and undergo a drastic reduction in L1 input/use, while becoming part of an L2 community and undergoing an increase in L2 input/use. However, for other bilingual speakers who emigrate after having fully acquired their L1 (such as the participants tested in the present thesis), the manifestation of lexical attrition is likely to be less severe, usually only affecting some aspects of L1 fluency, accuracy and complexity, as explained in the following section.

2.2.1.2 Changes in Fluency, Accuracy and Complexity

In both lexical production and comprehension, slowdown and failure are, according to Ecke (2004, 34) 'among the first and most obvious indicators of language attrition'. Importantly, as highlighted in Jarvis (2019, 242), these issues are a matter of access rather than of loss of memory representations – as opposed to the evidence of vocabulary loss discussed in the previous section (cf. also considerations on attrition as loss vs. online access in § 1.1.2).

Indeed, online instances of lexical attrition have been reported widely in the literature, especially when it comes to fluency, through means of increased and persistent pauses, repetitions, hesitations and self-corrections

(e.g., de Leeuw 2007; Schmid and Beers Fägersten 2010; Schmid and Jarvis 2014), tip-of-the-tongue phenomena (e.g., Kreiner and Degani 2015), lexical substitutions and circumlocution (e.g., Olshtain and Barzilay 1991), lexical borrowings and even language switching (e.g., Schmid 2011).

L1 attrition has further been found to affect lexical accuracy, which, as reminded by Jarvis (2019, 243) can be measured in terms of (1) accurate oral or written word ‘form’ production – i.e., using or comprehending words in a way that shows an understanding of the meaning of those forms – as well as (2) accurate ‘syntagmatic relationship’ production/comprehension, as found in multi-word lexical items. Importantly, in lexical L1 attrition semantic and syntagmatic accuracy seems to be affected more than form accuracy (Jarvis 2019, 243; see similar considerations on form and semantic interference as predicted by the Revised Hierarchical Model in L2-to-L1 translation in § 2.2.3.2). For instance, some reported phenomena are semantic extensions and loan translations, the latter being not only semantic but also syntagmatic – i.e., issues with compounds, collocations, idioms and clichés (Seliger and Vago 1991; Jarvis 2003).

Lastly, L1 attrition can also affect lexical complexity – that is, the nature and variety of words produced in speech or writing by a person (Jarvis 2019, 244; also cf. Bulté and Housen 2012). Lexical complexity is usually operationalised with measures looking at lexical diversity (i.e., the variety of words), lexical density (i.e., the proportion of lexical or content words) and lexical sophistication (i.e., the proportion of rare or less frequent words). For instance, Schmid and Jarvis (2014) investigate lexical diversity – in their study operationalised through a combination of measures, such as a measure of lexical repetition that does not vary as a function of text length (unlike previous research) together with a measure of evenness and a measure of lexical

dispersion – and lexical sophistication – argued to be part of lexical diversity itself, thus investigated through multiple measures of lexical rarity. Schmid and Jarvis (2014) find that lexical diversity in their two bilingual groups (i.e., German-Dutch and German-English attriters) is not only significantly lower than in their German controls, but also coincides with an increased reliance on highly frequent words in the L1.

Having given an overview of the different kinds of lexical L1 attrition reported in the literature, the next section presents some of the hypotheses put forward to explain lexical attrition, as well as the modulating factors in the degree of lexical attrition experienced.

2.2.2 Accounts of Lexical Attrition

Schmid (2002), Köpke and Schmid (2004) and, subsequently, Bardovi-Harlig and Stringer (2010) all provide overviews of the different hypotheses drawn up to explain instances of L1 attrition in different domains. Of these, three hypotheses seem particularly relevant to account for instances of L1 attrition in the lexicon such as the ones described in the previous section: (1) the ‘dormant language’ hypothesis; (2) the ‘threshold’ hypothesis; (3) the ‘interference’ hypothesis. As Jarvis (2019, 245) points out, these are not competing hypotheses, but rather complementary; they are reviewed below, along with some of the factors found to influence the degree of L1 attrition experienced – namely, age, environment, L1/L2 proficiency levels, and their potential interactions.

2.2.2.1 The Dormant Language Hypothesis

Firstly, the dormant language hypothesis, built on the evidence of memory retention, repetition effect, forgetting and the saving effect (cf. Ebbinghaus

1913; Nelson 1978), posits that languages (or parts thereof) are never completely lost but only dormant, and that there is potential for them to resurface through means of age regression hypnosis (e.g., Footnick 2007) or re-learning (e.g., Au *et al.* 2002; Oh *et al.* 2003; Oh, Au and Jun 2009; Isurin and Seidel 2015). Out of the above-mentioned studies, only Isurin and Seidel (2015) specifically tested the dormant language hypothesis in L1 lexical attrition (cf. § 2.2.2.1), finding that traces of L1 words can indeed be retrained even after thirty years of isolation from the L1. The results of the aforementioned phonetic and phonological studies, indicating an advantage in relearning for those who had been exposed to the language in childhood (e.g., Au *et al.* 2002; Oh *et al.* 2003; Oh, Au and Jun 2009), are in contrast with the evidence in other phonological studies (e.g., Ventureyra, Pallier and Yoo 2004) and even brain-imaging research (e.g., Pallier *et al.* 2003), which find no trace of the attrited language in adoptees. Given that these studies are beyond the focus of the present chapter, they are not reviewed here.

However, it needs to be pointed out that different methodological issues make all the apparent contrasting results debatable. As reported in Bardovi-Harlig and Stringer (2010, 7-12), some important issues, among others, are: the fact that the re-learners had had some continuous degree of exposure to the language in their childhood and in later years, as opposed to the adoptees; the implicit differences between a multilingual environment such as Los Angeles and a monolingual one such as that of the Korean adoptees before being adopted; the possibility, acknowledged by Pallier *et al.* (2003, 159) themselves, that no evidence of cerebral cortex blood flow during input exposure may not be indicative of L1 loss, but rather lack of active processing, as functional MRI (fMRI) is unable to detect implicit unconscious traces of language processing; finally, the very same fact that, in Ventureyra,

Pallier and Yoo (2004), one participant, who had been revising Korean before being tested, reported much higher accuracy than the other participants tested. As also pointed out by Montrul (2008), another issue to consider in this debate is the fact that, with no pre-attrition levels being recorded in any of the aforementioned studies, the possibility that these represent cases of incomplete acquisition altogether (rather than loss of access or knowledge itself) cannot be ruled out. Recently, research on the reversibility of attrition in late L2 acquisition (cf. § 1.1.2.3) has yielded results that seem to be compatible with the dormant hypothesis. Ultimately, more studies with a similarly solid methodology are needed to address the validity of its predictions.

2.2.2.2 The Threshold Hypothesis

A second hypothesis that has attracted favourable opinions in L1 (but also L2; cf. Bardovi-Harlig and Stringer 2013) lexical attrition research is the threshold hypothesis – also named, in Paradis (1993, 2004, 2007), ‘Activation Threshold Hypothesis’ (ATH), illustrated in Figure 5.

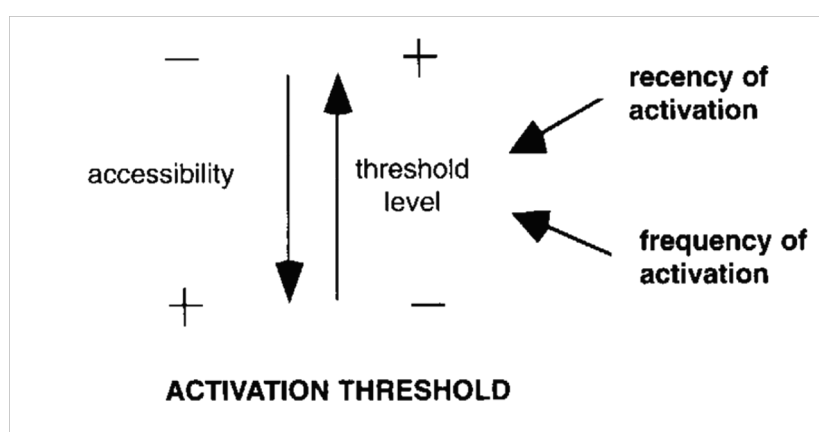


Figure 5. A visual representation of Paradis’ Activation Threshold Hypothesis, whereby recency and frequency of activation entail a lowering of the threshold, making items more accessible, from Köpke (2002, 120).

According to the ATH, access to mental representations of words requires variable amounts of neural impulses (i.e., the 'activation threshold'; AT) depending on to the frequency and recency of activation of the same representation. That is to say, the more a language item is used, the lower its AT is, the easier it is to activate said item; by contrast, access to items that have been inactive for some time is more difficult.

As pointed out by Jarvis (2019, 246), the ATH has gained lots of attention over the years as it easily accounts for a large variety of phenomena, such as the ones described in § 2.2.1.2 – for instance, retrieval slowdown (e.g., filled and empty pauses, repetitions and self-corrections), failure (e.g., lexical substitutions, circumlocution, borrowing and language switching), as well as reduced levels of lexical diversity and sophistication. On the basis of the ATH, lack of use is enough to trigger attrition, which, according to Paradis (2007, 125) can result from prolonged lack of stimulation (i.e., AT being raised as a result of non-activation). In addition, the AT can also be raised as a result of the constant inhibition exerted by bilingual speakers on the competitors that become automatically activated when a target item is selected in the lexicon (e.g., semantic and phonological neighbours, cognates, translation equivalents, etc.; cf. Green 1986, 1998; see §§ 1.1.1.2 and 1.1.3.3). This consequently makes it more difficult to access the inhibited items in the future (i.e., AT being raised due to inhibition).

In this light, results from primed-lexical decision tasks showing that bilinguals with higher L2 proficiency access L1 words more slowly than bilinguals with lower L2 proficiency (e.g., Segalowitz 1991) are explained by the ATH, given that more proficient bilinguals have higher ATs for L1 words as over time they have had to inhibit them more than bilinguals with lower L2 proficiency. Furthermore, the lower degree (and, in some cases, lack) of

attrition experienced by bilinguals who use the L1 for professional purposes (e.g., trainee and experienced translators; cf. Miličević Petrović and Kraš 2017; Miličević Petrović, Kraš and Lisica 2019) is also explained by the ATH, as the need to inhibit the L2 in a professional context more frequently than bilinguals who use their L1 with family or friends (where code-switching and code-mixing do not need to be inhibited) results in more practice at resisting any lexical (or other kinds) of intrusions from the L2 (e.g., Schmid 2007; de Leeuw, Schmid and Mennen 2010; Schmid and Dusseldorp 2010). The ATH ultimately overlaps not only with the dormant language hypothesis discussed earlier, but also with the interference hypothesis reviewed below.

2.2.2.3 The Interference Hypothesis

According to the interference hypothesis, attrition can be explained as the result of increased negative interference (also referred to as 'transfer'; Sharwood Smith 1989) from the L2 to the L1. Particularly, the version of the interference hypothesis formulated within the ATH sees the most frequently used L2 items replace the less frequently used L1 counterparts (cf. Paradis 2007, 125).

Consequently, this hypothesis explains some instances of attrition reported in lexical studies, such as the embedding of L2 lexical roots into L1 constructions and the use of L2 words in L1 speech without realising that the L2 words used do not exist in the L1 (Schmid 2011, 22). This hypothesis also proves to be compatible with the evidence discussed in the previous section, where the effects of the L2 on the L1 are reportedly more for bilinguals with higher L2 proficiency than for less proficient bilinguals (Segalowitz 1991). However, it needs to be pointed out that interference from the L2 may not account for all instances of L1 attrition by itself, especially when it comes to

other language domains (cf. earlier discussion on overextension of overt pronouns in two null-subject languages in § 1.1.3.2, and later in Chapter 3). This is one of the reasons why it is important to consider the interference hypothesis as complementary to the other hypotheses reported here, and why important factors such as age, environment and proficiency levels (reviewed below) must also be considered in order to get a fuller picture of L1 attrition, in the lexicon and beyond.

2.2.2.4 Role of Age, Environment and Proficiency

Different factors have been found to affect the degree of attrition experienced in the L1 (for a thorough overview, cf. Schmid and Köpke 2009; Bardovi-Harlig and Stringer 2010). With reference to some of the studies previously discussed, this section focuses on the role of an individual factor (i.e., age), a social factor (i.e., environment), a (psycho)linguistic factor (i.e., proficiency levels in the L1/L2), and their possible interactions, given their centrality in the lexical investigation carried out for the present thesis.

To begin with, the age at which L1 attrition starts has been found to be critical in the degree of attrition experienced. Indeed, dramatic levels of L1 (lexical) attrition are often reported for those who are exposed to attrition-inducing conditions (i.e., due to L1 use reduction, adoption in an L2-only-speaking family, or emigration to an L2 country) before puberty (e.g., Köpke and Schmid 2004; Montrul 2008; Bylund 2009) often to the point that the language seems to be lost entirely (cf. Nicoladis and Grabois 2002; Isurin and Seidel's 2015 case of TJ, discussed previously in § 2.2.1.1; Pallier *et al.* 2003, as well as Ventureyra, Pallier and Yoo 2004, reported in § 2.2.2.1). By contrast, as reminded by Schmid and Mehotcheva (2012, 113), dramatic levels of L1 lexical attrition are not found in studies of adolescent or adult attriters.

The role of the environment (i.e., either L1-speaking or L2-speaking environment) is also central, as it modulates the degree of inhibition applied (and, consequently, the degree of attrition experienced). As argued in § 2.2.2.2, for instance, the use of the L1 for professional purposes accurately predicts the degree of attrition experienced, in that bilinguals who use their L1 at work have been found to experience less attrition due to greater L2 inhibition (Schmid and Jarvis 2014, 730). Greater inhibition of the L1, on the other hand, has been found in contexts of immersion in an L2 environment (see § 2.2.3.4 later for a review of Linck, Sunderman and Kroll 2009, and Baus, Costa and Carreiras 2013), while other factors, such as education, have not been found to affect L1 attrition (e.g., Yağmur 1997; Dostert 2009) – contrary to findings in L2/foreign language (FL) attrition, where education is found to play a role (Bardovi-Harlig and Stringer 2010, 25).

Lastly, language proficiency levels in the L1 are also relevant, especially when it comes to pre-attrition L1 proficiency, as it is less likely for more proficient and experienced L1 speakers to have high L1 word ATs, and experience L2 lexical interference – although this is also dependent on L2 proficiency and experience levels (see discussion in Schmid and Jarvis 2014). Importantly, a confounding factor when examining the effects of proficiency on attrition is age. Indeed, roughly until puberty, age and L1 proficiency are correlated, meaning that the severe L1 attrition found in migrants before puberty and international adoptees may be due to their incomplete acquisition of the L1 coupled with early L2 acquisition, experience and dominance (Jarvis 2019, 248; cf. Montrul 2008, discussed in § 2.2.2.1).

2.2.3 Bilingual Lexical Access, L2 Immersion and L1 Inhibition

Having discussed some of the hypotheses and contributing factors accounting for the emergence and extent of lexical L1 attrition, the present section focuses on the phenomenon of bilingual lexical access, also known as lexical retrieval. It firstly analyses relevant models of bilingual lexical access, to then discuss research examining the attrition of L1 lexical retrieval in the context of L2 immersion, which is finally used as a basis for the present investigation.

2.2.3.1 Lexical Access in Bilingualism

Dijkstra (2005, 180) describes 'lexical access' as the process by which speakers enter the database of words in their mind (i.e., the 'mental lexicon') and retrieve word information, which can be of different kinds – e.g., orthographic, phonological, or semantic – whereas the retrieval of said information on the basis of an input string of letters is known as 'word recognition'.

Several possible orthographic candidates are known to be activated when monolingual speakers are presented with a particular letter string and asked, for instance, whether the string constitutes a word or not (e.g., 'cork', 'fork', and 'pork' all possibly becoming active when presented with the string 'work'). Therefore, Dijkstra (2005, 280) notes that, in the case of bilinguals, one may ask whether (1) lexical candidates from different languages become activated in a similar fashion when a letter string is presented, and whether (2) language information may be used to accelerate lexical processing – i.e., by suppressing the activation of items in the irrelevant language when provided by the context, or whether it is available in time to affect word recognition at all when provided by the item itself. Throughout the years, these questions have been explored by various studies, and different models of bilingual lexical access have been proposed. In the next sections, two of the most

prominent models are reviewed, along with supporting and opposing evidence for each: the Revised Hierarchical Model (Kroll and Stewart 1994) and the most recent version of the Bilingual Interaction Activation model (Dijkstra and van Heuven 2002).

2.2.3.2 The Revised Hierarchical Model

The Revised Hierarchical Model (RHM; Kroll and Stewart 1994), illustrated in Figure 6, integrates the Word Association and Concept Mediation models (Potter *et al.* 1984), and accordingly assumes two separate lexicons in the bilingual mind. It was initially formulated to account for the bidirectional and asymmetric relations between the two lexicons (Goral *et al.* 2006, 236), and for the developmental sequence found in Kroll and Curley (1988) and Chen and Leung (1989), whereby bilinguals move from initially relying on translation equivalents between the two languages to a stage when concept mediation is direct (Kroll and Tokowicz 2005, 545).

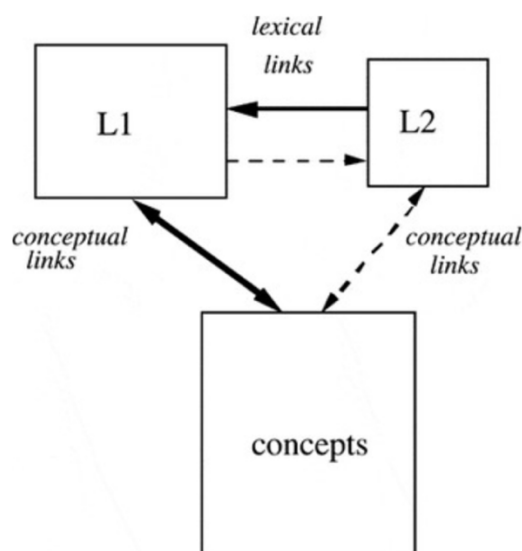


Figure 6. Kroll and Stewart's Revised Hierarchical Model, showing lexical and conceptual representations in bilingual memory, with full lines representing stronger links than dotted lines, from Kroll and Stewart (1994, 158).

The two critical assumptions of the RHM are that, in the early stages of late L2 acquisition, (1) the links between words and concepts are stronger in the L1 than in the L2, and (2) the links between words and their corresponding translation equivalents are stronger in the L2 than in the L1. These asymmetries are the result of L2 acquisition for late learners whose L1 lexicon is fully developed with its associated concepts, who rely on the L1 word-to-concept connections that are already in place to access meaning for the new L2 words they learn (thus having strong L2-to-L1 lexical links, and only weak L1-to-L2 lexical links).

The links between the lexicons are however subject to change as a function of proficiency and language use: indeed, as L2 proficiency increases in the later stages of L2 acquisition, learners become able to process L2 concepts directly, with no L1 mediation, although ‘the connections between words and concepts are assumed to remain stronger for L1 than for L2 for all but the most balanced bilinguals’ (Kroll and Tokowicz 2005, 546). A related question which may be asked, then, especially in the context of this thesis, is just how proficient (or balanced) L2 learners need to be, until the links between L2 words and concepts become as strong as, or even stronger than, those in the L1 (cf. Results and Interim Discussion sections in this chapter). Given the assumed asymmetry in translation performance – with forward L1-to-L2 translation being concept mediated, while backward L2-to-L1 translation relies on the lexical associations between L2 words and L1 translation equivalents – the RHM predicts forward translation to be slower and more likely to engage semantics. As the links between L2 words and concepts strengthen with increasing L2 proficiency, the translation asymmetry is predicted to decrease, and backward translation is predicted to become more conceptually mediated (Kroll and Tokowicz 2005, 456).

Corroborating evidence for the RHM comes from several studies. Initially, Kroll and Stewart (1994) had relatively proficient Dutch-English bilinguals perform forward and backward translation by manipulating the semantic context of the translation lists. Specifically, they presented participants with two lists, one which was semantically mixed, and the other which was semantically blocked (i.e., only animals, only fruits, etc.). Given that they found an effect of semantic blocking in the forward direction of the translation (i.e., L1-to-L2), but not in backward translation, they concluded that only forward translation necessarily involves concept mediation.

A further study by Talamas, Kroll and Dufour (1999) also provided evidence in favour of the RHM, particularly for its developmental predictions. The researchers tested more and less proficient English-Spanish bilinguals on de Groot's (1992) translation recognition task (TRT) – an adaptation of which is also employed in the present study (cf. § 2.3.1) – in which a pair of words (in the order English-Spanish or Spanish-English) was presented to the participants, who needed to decide whether the two words were translations of each other. Critical items were either (1) related in lexical form to the correct translation (e.g., *garlic-ojo* [i.e., eye] for *ajo*) or (2) related in meaning to the correct translation (e.g., *garlic-cebolla* [i.e., onion] for *ajo*). The degree of interference was found to be modulated by L2 proficiency, thus in line with the predicted developmental shift from form to meaning predicted by the RHM: less proficient L2 speakers were found to be more sensitive to lexical form than meaning distractors, while, vice-versa, more proficient speakers were more sensitive to meaning than lexical form distractors.

Among further studies, some have found counterevidence for the RHM. For instance, access to L2 word meaning has been found also in non-proficient learners (e.g., Sunderman and Kroll 2006), and even highly

proficient bilinguals have been found to have limited access to semantics for L2 words, on the basis of their learning history – i.e., whether they acquired the L2 early in childhood or later in adulthood (cf. Silverberg and Samuel 2004) – as well as according to the type of semantic relation (e.g., Ferré, Sánchez-Casas and Guasch 2006). Interestingly, language typology has not been found to play a role in lexical form interference, which has been reported both in bilingual speakers of typologically close languages (e.g., Spanish-Catalan bilinguals in Guasch *et al.* 2008) and bilinguals of typologically distant languages (e.g., Arabic-English in Qasem and Foote 2010).

Evidence from studies using event-related potentials (ERPs), such as Thierry and Wu (2007), have further revealed, against the RHM predictions, that highly proficient bilinguals of L2 English show activation of the L1 when the L2 word is processed, with lexically mediated connections from the L2 to the L1 thus being salient for all speakers, and not only during early stages of L2 acquisition. More recently, research has shown that low proficiency learners are sensitive to the meaning of words in the L2 when they have to comprehend meaning. For example, in Ma *et al.* (2017), low proficiency and high proficiency bilinguals alike showed sensitivity to semantic distractors in both short and long stimulus onset asynchronies between the two words in a TRT – which, as noted by Guo *et al.* 2012, might have been the reason why proficient bilinguals have been found to activate the L1 translation during L2 word meaning retrieval. The fact that both groups of learners in Ma *et al.* (2017) were found to be sensitive to semantic distractors suggests that the L1 does not necessarily mediate access to meaning in early stages of L2 learning.

In sum, there is reason to believe that the L1 translation may be active for all L2 speakers under a range of circumstances, and that the L1 may have a limited role in accessing the meaning of an L2 word during comprehension

in spite of L2 proficiency and language similarity. However, as pointed out by Kroll and Ma (2018, 30), the possibility remains that the low proficiency bilinguals found to show semantic sensitivity 'were already past a critical early stage of learning', thus not behaving as predicted by the RHM – a crucial point further addressed when discussing the results of the present study in § 2.5. It is important to notice that the predictions of the RHM are mainly formulated for word production, in which, as pointed out by Kroll *et al.* (2014), evidence of top-down activation of meaning-related neighbours is present (e.g., semantic relatives in both languages, including translations); other models, such as Dijkstra and van Heuven's (2002) Bilingual Interaction Activation + (BIA+), formulate predictions for word recognition, as discussed below.

2.2.3.3 The Bilingual Interaction Activation +

The BIA+ model (Dijkstra and van Heuven 2002), illustrated in Figure 7, is an extension of the BIA model (Dijkstra and van Heuven 1998; van Heuven, Dijkstra and Grainger 1998), which is itself an adaptation of the Interactive Activation Model initially proposed by McClelland and Rumelhart (1981) to account for word recognition in monolinguals.

The BIA+ is a connectionist model, which, unlike Kroll and Stewart's (1994) RHM, assumes only one integrated L1-L2 lexicon for bilingual speakers, as bilingual word recognition is thought of as a non-selective process with both languages being active simultaneously during processing. As well as language nodes and representations of lexical orthography, the most recent version of the BIA also contains phonological and semantic representations. Together, these representations form part of the word identification system, which provides output to the task/decision system. In other words, the BIA+ rigorously assumes bottom-up processing of sub-lexical information, without

any influence of the task/decision system on the word activation state. When a word is presented, features of the individual letters are activated, after which letters matching those specific features also become activated. This process creates parallel activation of orthographic and phonological information in both languages, generating competition between candidates at all levels.

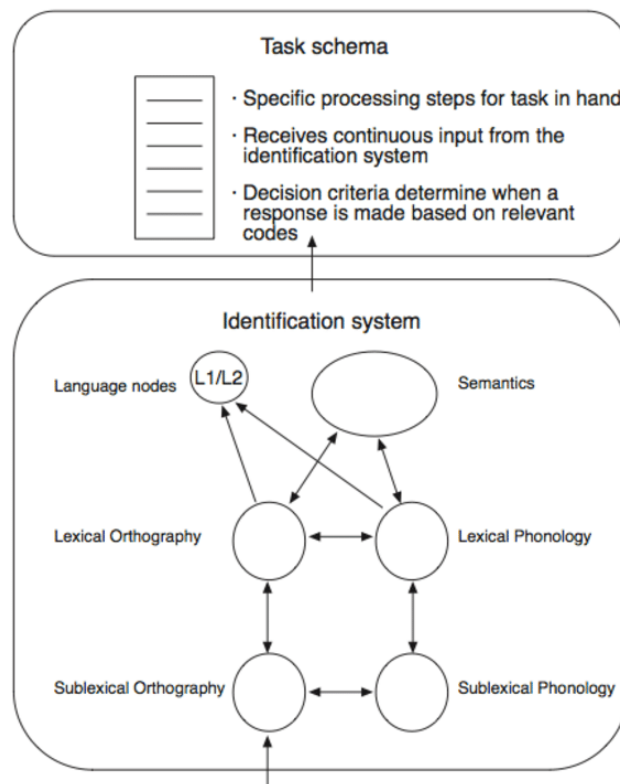


Figure 7. Dijkstra and van Heuven's Bilingual Interactive Activation + model, illustrating bottom-up bilingual language processing, from Dijkstra and van Heuven (2002, 182).

Corroborating evidence for the BIA+ comes from experiments on orthographic neighbours, that is to say, words of similar length that differ only by one letter – e.g., *bat*, *mat*, *fat*, *sat*, etc. being orthographic neighbours of *cat* (cf. Coltheart *et al.* 1977). By manipulating the number of orthographic neighbours across languages, some researchers aimed to understand whether both languages are active during early stages of L2 processing. For instance, van Heuven, Dijkstra and Grainger (1998) found that Dutch-English bilinguals

took longer to recognise L2 English words when the same words had more Dutch orthographic neighbours – suggesting, indeed, that both languages are active during the early stages of processing in word recognition.

Later studies examined the activation level of the non-active or non-target language on the language in use – both when the non-active/non-target language is the L1 and when it is the L2 – in lexical decision tasks, also using eye-tracking methodologies (e.g., Spivey and Marian 1999; Dijkstra, Timmermans and Schriefers 2000; Sunderman and Kroll 2006). As noted in Marian and Spivey (2003), it seems that the activation of the irrelevant language is stronger when it is the L1 as opposed to the L2, depending on the different levels of proficiency between the participants of the previously reported studies. Moreover, recent ERP studies have provided further (neurological) evidence in favour of the co-activation of both languages in lexical retrieval (e.g., Wu and Thierry 2010; cf. also Thierry and Wu 2007 already mentioned in the previous section), thus supporting the predictions of the BIA+ model, which assumes a minimal role of top-down influences in word recognition.

Given that bottom-up processes activate lexical alternatives simultaneously in their L1 and L2 due to the properties of the words spoken/read, Kroll and Ma (2018, 303) note that an inhibitory control mechanism must therefore be in use by bilinguals to regulate the influence of unintended lexical forms. Importantly, research by Pivneva, Mercier and Titone (2014) revealed individual differences to differentiate between language proficiency and inhibitory control in French-English bilinguals. Specifically, cognate facilitation (i.e., easiness of recognition of words that share orthography and meaning between languages) was found to be reduced for bilinguals with higher L2 proficiency, independently of inhibitory

control. By contrast, homograph interference (i.e., difficulty in word recognition due to words sharing similar orthography, but different meaning, between languages) was found to be reduced for bilinguals with greater inhibitory control, regardless of proficiency. Thus, as argued by Kroll and Ma (2018, 303), these results suggest the need for a more nuanced model of bilingual lexical processing, as important individual differences such as the ones described above must not be overlooked.

Indeed, while the body of research presented here seems to overall support the BIA+ claims and predictions, the findings by Pivneva, Mercier and Titone (2014) suggest that top-down influences may be at play even during the earliest stages of visual word recognition – something not accounted for by the model. It therefore seems that, while neither the RHM nor the BIA+ is able to account fully for what happens in bilingual language processing and L2 development, both importantly contribute individually to our present-day understanding of these processes. Indeed, as reminded by Kroll *et al.* (2010, 378-379), the BIA+ may be able to handle details of visual word recognition, but it is not able to address the changes that occur during L2 development without additional assumptions. By contrast, a fundamental contribution of the RHM is that of identifying the relative strength of word-concept connections as important in understanding bilingual language processing not only in high proficiency bilinguals, but also in low proficiency L2 learners. Before delving into the details of the present study, the next section reviews specific evidence from research on reduced access in the L1 of intermediate L2 learners – which, in line with the predictions of the RHM, indicates a shift towards the L2 in lexical access as a consequence of the greater inhibition applied to the L1 in situations of L2 immersion.

2.2.3.4 Attrition in Lexical Access: L1 Inhibition via L2 Immersion

Research on L2 immersion suggests that, within an L2-dominant context, the L1 becomes less accessible. For instance, given some evidence suggesting that studying a language abroad may help learn the L2 successfully (e.g., Freed 1995), Linck, Kroll and Sunderman (2009) tested the hypothesis that L2 immersion may facilitate L2 learning by allowing adult learners to reduce L1 activity. In their study, two groups of L1 English-speaking university students of comparable L2 Spanish intermediate proficiency were tested: both groups were studying L2 Spanish at university, with one group being immersed in a Spanish-speaking environment during a study-abroad semester, while the other was studying Spanish in classroom settings. The two groups performed a battery of lexical access tasks consisting of a comprehension task (i.e., a translation recognition task similar to the one used in Sunderman and Kroll 2006) and a production task (i.e., a verbal fluency task conducted separately for the L1 and the L2; e.g., Gollan, Montoya and Werner 2002), with the immersed group being tested as soon as (almost) four months in their semester abroad.

The results of the verbal fluency task revealed that the immersed group produced significantly fewer words in L1 English than classroom learners who did not travel abroad. Moreover, in contrast to previous research reporting the influence of cross-language neighbours on word recognition in highly proficient bilinguals (e.g., Dijkstra 2005; Sunderman and Kroll 2006), in the TRT – where an L2 Spanish word was presented followed by a possible L1 English translation – immersed learners showed no sensitivity to lexical-neighbour distractors (i.e., L1 translations similar in form to the L2 word; e.g., ‘card’ for *cara* [i.e., face]), they were sensitive to semantic interference (e.g., ‘head’ for *cara* [i.e., face]). The opposite was true for classroom learners, who

showed greater sensitivity to lexical neighbours and lower sensitivity to semantic interference than immersed learners. The authors later retested a subset of the immersed learners six months after their return to the L1 environment and found that, while L1 verbal fluency rebounded at retest – cf. graph (a) in Figure 8 – on the TRT participants kept on showing no sensitivity to lexical-neighbour distractors – cf. graph (b) in Figure 8.

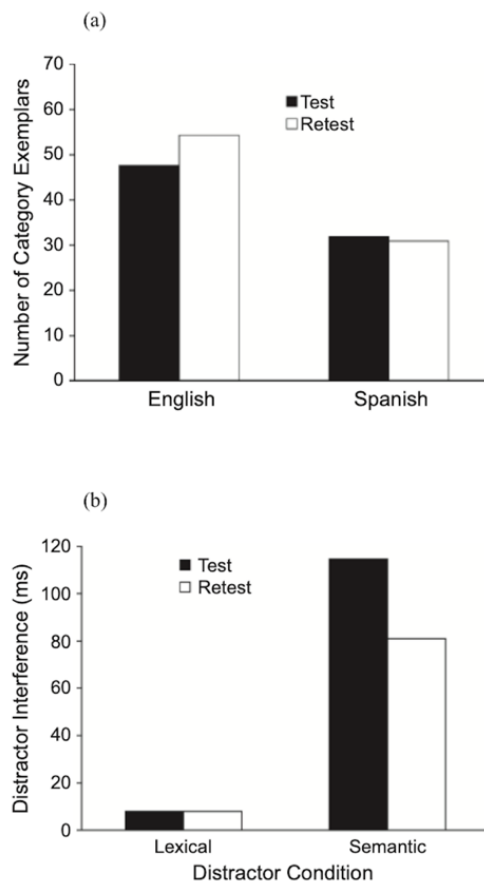


Figure 8. Test and retest results for immersed learners of Spanish in (a) verbal fluency and (b) translation recognition, showing a rebound in L1 verbal fluency and persistent insensitivity to lexical interference in translation recognition, from Linck, Kroll and Sunderman (2009, 1513).

The authors note that such results are in line with an inhibitory account, as they suggest that L2 immersion encourages inhibition of the L1, which allows immersed learners to develop inhibitory control skills deployed to mitigate L1 interference even after going back to the L1 environment. Moreover, the

insensitivity to lexical neighbour distractors found both at test and retest is, in their opinion, also potentially compatible with Kroll and Stewart's (1994) RHM, which predicts that with increasing L2 proficiency the links between concepts and L2 words become stronger. The strong inhibition applied during L2 immersion may consequently make it possible for stronger lexical-conceptual links to form in the L2, ultimately allowing learners to resist L1 interference even upon returning to an L1-dominant environment. Given that an initial decrease in L1 verbal fluency, however, is not accounted for by a link-strengthening account, Linck, Kroll and Sunderman (2009, 1513) conclude by stating that an inhibitory account best explains their results.

The idea that the L1 becomes less accessible after periods of L2 immersion has also been corroborated by more recent studies that have found cognate status to be a modulating factor. For instance, Baus, Costa and Carreiras (2013), in a picture-naming task, found slower naming latencies in the L1, especially for low frequency non-cognates, following four months of L2 immersion for German speakers learning Spanish in Spain. The researchers further found differences on an L1 semantic fluency task that were also modulated by cognate status – i.e., with more cognates being produced in the L1 at the end of the L2 immersion experience compared to the participants' production upon arrival in Spain. These results, too, are in line with an inhibitory account, as cognates would not be expected to compete for selection, given the strong orthographic and/or phonological similarity between L1 and L2 word forms – on the other hand, non-cognates and lower frequency words may be more vulnerable to inhibition, given the greater potential for cross-language competition. As noted by Linck and Kroll (2019, 95), a possible explanation in this case may also be that the reduced access to the L1 results from the weakening of the links between concepts and forms,

due to the reduction in frequency of use of L1 words in L2 immersion (i.e., the ‘weaker links’ hypothesis; cf. Gollan *et al.* 2008). However, such an account cannot explain the persistent insensitivity to lexical interference found in Linck, Kroll and Sunderman (2009), as previously discussed, while both studies are ultimately congruent with the hypotheses of an inhibitory account.

2.2.4 Summary of the Literature and Aims of the Study

The research reviewed in this chapter points to the fact that the type and degree of lexical attrition experienced may be modulated by linguistic and non-linguistic factors. As discussed in § 2.2.1, a dramatic loss of vocabulary is documented only in cases where speakers are exposed to attrition-inducing conditions before the age of puberty, while less severe issues with lexical fluency, accuracy and complexity are reported for bilingual speakers who acquire an L2 after reaching puberty. As further argued in §§ 2.2.2-2.2.3, L1 (as well as L2) lexical access is also affected by bilinguals’ L2 proficiency levels and the context in which they operate. Specifically, links between L2 words and concepts are thought to get stronger with increasing levels of L2 proficiency, and the L2 immersion context is found to facilitate L2 acquisition by enhancing L1 inhibition – ultimately resulting in enhanced lexical access in the L2 and, vice-versa, reduced lexical access in the L1.

Given the evidence summarised above, the present study aims to investigate possible changes in lexical access in late bilingual speakers of two different proficiencies (intermediate/advanced)⁶ in two different environments (L2 instruction in an L1 context/immersion in an L2 context).

⁶ Initially, the study aimed to test for the effects of immersion in an L2-speaking environment, with two groups of similar L2 proficiency only differing in terms of environment; however, as

2.2.4.1 Research Question

Specifically, this study addresses the following question: are there any differences between lower proficiency classroom-based L2 (i.e., Italian) learners in an L1- (i.e., English) speaking context and higher proficiency long-term residents in an L2-speaking context in terms of (1) their activation of L1 lexical information and access to L2 meaning and (2) their accuracy and speed in L1 and L2 word production?

2.2.4.2 Hypotheses and Predictions

In line with the developmental hypotheses of the RHM for bilingual lexical access (cf. § 2.2.3.2) and previous findings of studies on the effects of L2 immersion on L1 inhibition (cf. § 2.2.3.4), the following has been predicted:

1. With regards to the activation of L1 lexical information and access to L2 meaning, classroom-based learners are expected to access L2 meaning via L1 mediation, thus experiencing more lexical interference and less semantic interference; by contrast, long-term residents are expected to access L2 meaning directly, thus experiencing more semantic interference and less lexical interference.
2. With regards to accuracy and speed in L1 and L2 word production, classroom-based learners are expected to be dominant in their L1, thus producing more words in the L1, and doing so faster than in the L2; by contrast, long-term residents are expected to be dominant in their L2, as well as more frequently inhibit their L1, thus producing more words in the L2, and doing so faster than in the L1.

it became increasingly difficult to recruit online participants who could be matched on proficiency (due to COVID-19 travel restrictions), the proficiency requirement was dropped.

2.3 Methodology

2.3.1 *Participants*

Participants were recruited on social media platforms (e.g., Facebook, Twitter, Instagram) and by word of mouth (at the University of Edinburgh, in other UK universities, and elsewhere). A total of 113 participants were recruited, divided into:

1. British university students in their final year of Italian studies at different UK universities, born in the UK and grown up with English as their only L1 – currently living in the UK (n = 27).
2. British long-term residents in Italy, born in the UK and grown up with English as their only L1 – currently living in Italy after having emigrated there (and started learning Italian) at sixteen years of age or older (n = 27).
3. L1 English controls, born and living in the UK and fluent in no other language aside from English – with knowledge of an L2 at school level permitted, as long as it was not deemed fluent (n = 31).
4. L1 Italian controls, born and living in Italy and fluent in no other language aside from Italian – with knowledge of an L2 at school level permitted, as long as it was not deemed fluent (n = 27).

Background information was collected through the use of the Language Experience and Proficiency Questionnaire (Marian, Blumenfeld and Kaushanskaya 2007) administered on the Qualtrics XM platform (<https://www.qualtrics.com>). The rest of the experiment was carried out on Testable (<https://www.testable.org>), where bilingual participants were also asked to complete Amenta, Badan and Brysbaert's (2021) LexITA vocabulary

test to assess their L2 proficiency levels, as well as a reading-span (Waters and Caplan 1996) task (in their respective L1s) to measure working memory capacity. Table 1 shows the main characteristics of the four participant groups.

Table 1. Characteristics of the participant groups

Characteristic	University students	Long-term residents	L1 English controls	L1 Italian controls
Number of participants	27	27	31	27
Born in	UK	UK	UK	Italy
Living in	UK	Italy	UK	Italy
L1	English	English	English	Italian
L2	Italian	Italian	N/A	N/A
Gender ^a	♀ =24 ♂ =3 ♀ =0	♀ =21 ♂ =6 ♀ =0	♀ =17 ♂ =13 ♀ =1	♀ =23 ♂ =4 ♀ =0
Age (years)	M=21.9 σ=1	M=45.4 σ=14.4	M=27 σ=6.2	M=28.2 σ=7.9
Age of L2 acquisition (years)	M=17.6 σ=1.3	M=24 σ=7.7	N/A	N/A
Length of residence in L2 country (years) ^b	M=0.1 σ=0.3	M=20.4 σ=14.1	N/A	N/A
L2 proficiency score ^c	M=32.2 σ=24.1	M=69.9 σ=16.6	N/A	N/A
Working memory score (number recalled) ^d	M=46.4 σ=9.8	M=49.7 σ=8.3	M=45.7 σ=10.7	M=47.7 σ=5.5

^aGender is reported as follows: ♀ (female), ♂ (male), ♀ (other/non-binary). ^bTwo university students both reported spending one year in Italy prior to testing; hence, mean (M) and standard deviation (σ) have been reported for students as well as long-term residents' length of residence. ^cL2 proficiency scored as N words correctly identified as being Italian words – 2*N of non-words wrongly identified as Italian words (out of 90 words). ^dWorking memory scored as the number of correctly recalled to-be-remembered words (out of 60).

2.3.2 Materials

To investigate the activation of L1 lexical information and access to L2 meaning, Sunderman and Kroll's (2006) translation recognition task (TRT) was adapted from Spanish to Italian for the purposes of this study (see Appendix A for full list of materials used). The task included 120 trials for each

participant, with sixty baseline trials (i.e., yes trials) and sixty target (i.e., *no* trials). Half of the *no* trials included related (+) distractors of three kinds (see Table 2 for an example):

1. Lexical Neighbour (LN) distractors, where the second word presented (the L1 word; e.g., ‘amber’) is similar to the first word (the L2 word; e.g., ‘*albero*’ [i.e., ‘tree’]) in form.
2. Translation Neighbour (TN) distractors, where the second word presented (e.g., ‘spree’) is similar in form to the correct L1 translation (e.g., ‘tree’ for *albero*).
3. Semantic (S) distractors, where the second word presented (e.g., ‘leaves’) is similar in meaning to the correct L1 translation (e.g., ‘tree’ for *albero*).

Table 2. Illustration of the distractors for *albero-tree* used in the translation recognition task

Italian	English	Related (+)			Unrelated (-)		
		LN+	TN+	S+	LN-	TN-	S-
albero	tree	amber	spree	leaves	norms	hirer	agenda

Note. LN = lexical neighbour (distractor related orthographically to L2 word); TN = translation neighbour (distractor related orthographically to L1 translation); S = semantic (distractor related in meaning to L1 translation). Each participant saw only one of the six possible distractors for *albero*. Unlike the original task employed in Sunderman and Kroll (2006), no grammatical class condition was included. Since the TRT engages both L1 and L2, only bilinguals performed the task.

Following Sunderman’s (2013) recommendations, the remaining *no* trials included unrelated (-) trials matched to the related (+) trials for length and frequency, with frequencies retrieved from the WaCky corpora (Baroni et al. 2009), using ukWaC for English and itWaC for Italian, respectively (<https://wacky.sslmit.unibo.it/doku.php?id=download>). The LN trials were controlled for onset code change and Levenshtein distance from the L2 word, whereas the TN trials were controlled for onset code change and Levenshtein

distance from the L1 word (Levenshtein 1966). 'Yes' trials items were created separately and matched to 'no' trials for frequency and length. Six lists were created to counterbalance the trials.

To investigate accuracy and speed in L1/L2 word production, two verbal fluency tasks were used (cf. Ardila, Rosselli and Puente 1994; Spreen and Strauss 1998; Costa *et al.* 2014). Specifically, verbal fluency within a phonemic category, with three one-minute oral fluency trials using the letters F, A, S in both languages, and verbal fluency within a semantic category, with a one-minute fluency trial using animals as the semantic category also in both languages.

2.3.3 Procedure

The study obtained ethics approval from the School of Philosophy, Psychology and Language Sciences Research Ethics Committee at the University of Edinburgh (ref. 167-2021/7). Due to COVID-19 restrictions, participant recruitment and data collection were carried out entirely online. All participants signed a consent form which informed them of their rights and that compensation would be given upon completion of all study tasks, with £5.5/€6 awarded to participants completing tasks in one language only and £11/€12 to participants completing tasks in both languages on two separate sessions (six days apart from each other).

The TRT was specifically administered last during the L2 session, due to the nature of the task which engages both the L1 and the L2 – therefore, only the two bilingual groups completed the task. As participants completed all tasks on their own, they were instructed to be in a quiet room, turn off any devices, and read carefully the instructions on the screen. Participants were explicitly informed that both their responses (either via keyboard or

microphone) and speed were being collected throughout the task. The TRT consisted in reading words shown on the screen: an Italian word would appear on the middle of the screen for 400 milliseconds, followed by a short inter-stimuli interval of 100 milliseconds. A second word, this time in English, would then appear in the middle of the screen. Participants were asked to press '1' if the English word was the correct translation of the previous Italian word, or '0' if the English word was not the correct translation. The experiment began after ten practice trials, and participants were allowed to take a break halfway through the task when instructed to do so on the screen.

The verbal fluency tasks were completed by the participants first in one language and only six days later in the other language. When completing the phonemic verbal fluency task, participants were instructed to read the letter appearing in the middle of the screen (F, A, S; one at a time), and to say out loud as many words as they could beginning with the letter in one minute. Participants were instructed to do the same when completing the semantic verbal fluency task, consisting of only one category (animals). Unfortunately, due to technical issues, participants' verbal fluency recordings did not save properly (i.e., recordings either did not save at all, or the initial parts were missing from the saved files) and could thus not be analysed.

2.3.4 Design Measures and Predicted Outcomes

The dependent variables measured in the TRT task are accuracy (1 = accurate, 0 = inaccurate) and reaction time (RT). Two are the discrete independent variables – group (students, residents) and condition (LN+, LN-, S+, S-, TN+, TN-, yes) – and two are the continuous independent variables – age and reading-span score.

Accuracy was planned to be analysed through a mixed-effects binomial logistic regression, which was predicted to yield a significant interaction of group and condition. Specifically, responses in S+ trials were predicted to be significantly less likely to be accurate than in S- trials only for residents, due to the greater degree of semantic interference reported for highly proficient L2 speakers. Responses in TN+ trials, on the other hand, were predicted to be significantly less likely to be accurate than in TN- trials only for students, due to the greater degree of lexical interference reported in bilinguals of lower L2 proficiency (cf. § 2.2.4.2). Reaction times (RTs) were planned to be analysed by means of a linear mixed-effects model. The model for RT was predicted to yield a significant interaction of group and condition, similar to the one for accuracy. Specifically, RTs in S+ trials were predicted to be significantly longer than RTs in S- trials only for residents, due to the greater degree of semantic interference reported in highly proficient L2 speakers. RTs in TN+ trials, on the other hand, were predicted to be significantly longer than RTs in TN- trials only for students, due to the greater degree of lexical interference reported in bilinguals of lower L2 proficiency (cf. § 2.2.4.2).

2.4 Results

An overall descriptive table containing mean RT in milliseconds and percent accuracy for both bilingual groups⁷ for all trials is reported in Table 3. In line with Sunderman (2013), while the analysis for accuracy included both correct and incorrect trials, RTs were only analysed for correct trials. Moreover, following Ratcliff (1993), in both accuracy and RT analyses trials with extreme

⁷ Note the absence of monolingual control groups on this task, with results being reported only for bilingual participants in Table 3 and in the statistical analyses later in the section. This is due to the nature of the TRT engaging both L1 and L2, as explained in § 2.3.3.

RTs over 3000 milliseconds (reflecting lack of concentration) and below 300 milliseconds (reflecting non-intentional responses) were excluded, amounting to 1.69% of all trials.

Table 3. Mean RT (ms) and percent accuracy in the translation recognition task

	University students		Long-term residents	
	RT	Accuracy	RT	Accuracy
Yes trials	738	78.2%	775	94.1%
No trials				
Lexical neighbour				
Related	788	96.2%	859	96.6%
Unrelated	733	98.9%	777	99.3%
Interference	55	2.7%	82	2.7%
Translation neighbour				
Related	777	93.3%	843	94.1%
Unrelated	726	97.0%	815	100%
Interference	51	3.7%	28	5.9%
Semantic distractor				
Related	847	79.8%	1000	87.1%
Unrelated	691	98.5%	797	98.1%
Interference	156	18.7%	203	11%

Note. Lexical neighbour distractors are related orthographically to the L2 word; translation neighbour distractors are related orthographically to the L1 translation; semantic distractors are related in meaning to L1 translation. Interference is computed as the difference between related and unrelated conditions. Accuracy percentages include both correct and incorrect trials, while RT milliseconds are only computed for correct trials.

The data were analysed on the open-source, R-based software Jamovi (The jamovi project 2021) using the General Analyses for Linear Models (GAMLj) module (Gallucci 2019). Accuracy was analysed through a mixed-effects binomial logistic regression, and reaction times (RTs) were analysed by means of a linear mixed-effects model. Following Barr *et al.* (2013), a maximal random effects structure was used, with random intercepts and slopes included for participants (subjectID), while only random intercepts were included for items (itemID) given that not all items were seen in different

conditions. In cases of convergence difficulties, random correlations were removed, with the model complexity being reduced stepwise by excluding terms that accounted for the least variance first (for full model details, see Appendix B).

The logistic mixed model fitted to predict accuracy (1 = accurate, 0 = inaccurate) included the contrast-coded fixed-effect predictor variables group (students, residents), condition (LN+, LN-, S+, S-, TN+, TN-, yes⁸) and the interaction of group and condition. Both participants (subjectID) and items (itemID) were included as random effects. Initially, varying intercepts and slopes were included for participants, and only varying intercepts were included for items (as not all items were seen in different conditions). Due to single fit of the model, random slopes were removed for participants (which accounted for least variance) and only varying intercepts were retained. The main effects plots are illustrated in Figure 9, with key main effects and interactions discussed below (for full model details, see Appendix B).

A significant main effect of condition, $\chi^2(6) = 47.62, p < .001$, along with a significant interaction between group and condition, $\chi^2(6) = 43.85, p < .001$, were found. Bonferroni adjusted post-hoc analyses showed that, within groups, only responses in S+ trials were significantly less likely to be accurate than in S- trials for both students (OR = .02, $p = .001$) and residents (OR = 0.02, $p = .031$). Thus, it is likely that the strength of the reported difference, larger in students than in residents, gave rise to the interaction. Between groups, only in yes trials students' responses were significantly less likely to be accurate than residents' responses (OR = 0.11, $p < .001$).

⁸ Contrary to the preregistered analyses, yes trials were added to the regression model by removing the independent variable relatedness and including all conditions in one model.

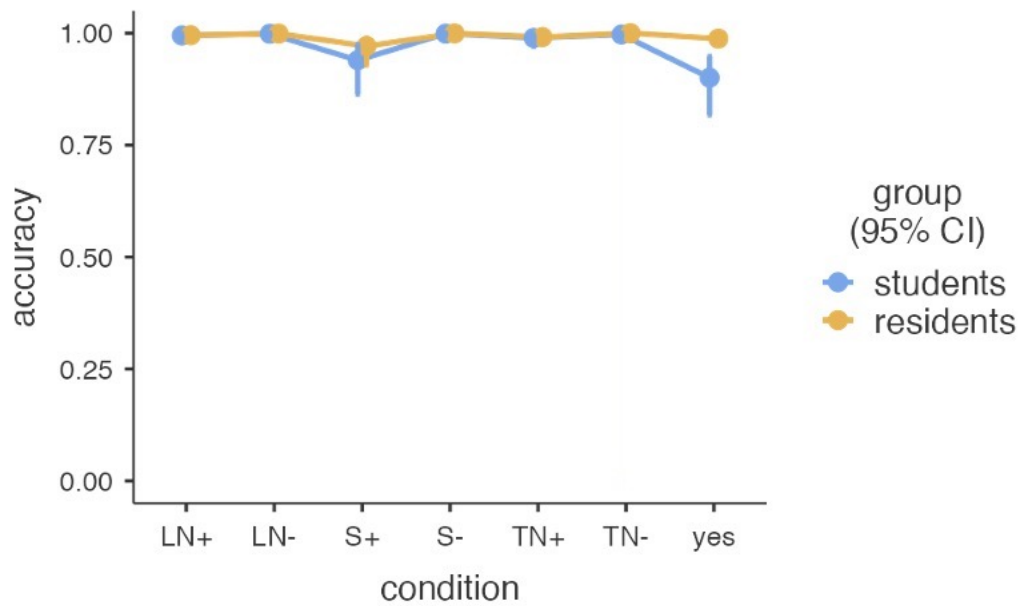


Figure 9. Accuracy (1 = accurate, 0 = inaccurate) in different conditions of the translation recognition task for students and residents. LN = lexical neighbour distractor; TN = translation neighbour distractor; S = semantic distractor. +/- signs = related/unrelated trials. Error bars = 95% confidence interval (CI).

The linear mixed model fitted to predict RT included the contrast-coded fixed-effect predictor variables group (students, residents), condition (LN+, LN-, S+, S-, TN+, TN-, yes^{8 above}), the interaction of group and condition. Age and reading-span score, previously decorrelated on R (R Core Team 2022), were included as covariates. Both participants (subjectID) and items (itemID) were included as random effects. Initially, varying intercepts and slopes were included for participants, and only varying intercepts were included for items (as not all items were seen in different conditions). Due to single fit of the model, random slopes were removed for participants (which accounted for least variance) and only varying intercepts were retained. Again, the main effects plots are illustrated in Figure 10, with key main effects and interactions discussed below (for full model details, see Appendix B).

A significant main effect of condition, $F(6, 507.8) = 13.02, p < .001$, as well as a significant interaction between group and condition, $F(6, 5578.1) = 3.8, p < .001$, were found. Bonferroni adjusted post-hoc analyses revealed that, within groups, (only) in S+ trials RTs were significantly longer than in S- trials for both students, $t(1630.3) = 5.13, p < .001$, and residents, $t(1524.4) = 6.64, p < .001$. The interaction was possibly due to the difference reported, greater for residents (222.29ms) than students (175.22ms). Between groups, no differences were found across conditions (all $ps > .05$), and, overall, neither age nor reading-span score significantly predicted RT (both $ps > .05$).

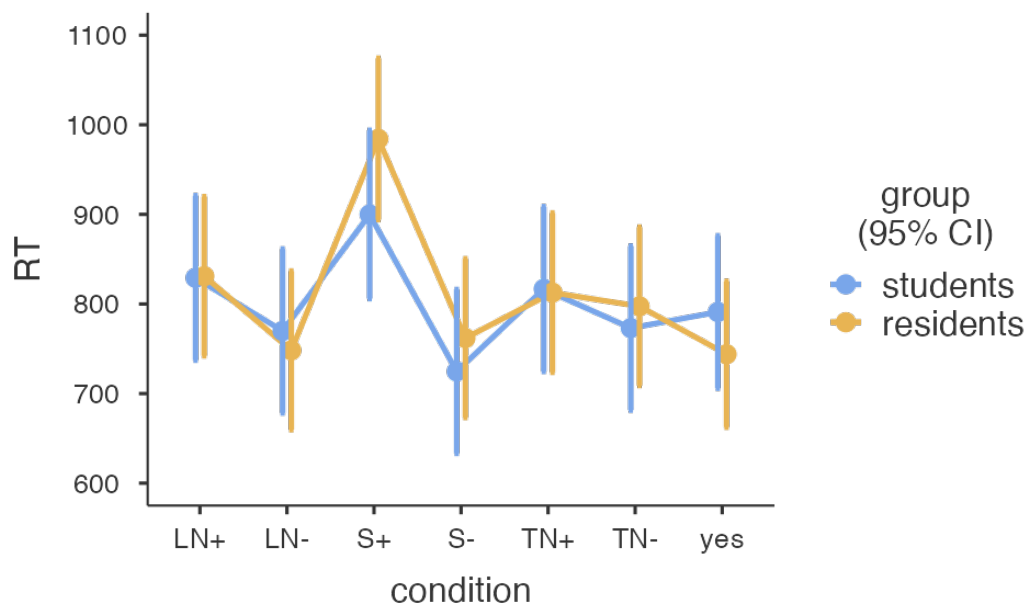


Figure 10. Reaction time (RT) in different conditions of the translation recognition task for students and residents. LN = lexical neighbour; TN = translation neighbour; S = semantic neighbour. +/- signs = related/unrelated trials. Error bars = 95% confidence interval (CI).

2.5 Interim Discussion

This first study wished to investigate the activation of L1 lexical information and access to L2 meaning in British students of Italian at UK universities and

British long-term residents in Italy. The predictions for the student group were that they would experience more lexical interference as a consequence of L2 meaning access via L1 mediation. By contrast, long-term residents were expected to experience more semantic interference and less lexical interference as a consequence of direct access to semantics due to greater L2 proficiency, and greater inhibition due to L2 immersion.

The results of the TRT show that, while the above predictions were met for the group of long-term residents, university students did not behave as expected. Specifically, the two groups both experienced greater sensitivity to semantically related trials, as revealed on both accuracy and RT analyses. Indeed, not only were both groups less accurate and slower in semantically related trials, but there were also no significant differences in either accuracy or RTs between the two groups on those trials. In fact, the only significant difference between groups was found in *yes* trials, with long-term residents being significantly more accurate than university students (94.1% versus 78.2% accuracy, respectively). While the difference between groups in the *yes* trials is not surprising given the large difference in L2 proficiency between the two groups (with a mean LexITA score of 69.88/90 for long-term residents and 32.22/90 for university students), a possible explanation for students' unexpected results in the *no* trials may actually be found in L2 proficiency as well. Indeed, this study's predictions were formulated on the basis of Stewart and Kroll's (1994) RHM, which assumes an asymmetry in translation performance that is subject to change as a function of L2 proficiency and use. Specifically, increasing L2 proficiency and L2 use predict a strengthening of the links between L2 words and concepts, as well as a decrease in translation asymmetry, with backward translation becoming increasingly more conceptually mediated (see Kroll and Tokowicz 2005, and § 2.2.3.2). While

the university students taking part in this study were not as proficient in their L2 as the long-term residents, they were also certainly not beginner L2 learners, being in their final year of Italian studies. Thus, in line with the earlier-mentioned claims by Kroll and Ma (2018, 30) for studies reporting semantic sensitivity in lower proficiency bilinguals as well (e.g., Ma *et al.* 2017), it is plausible to suggest that the university students taking part in this study may have also been past a ‘critical stage of learning’, thus not behaving as initially predicted. Future studies could address this issue, by explicitly employing learners of lower L2 proficiency (i.e., students in their first/second year of studies), whilst also having to pay particular attention to the design of the items employed in the task – to avoid confounds due to unfamiliarity with words rather than lexical interference. Lastly, future research may also wish to reconsider using the terms ‘translation neighbours’ and ‘lexical neighbours’ widely employed in the literature – thus, in the present work – as they both rely on phonological similarity and, as such, may not be sufficiently distinct.

In sum, the type of interference experienced in lexical access by the university students and long-term residents tested in this study is similar between the two groups, both reporting greater semantic interference and lower lexical interference, with only a slightly higher degree of interference reported in long-term residents in comparison to students. While lexical production in the L1/L2 could not be determined due to technical issues in the online testing, it would have been informative to know whether the two groups would report similar interferences in L1/L2 lexical production as well.

Syntactic Attrition

3.1 Introduction

This chapter introduces the second language domain under investigation – that is, syntax. The debate surrounding the reported vulnerability of some syntactic aspects to L1 attrition is presented by outlining, first, the differences, within generative models of grammar, between aspects belonging to narrow syntax and interpretable features at the interfaces. One of the most influential accounts for the attrition of some interface structures but not others – i.e., Sorace and Filiaci’s (2006) Interface Hypothesis – is hence presented, along with its contested limitations and more recent advancements (e.g., Sorace 2011, 2016, 2020). A special focus is placed on reviewing existing evidence of attrition in the resolution of ambiguity for (1) pronouns and (2) relative clause attachment, which are the two grammatical structures subject to scrutiny in the present investigation. After having established the foundations for the experimental work on syntactic attrition done for this thesis, its methodology and results are presented and lastly discussed.

3.2 Background

3.2.1 *The Attrition of Interpretable Interface Features*

L1 attrition has been described as being highly selective, not only as some language domains seemingly attrite faster than others (cf. discussion on the high vulnerability of the lexicon to attrition in § 2.2.1), but also due to the fact that some structures seem to be more prone to attrition than others (see earlier discussion on the absence of attrition in Spanish direct object marking

as opposed to pronoun resolution in § 1.1.2.3). The reasons behind the selectivity of attrition in terms of the structures it affects have especially been explored from a generativist perspective, where a theoretical framework that has allowed researchers to investigate the architecture of the language system – therefore making concrete predictions on L1-L2 contact and CLI in different language phenomena – is Chomsky's (1993, 1995, 2000) Minimalist Program (MP). Some of the main minimalist assumptions are outlined below in relation to their relevance for L1 attrition frameworks of study.

3.2.1.1 Minimalism, Narrow Syntax and Interfaces

In its original discussion (Chomsky 1993), the object of scrutiny of the MP is the (so-called) 'native' speaker's linguistic knowledge, also referred to as 'I'-language (where 'I' stands for intensional, internal, and individual) as opposed to 'E'-languages (i.e., external languages used by populations, such as English, Swahili, etc.). An I-language is modelled through a computational system (C_{HL}) that operates on lexical items in the formation of linguistic expression representations for the sounds and meanings of each linguistic expression. The lexicon and the C_{HL} form part of the grammar of a language, which in itself serves as a theory of the I-language. Broadly, there are grammatical mechanisms and general constraints that apply across I-languages, which belong to the general theory of I-languages (that is, UG). These mechanisms characterise the initial state (S_0) of the Faculty of Language (FL), which is thought to exist in the mind of all speakers. S_0 contains a series of invariant principles and parameters that determine a language, the acquisition of which consists in acquiring a lexicon and fixing the values of those parameters, ultimately leading to syntactic language variation (Chomsky 1995).

Further, according to the MP, linguistic expressions are argued to have two levels of representation, the Phonetic Form (PF) and the Logical Form (LF) – the former including sounds and the latter including meanings – which interface, respectively, with the Articulatory-Perceptual (A-P) systems and the Conceptual-Intentional (C-I) systems. Importantly, only interpretable features are found at the interfaces, while uninterpretable features are unacceptable and need to be removed by checking, before the derivation reaches the interfaces, for the representation to converge (Chomsky 2000). Among the uninterpretable features situated in narrow syntax are the recursive-embedding operation Merge, transfer to the semantic and phonological components, and phenomena that are manifest in the phonological component without seemingly being motivated by the semantic component, such as the extended projection principle (EPP), subject-verb agreement, and structural case marking.

The distinction between narrow syntax and interfaces is crucial within generative-based frameworks of L1 attrition. Indeed, as noted by Tsimplici (2007, 85-86), if the PF and LF levels interface with external systems, and narrow syntax is impenetrable by other modules, then attrition could be thought of as a process which affects only interpretable features at either PF, LF, or both levels, as opposed to syntax proper and parametric choices in the computational domain. An influential hypothesis put forward to account for the occurrence of attrition at the interfaces is the Interface Hypothesis, originally formulated by Sorace and Filiaci (2006) and subsequently reworked by Sorace and colleagues (i.e., Tsimplici and Sorace 2006; Sorace 2011, 2012, 2016, 2020), as discussed below.

3.2.1.2 The Interface Hypothesis within L1 Attrition Research

Sorace and Filiaci (2006) initially formulated their Interface Hypothesis (IH) to account for the non-convergence and residual optionality found in highly advanced (or 'near-native') L2 learners, both in the production and comprehension of certain structures. Specifically, the IH initially proposed that language structures situated at the interface of syntax and other domains (e.g., syntax-pragmatics) are more difficult to be acquired in the L2 than structures pertaining to 'narrow' syntax (see earlier discussion in § 3.2.1.1). The IH was, at the same time, extended to early bilingual acquisition as well as individual (first generation) L1 attrition, given that the same structures exhibit, in each respective case, protracted indeterminacy (e.g., Serratrice, Sorace and Paoli 2004) and emerging optionality (e.g., Tsimpli *et al.* 2004).

However, the initially clear-cut distinction between narrow syntax and interface structures within the IH soon grew to rather distinguish between 'external' and 'internal' interfaces, both due to the developmental differences among interfaces and the possibility that *all* structures may require (different kinds of) interfaces (Tsimpli and Sorace 2006). Specifically, the refined version of the hypothesis describes 'external' interfaces (e.g., the syntax-pragmatics interface) as including conditions that involve integrating contextual and pragmatic information in real-time, while 'internal' interfaces (e.g., syntax-phonology, syntax-morphology or syntax-semantics) involve integrating information that is not sensitive to contextual changes, ultimately relying on well-rehearsed processing mechanisms.

Some criticisms following Sorace's (2011) IH keynote article have addressed, beyond other points, the definition of interface, which seems to be driven by a speaker's behaviour – e.g., a phenomenon belongs to an interface because it is difficult for the speaker, and it is difficult because it

belongs to an interface (see Duffield 2011; Gürel 2011; Pérez-Leroux 2011; White 2011). Sorace (2012) has subsequently suggested that the term 'interface' be used to capture different types of conditions on syntactic realisations, therefore giving up rigid dichotomies such as 'narrow syntax vs. interfaces' or even distinctions between 'syntax and pragmatics' or 'syntax and semantics', and rather place emphasis on computational complexity as a key explanatory factor (cf. Hopp 2011). As more recently stated, 'there is no syntax that is unaffected by conditions of any kind' (Sorace 2020, 205). Moreover, Sorace (2012, 210) has further noted that there are overall processing resources which may not be available for all kinds of computations, and that specific interface mapping operations might require different types of cognitive resources. Consequently, it may be the case that structures requiring more proceduralised internal mappings are less taxing than those requiring the integration and updating of contextual information in real time (cf. Sorace 2016; also see earlier § 1.1.3.3 for a discussion on competition in cognitive resources allocation). By considering the interactions of linguistic and non-linguistic factors, far more importance is placed on individual differences (e.g., in terms of working memory and executive functions). Given the limited explanatory power of linguistic theory on its own, this seems to be a fruitful way forward in L1 attrition/L2 acquisition research. Indeed, as Sorace (2012, 215) reminds us, 'phenomena are generally not due to *either* linguistic or to processing factors, but are likely to be determined by complex interactions between the two'.

Having provided an overview of the original formulation of the IH along with its limitations and more recent developments as a framework to study grammatical L1 attrition, the next sections review corroborating evidence for the predictions of the IH as well as some (seemingly) inconsistent findings.

3.2.2 *Anaphora Resolution*

The predictions of the IH have found extensive support in research examining the attrition of interface structures, especially in the resolution of ambiguous pronouns (e.g., in Tsimpli *et al.* 2004; Gürel 2004; Wilson 2009; Chamorro, Sorace and Sturt 2016). In the first part of this section, the main findings of these studies are hence reviewed. The second part of this section explains how research on the overextension of overt pronouns in two null subject languages (e.g., de Prada Pérez 2009; Michnowicz 2015; Bonfieni *et al.* 2019) can also be reconciled with the latest reconceptualisations of the IH (in Sorace 2011, 2012, 2016), by placing more emphasis on computational complexity and processing demands (cf. §§ 1.1.3.1-1.1.3.2) rather than on interface conditions or structural overlap.

3.2.2.1 Overview of Studies on Anaphora Resolution

As reported in Gürel (2019, 251), one of the earlier theoretical motivations for pronoun L2 acquisition studies, which subsequently paved the way for pronoun L1 attrition research, is embedded in generativist theories analysing null and overt pronouns as parameterised UG options. According to this view, the use of null and overt pronouns is governed by specific discourse-pragmatic constraints. In particular, the theoretical conceptualisation of null and overt pronouns has changed over the years, especially since the advent of Chomsky's MP (discussed earlier in § 3.2.1.1). According to some (e.g., Alexiadou and Anagnostopoulou 1998), it is the interpretability of agreement features that licenses null pronouns, while obligatory overt subjects are the result of feature movement. Therefore, in English and other non-null subject languages, the subject needs to be merged in the specifier of Agreement position to check the EPP feature, a [-interpretable] feature (for alternative

views, see Holmberg 2005 and Roberts 2007). On the other hand, the distribution of null and overt subjects depends on [+interpretable] features, such as [+Topic Shift].

The prediction in L1 attrition – which, in this light, entails losing or resetting the specifications of these features in the L1 – is that the distribution of overt subjects, unlike null subjects, will be affected in null-subject languages such as Italian under the influence of L2 English (e.g., in Sorace 2000). Specifically, given that English pronouns are not obligatorily specified for [+Topic Shift], overt pronouns in Italian should also become optionally unspecified for [+Topic Shift], ultimately leading to infelicitous overt pronoun use in [-Topic Shift]. By contrast, for Italian L2 speakers of English, null pronouns should occur in the same contexts they occur for Italian monolinguals (i.e., [-Topic Shift] contexts) as they are the result of the specification of [-interpretable] features. Indeed, the production and comprehension of pronominal subjects have been found to diverge between monolinguals and adult late bilinguals – i.e., speakers with high proficiency in an L2 learnt after puberty – with greater variability displayed in bilinguals' comprehension and production in both languages (Sorace 2016, 3).

One of the first studies to document this type of variability in L1 anaphora resolution is Tsimpli *et al.* (2004). Specifically, the researchers tested the production and interpretation of null and overt pronouns of a group of Italian 'near-native' speakers of English through means of a picture verification task. Participants were presented with an ambiguous sentence, such as the ones for Italian in (1), where the main clause was either preceded (1a) or followed (1b) by the subordinate clause containing the ambiguous pronoun (i.e., 'forward' or 'backward' anaphora). Participants were then asked to select

the picture that matched the meaning of the sentence among three options, as shown in Figure 11.

- (1) a. Quando lei_{k/l}/*pro*_i attraversa la strada, l'anziana signora_i saluta la ragazza_k.
while she/*pro* crosses the street the old woman greets the girl

"While she crosses the street, the old woman greets the girl."

- b. L'anziana signora_i saluta la ragazza_k quando lei_{k/l}/*pro*_i attraversa la strada.
the old woman greets the girl when she/*pro* crosses the street

"The old woman greets the girl while she crosses the street."



Figure 11. Three options presented for the resolution of overt and null pronouns in Tsimpli et al.'s picture verification task, from Tsimpli et al. (2004, 277).

The results of Tsimpli et al.'s (2004) study confirmed the prediction that null pronouns would not be affected by attrition. Indeed, in sentences containing forward anaphora such as (1a), null (i.e., *pro*) subjects were interpreted as referring to the subject (e.g., *l'anziana signora*) by both Italian monolinguals and Italian near-native speakers of English (87% vs. 85%). On the other hand, attrition showed in the interpretation of overt subjects for the same types of sentences. That is, while Italian monolinguals strongly favoured (63%) an external referent (i.e., neither *l'anziana signora* nor *la ragazza*), near-native speakers accepted almost equally all three referents. Further, with regards to sentences containing backward anaphora such as (1b), either the subject (e.g., *l'anziana signora*) or the object (e.g., *la ragazza*) were possible referents for

Italian monolinguals (50.75% vs. 44.05%), while near-natives had a definite preference for the subject over the object (69.8% vs. 24.85%). On the other hand, although both groups' preferred interpretation of overt pronouns referred to an object antecedent, the near-native group still showed a significantly higher subject preference than the monolingual group (21.15% vs. 7.6%), taken by the researchers as evidence of L1 attrition.⁹ Overall, their results led Tsimpli et al. (2004, 272-274) to conclude that attrition affects aspects of the distribution and interpretation of subjects that are due to syntactic/pragmatic (i.e., interpretable) features, as opposed to aspects of the syntax of subjects that have been argued to be due to the parametrisation of purely formal (i.e., uninterpretable) features.

Similar to Tsimpli et al. (2004), Gürel (2004) found attrition to be selective in the case of null and subject pronouns for Turkish L2 learners of English. Specifically, Gürel used a written interpretation task, a truth-value judgment task and a picture identification listening task to investigate the interpretation of the Turkish overt pronouns – i.e., *o* '(s)he', and *kendisi* 'self' – and the null pronoun. As can be seen in the examples below, all three pronouns can appear in subject (2) and object (3) position. However, when they appear in object position, only *kendisi* and the null pronoun can refer to the subject of the main clause, such as *Burak* in (3).

- (2) O/kendi-si/*pro* Londra'ya git-ti.
 (s)he/self-3SG/*pro* London-DAT go-PST
 "(S)he went to London."

⁹ Although beyond the focus of this chapter, Tsimpli et al. (2004) also tested the interpretation of preverbal and postverbal subjects in a group of Greek near-native speakers of English, who reported significantly more indeterminacy than monolinguals in the interpretation of preverbal subjects (usually interpreted as 'old' information, i.e., topic). The authors took these results, too, as evidence of attrition.

- (3) Burak_i o-nu_{*i/j}/kendi-si-ni_{i/j}/pro_{i/j} beğen-iyor.
Burak (s)he-ACC/self-3SG-ACC/pro like-PGR
"Burak_i likes him_{*i/j}/self_{i/j}/pro_{i/j}."

The results of Gürel (2004) revealed that Turkish L2 learners of English interpreted the overt pronoun *o* as referring to the subject antecedent, unlike monolingual Turkish (in which an object-antecedent interpretation would be preferred). On the other hand, the interpretation of the other overt pronoun *kendisi*, and that of the null pronoun, did not undergo attrition. The author attributed the change in interpretation of the overt pronoun *o* to the influence of L2 English. In other words, in line with Paradis' ATH (discussed in § 2.2.2.2), Gürel (2004, 74-75) argues that attrition arises due to the competition of the overt pronoun *o* (used less frequently, therefore less available) with the English overt pronoun *(s)he* (used more frequently, therefore more available). By contrast, because the overt pronoun *kendisi* and the null pronoun do not have corresponding items in the L2, they do not undergo attrition. This interpretation, as highlighted in Chamorro and Sorace (2019, 28) is also partly compatible with the IH, in that it provides a (mainly) CLI-based processing explanation.

Studies using eye-tracking methodologies, such as Wilson (2009), found evidence of attrition in the resolution of German anaphora with demonstratives and pronouns. Specifically, monolingual German speakers use personal pronouns (i.e., *er/sie/es*) to refer to subject antecedents, and demonstratives (i.e., *der/die/das*) to refer to object antecedents. Therefore, Wilson (2009) presented German L2 learners of English with a pair of sentences such as the ones in (4) and a corresponding picture (Figure 12).

Participants were then asked to answer a yes/no question revealing their antecedent preferences.

- (4) a. Der Kellner erkennt den Detektiv als das Bier umgekippt
the-NOM waiter recognises the-ACC detective as the beer tipped-over
wird. Er ist offensichtlich sehr fleißig.
is he-PRON is clearly very hard-working

“The waiter recognises the detective as the beer is tipped over. He is clearly very hard working.”

- b. Der Kellner erkennt den Detektiv als das Bier umgekippt
the-NOM waiter recognises the-ACC detective as the beer tipped-over
wird. Der ist offensichtlich sehr fleißig.
is he-DEM is clearly very hard-working

“The waiter recognises the detective as the beer is tipped over. He is clearly very hard working.”



Figure 12. Example of a picture presented in Wilson (2009) for anaphora resolution of German pronouns and demonstratives, from Wilson (2009, 124).

The results of the eye-tracking experiment in Wilson (2009) showed that German L2 speakers of English experienced more attrition effects with demonstratives than with pronouns, with no clear preference for object antecedents, as opposed to monolingual German controls.¹⁰ Importantly, Wilson (2009, 194-205) notes that the degree of L1 attrition was significantly affected by both length of residence (LoR) in Great Britain and use of L1 German. Specifically, a strong NP2 preference was reported for demonstratives with shorter LoR and more frequent L1 use, which turned into a moderate preference for NP1 with longer LoR (but, still, with more frequent L1 use). The explanation put forward by Wilson is that the German speakers living in Great Britain for longer who still use the L1 actively are receiving input in their L1 that is, in itself, possibly attrited. Because the input they receive is in (L1) German, this causes it to have a greater effect than competition from (L2) English.

The last study reviewed here, providing evidence in support of the IH, is Chamorro, Sorace and Sturt (2016). The researchers investigated (a) whether pronominal subjects would undergo attrition in L1 Spanish under exposure to L2 English and, importantly, (b) whether attrition would only affect online processing or also underlying representations (cf. earlier discussion on what attrition entails in § 1.1.2). Addressing the latter point is especially important given the mixed results reported in some literature on L2 learners and heritage speakers (e.g., in Slabavoka and Montrul 2003; Rothman and Iverson 2008; Judy and Rothman 2014; Leal Méndez, Rothman and Slabakova 2015), which typically make use of offline measures involving metalinguistic tasks. As

¹⁰ Interestingly, similar results were reported in the case of another experiment in Wilson (2009), investigating the same phenomenon in the L2 of English-speaking learners of German. Similar parallel findings have also been reported in studies on English and Italian (cf. § 1.1.3.3, and the discussion of the convergence between L1 attriters and L2 learners in Sorace 2016).

pointed out in Chamorro and Sorace (2019, 29), such kinds of tasks are not suitable to investigate the predictions of the IH, which are formulated for the online processing of vulnerable structures to attrition. Therefore, both an online eye-tracking-while-reading task and an offline naturalness judgment task were employed in Chamorro, Sorace and Sturt (2016) to probe into online and offline preferences, respectively. Participants were presented with sentences which contained pronouns agreeing in number with the pragmatically infelicitous antecedent, such as (5a) and (5b), and sentences with pronouns agreeing in number with the pragmatically felicitous antecedent, such as (5c) and (5b). The sentences had been created on the basis of Carminati's (2002) Position of Antecedent Strategy (PAS), originally formulated for Italian and later shown to also apply to Spanish by Alonso-Ovalle *et al.* (2002), which postulates the tendency for null pronouns to refer to subject antecedents and overt pronouns to refer to object antecedents.

- (5) a. La madre saludó a las chicas cuando ella cruzaba
The mother greeted-SG to the girls when she crossed-SG
una calle con mucho tráfico.
a street with much traffic
"The mother greeted the girls when she crossed a street with a lot of traffic."

- b. Las madres saludaron a la chica cuando ella cruzaba
The mothers greeted-PL to the girls when she crossed-SG
una calle con mucho tráfico.
a street with much traffic
"The mothers greeted the girl when she crossed a street with a lot of traffic."

- c. La madre saludó a las chicas cuando *pro* cruzaba
 The mother greeted-SG to the girls when *pro* crossed-SG
 una calle con mucho tráfico.
 a street with much traffic

"The mother greeted the girls when she crossed a street with a lot of traffic."

- d. Las madres saludaron a la chica cuando *pro* cruzaba
 The mothers greeted-PL to the girls when *pro* crossed-SG
 una calle con mucho tráfico.
 a street with much traffic

"The mothers greeted the girl when she crossed a street with a lot of traffic."

While the results of the offline judgment task showed no attrition effects, with Spanish L2 speakers of English showing similar sensitivity to the pronoun mismatch as Spanish monolinguals, attrition effects were found in the online eye-tracking results. In particular, monolinguals showed a significant mismatch sensitivity in both the critical and post-critical regions, while L2 speakers did not show online mismatch sensitivity, with a significantly different performance from monolinguals. These results ultimately led Chamorro, Sorace and Sturt (2016) to conclude that attrition affects online sensitivity, particularly with structures at the syntax-pragmatics interface, but not underlying representations, in line with Sorace's (2011, 2016) claims¹¹.

¹¹ In the same study, Chamorro, Sorace and Sturt (2016) also investigated whether attrition effects would disappear following a period of re-immersion in the L1 country. As this particular aim of the study goes beyond the scope of the present chapter, its results are not presented here; they are however discussed in §§ 1.1.2.3, along with the results of another study by the same authors (i.e., Chamorro, Sturt and Sorace 2016) on the selectivity of L1 attrition.

3.2.2.2 Implications of Overt Pronoun Overextension for the IH

It is important to note that the studies reviewed so far report evidence of L1 attrition in language pairs that work differently with regards to the resolution of anaphoric dependencies under investigation. In these cases, English – the *less* restrictive language of the pair, with overt pronouns as the only option – influences the other language – which is *more* restrictive, as specific pragmatic factors govern the choice between overt and null pronouns (e.g., in Italian and Spanish) or between overt pronouns and demonstratives (e.g., in German). This is in line with the two conditions postulated by Müller (1998), Hulk and Müller (2000), and Müller and Hulk (2001) for CLI to take place: namely, (1) structural overlap and (2) the presence of an interface level between two modules of grammar.

However, the overextension of the scope of overt pronouns has also been found in pairs of null subject languages, both in bilingual adults – i.e., L1 Spanish-L2 Italian (e.g., Bini 1993), L1 Greek-L2 Spanish (Margaza and Bel 2006; Lozano 2006), L1 Spanish-L2 European Portuguese (e.g., Guido Mendes and Iribarren 2007), L1 Spanish-L2 Catalan (e.g., de Prada Pérez 2009) – and in bilingual children – i.e., Italian-Spanish (e.g., Sorace *et al.* 2009), Maya-Spanish (e.g., Michnowicz 2015), Spanish-Basque (e.g., Rodríguez-Ordóñez and Sainzmaza-Lecanda 2018), and Italian-Sardinian (e.g., Bonfieni *et al.* 2019). In this light, Sorace's (2011, 2012, 2016) latest claims on the importance of computational complexity and processing demands provide a better explanation for the occurrence of L1 attrition, rather than the presence of interface conditions or structural overlap from a crosslinguistic perspective (cf. §§ 1.1.3.1-1.1.3.2). Indeed, important aspects of executive function may affect how speakers resolve anaphoric ambiguity. As summarised in Sorace (2014, 73), the fact that bilinguals, regardless of

language combination, are less efficient than monolinguals in retrieving object antecedents in the resolution of overt pronouns is possibly due to any of the following: (1) slower inhibition of the subject in the matrix clause as the other potential antecedent; (2) slower inhibition of the pronoun-antecedent mappings of the other language; (3) slower incremental integration of information with the unfolding of the sentence. Consequently, as also explained in § 1.1.3.2, the default reliance on the overt pronoun-subject antecedent mapping may be a way for bilinguals to cope with the increasing cognitive competition of the two simultaneously active languages, ultimately relieving the processing demands of integrating pragmatic and/or contextual information in real time.

Following from the aforementioned idea that all syntactic structures are affected by conditions of some kind (cf. Sorace 2016, 2020), the next section analyses L1 attrition findings in the resolution of a second syntactic structure – i.e., relative clause (RC) attachment – showing how similar considerations to the ones put forward for the overextension of overt pronouns can also explain the occurrence of attrition within RC attachment ambiguity resolution.

3.2.3 Relative Clause Attachment Ambiguity Resolution

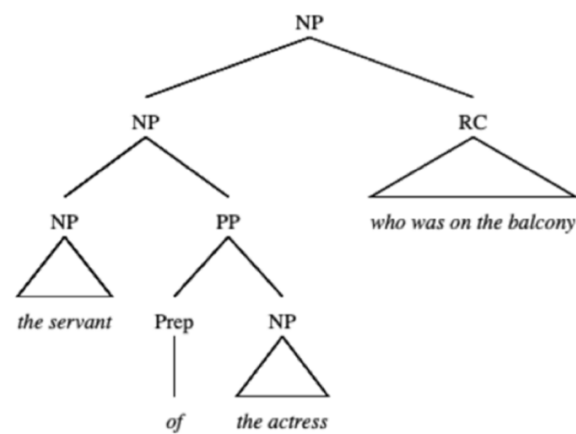
3.2.3.1 Overview of Studies on RC Attachment Resolution

Before examining the evidence of L1 attrition in studies on the resolution of RC attachment ambiguity, it is necessary to give an overview of the initial findings on crosslinguistic variation in RC attachment ambiguity resolution. Precisely, the first ones to study RC attachment ambiguity were Cuetos and Mitchell (1988), who found that the ambiguity in RC attachment is processed differently by speakers of different languages. For instance, in the Spanish

sentence (6a), of which (6b) is the English equivalent translation, the RC *que estaba en el balcón* ('who was on the balcony') is ambiguous, as it can be attached to either the closer noun phrase *la actriz* ('the actress', i.e., the NP2), or to the higher one *la criada* ('the servant', i.e., the NP1). The two interpretations are illustrated in Figure (13).

- (6) a. Alguien disparó contra la criada de la actriz que estaba en el balcón.
b. Someone shot the servant of the actress who was on the balcony.

(a) NP1 attachment



(b) NP2 attachment

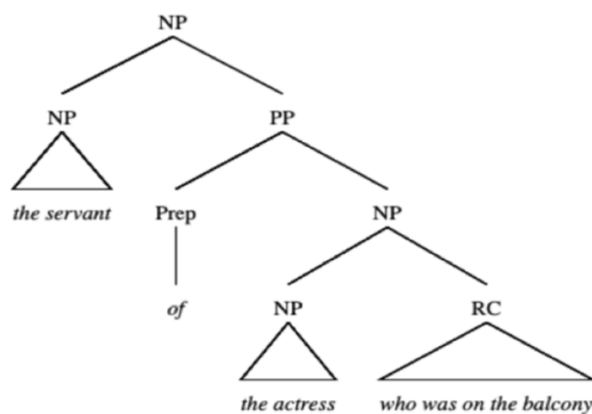


Figure 13. Examples of two preferences in relative clause (RC) attachment resolution: respectively, (a) high (i.e., NP1) attachment and (b) low (i.e., NP2) attachment.

In their study, Cuetos and Mitchell (1988) tested RC attachment preferences of monolingual English speakers and monolingual Spanish speakers through the use of a questionnaire and a self-paced reading task. Their findings for both tasks showed that in ambiguous sentences such as the pair in (6), monolingual English speakers tended to resolve the ambiguity by attaching the RC *low* to the NP2 (i.e., *the actress*) 58% of the time¹², while Spanish speakers preferred to attach the RC *high* to the NP1 (i.e., *the servant*) 63% of the time. These findings called into question different theories of syntactic parsing, such as Frazier's (1978) Late Closure principle in Garden-Path Theory – according to which new information is preferably attached to the last constituent parsed – thus questioning the very existence of universal principles of language processing.

Since Cuetos and Mitchell (1988), many researchers have investigated crosslinguistic variation in the resolution of RC attachment ambiguity by employing several experimental techniques, such as self-paced readings, eye-tracking experiments and electrophysiological correlates. Numerous studies have found an NP1 preference in languages such as Spanish (e.g., Mitchell and Cuetos 1991; Gibson, Pearlmutter and Torrens 1999), Dutch (e.g., Desmet, Brysbaert and de Baecke 2002), French (e.g., Mitchell, Cuetos and Zagar 1990), and Greek (e.g., Papadopoulou and Clahsen 2003), while others have found an NP2 preference in other languages, such as English (e.g., Henstra 1996; Dussias 2003), Arabic (e.g., Abdelghany and Fodor 1999), Chinese (Shen 2006), Swedish, Norwegian and Romanian (Ehrlich et al. 1999). By contrast, the evidence gathered for Italian – the language, other than

¹² It needs to be pointed out that the NP2 preference in English was found for materials in which both referents were human nouns. By contrast, when the first referent was non-human and the second was human, an NP1 preference was found in 67.5% of the cases. A similar bias has been found in the present study (cf. later § 3.4).

English, which the research carried out for this thesis focuses on – is mixed. Indeed, early research on the resolution of RC ambiguity in Italian monolingual speakers found a preference for NP2 attachment (e.g., de Vincenzi and Job 1993, 1995). However, later research in Italian using the same materials as the ones employed by de Vincenzi and Job found no clear NP2 attachment preference (cf. Frenck-Mestre and Pynte 2000a). As Frenck-Mestre and Pynte (2000a, 561) further argue, de Vincenzi and Job’s (1993, 1995) conclusions in favour of an NP2 preference in Italian were formulated on the basis of the results for a set of ‘NP1-of-NP2’ together with another set of ‘NP1-with-NP2’ sentences combined. Therefore, the overall NP2 preference reported in earlier studies does not hold for the ‘NP1-of-NP2-RC’ sentences when these are processed independently. Indeed, further research conducted in French by Frenck-Mestre and Pynte (2000b) using ambiguous RC sentences containing either *de* (‘of’) or *avec* (‘with’) found a strong preference for NP1 attachments for sentences containing the preposition *de*, while participants preferred NP2 over NP1 attachments for sentences containing *avec* (see example 7).

- (7) a. Jean photographie la fille de/avec Charles qui semble
Jean photographs the girl of/with Charles who seems
plus dédaigneux/se que d’habitude.
more disdainful(MASC/FEM) than usual
“Jean photographs the girl of/with Charles who seems more disdainful than usual”

Frenck-Mestre and Pynte (2000b) used their findings to argue that the preposition ‘with’ systematically leads to an NP2 preference in Spanish, Italian, French and English – which may also explain why self-paced reading

research, such as de Vincenzi and Job's (1993, 1995) studies, failed to find an NP1 preference for this structure when the preposition was 'of'. Thus, in the case of Italian, if NP2 attachment seems to be clearly preferred with the preposition *con* ('with'), the same cannot be said with certainty with regards to the preposition *di* ('of').

However, it is important to note that an offline (questionnaire) study by Clifton (1988) employing the same sets of materials as the ones in Cuetos and Mitchell (1988) found an NP1 preference (55%) also in English, a language that has normally been taken to follow the Late Closure principle, calling for a more thorough explanation. As proposed by de Vincenzi and Job (1993, 1994), for instance, the fact that some studies have found an NP1 preference in English (55%), Spanish (63%) and Italian (65%), albeit to a greater extent in the latter two languages, could be linked to Grice's (1975) maxim of manner (i.e., being clear and avoiding ambiguity). Specifically, in English the unambiguous way of conveying an NP1 attachment meaning for (8a) below is through the possessive construction (8b):

- (8) a. The servant of the actress who was on the balcony.
 b. The actress' servant who was on the balcony.

Therefore, using (8a) – also known as the Norman genitive – to convey the same meaning conveyed by (8b) – that is, the Saxon genitive – would violate the Gricean maxim of manner, as the speaker would be choosing an ambiguous structure instead of an unambiguous structure available in the English language (cf. Frazier 1990). Because, on the other hand, in Spanish and in Italian the same possessive construction is not available, the NP1

disambiguation is not possible as it is in English – ultimately resulting in more ambiguity for NP1 attachment resolution in Spanish and Italian than in English.

These language-specific rules fit in with other factors that, according to Construal Theory (also referred to as the Construal hypothesis) by Frazier and Clifton (1996), explain parsing decisions involving RCs: namely, the thematic processing domain and interpretative principles (i.e., the Referentiality Principle and Gricean maxims, such as the one of manner). In brief, under the Construal hypothesis, a complex NP (e.g., ‘the servant of the actress’) represents the current thematic domain due to the fact that the preposition ‘of’ does not introduce a new thematic domain. Consequently, either of the two nouns within the thematic domain can be the host of the RC: it is discourse principles, among which the most important is the Referentiality Principle, that introduce a bias for high attachment. Specifically, the parser attaches the RC high (e.g., to the NP1 ‘the servant’) because (1) the NP1 is the head of the complex NP and due to (2) the direct relevance of the NP1 to the main assertion of the sentence. According to this universal principle, all languages are supposed to show the same preference bias. The difference between English and Spanish (or Italian), then, is explained, as mentioned earlier, by the interworking of Grice’s maxim of manner and language-specific rules. In other words, the parser’s final choice to attach the RC high, to the NP1, or low, to the NP2, depends on semantic and interpretative considerations, as well as on whether the grammar of the language has a grammatical option to block one of the two competing interpretations. According to Frazier and Clifton (1996), it is for this reason that in languages like English, unlike Spanish or Italian, the parser will be more likely to choose the second NP as the host of the RC (i.e., given the grammaticalisation of a Gricean effect in English, but not in the other two languages).

The studies and explanations reported thus far only looked at the resolution of RC ambiguity in monolingual speakers. More recent studies have begun looking at the same phenomenon in bilingual populations. Papadopoulou and Clahsen (2003), for example, examined online and offline RC ambiguity resolution in the L2 of advanced learners of Greek whose L1s were Spanish, German, or Russian. Their results showed that, despite 'native-like' mastery of the constructions investigated (as supported by high scores in a grammaticality judgment task), L2 learners showed RC attachment preferences that were different from those of a control group of Greek native speakers. Specifically, despite the fact that the learners' L1s (Spanish, German and Russian) are languages that usually prefer NP1 attachment, none of the learners showed any preference at all with regards to relative clauses preceded by complex genitive antecedents in their L2. In other words, there seemed to be no transfer of L1 parsing strategies even when the preferred L2 ambiguity resolution strategy was the same as in the L1.

In addition, other studies on L2 syntactic parsing by Frenck-Mestre (2002, 2005) found L2 proficiency to be a modulating factor. Specifically, in both studies, French monolinguals and two groups of L1-English/L2-French bilinguals (one with low L2 proficiency, and another with high L2 proficiency) were tested using an eye-tracking-while-reading task. The results revealed an NP2 attachment preference for participants with low levels of L2 proficiency in line with English RC resolution preferences, and an NP1 attachment preference for bilinguals with high levels of L2 proficiency, similar to the French monolinguals also tested in the study. However, whether L1 parsing strategies in advanced L2 learners may also differ from monolinguals was not taken in consideration by either Papadopoulou and Clahsen (2003) or Frenck-Mestre (2002, 2005).

Therefore, a series of studies by Dussias and colleagues (Dussias 2003; Dussias and Sagarra 2007) investigated precisely whether exposure to an L2 would influence sentence parsing in the L1. In Dussias (2003), both the L1 and L2 of proficient L1-Spanish/L2-English bilinguals and L1-English/L2-Spanish bilinguals were tested in an offline questionnaire and an online self-paced reading task while living in the United States (i.e., a predominantly English-speaking environment). In both English and Spanish, both groups of participants preferred NP2 attachment over NP1 attachment¹³ in line with the most common parsing strategy of English (i.e., the language that all participants were exposed to the most at the time of testing). This finding led Dussias to suggest that the proportion of exposure to each of the two languages affects bilingual parsing preferences.

Similar results were found in a subsequent study by Dussias and Sagarra (2007) where the linguistic environment of the participants was varied. Specifically, the study tested (only the L1) parsing preferences of highly proficient L1-Spanish/L2-English bilinguals. Participants belonged either to a group of bilinguals who had been living in the US for 7.1 years on average (i.e., with extensive L2 exposure), or to a second group of bilinguals who were living in Spain at the time of testing and had been living in an L2-speaking environment for 8.5 months prior to testing (i.e., with limited L2 exposure). The results showed that bilinguals with limited L2 exposure reliably attached the RC to the NP1, similar to Spanish monolinguals, whereas those with extended L2 exposure attached the RC to the NP2. Therefore, these findings

¹³ Precisely, low attachment in English was preferred 72% of the time by L1-English/L2-Spanish bilinguals and 78% of the time by L1-Spanish/L2-English bilinguals; low attachment in Spanish, on the other hand, was preferred 56% of the time by the former group and 72% of the time by the latter group, respectively.

also seemed to suggest that parsing strategies in the L1 can be influenced by the linguistic environment surrounding participants and, more specifically, by prolonged L2 exposure.¹⁴

On the one hand, as noted by Dussias and Sagarra (2007, 114), the observed permeability of the L1 system with regards to sentence parsing finds a readily explanation in a frequency-based model such as Linguistic Tuning, also known as the Tuning hypothesis (cf. Cuetos, Mitchell and Corley 1996). Specifically, because the Tuning hypothesis states that the parser's analysis of an ambiguous structure is influenced by previous encounters with similar types of ambiguities, exposure to English 'NP1-of-NP2-RC' constructions (resolved with a preference for NP2 attachment) may have made this interpretation more available when resolving L1 RC ambiguity. On the other hand, the Construal hypothesis (discussed in the previous section) does not seem to be supported by these findings, at least in the way it is currently formulated. Specifically, according to Dussias and Sagarra (2007, 114), the absence of a Saxon genitive in Spanish did not indicate to all speakers alike that the intended meaning for the attachment of the RC was to the first noun of the complex NP. In other words, while Spanish monolingual speakers and bilinguals with limited L2 English exposure revealed high attachment preferences, bilinguals with extensive L2 English exposure opted for low attachment despite the fact that only one syntactic construction is available in Spanish to express genitive relationships.

¹⁴ It is to be noted that, unlike Dussias (2003), Dussias and Sagarra (2007) did not test parsing strategies also in the L2.

3.2.3.2 Implications of Attrition in RC Resolution for the IH

A possible explanation for the findings in Dussias and Sagarra (2007) can however be sought in the latest reformulations of the Interface Hypothesis (cf. § 3.2.1.2). Specifically, recall that earlier accounts of the IH (e.g., Sorace and Filiaci 2006; Tsimpli and Sorace 2006) placed emphasis on (1) interface conditions and (2) structural overlap. With regards to the first point, it is not entirely clear which interface RCs belong to (if any at all, cf. Iverson 2012, 51), considering that both semantic and contextual cues may be at play in RC resolution depending on the specific design of the items employed in each study. Even assuming that RCs fall at the interface of syntax, semantics *and* pragmatics, the evidence of attrition in RC attachment resolution would not be congruent with the way RCs overlap in the two languages. Indeed, recall again the example of pronouns: languages like Italian and Spanish have two options (null and overt) whilst languages like English only have one option (overt). Under a CLI-based account (cf. Müller and Hulk 2001) of the IH, it would be the language with only one option (i.e., the less restrictive language, hence English) that influences the one with two options (i.e., the more restrictive language, thus Italian or Spanish), but not vice-versa. In the case of NP1-of-NP2-RC sentences, languages like Spanish (and Italian, although this is debatable, as explained earlier in this section) are less restrictive, allowing only the 'of' syntactic constructions to express genitive relationships. By contrast, languages like English are more restrictive, with 'of' constructions signalling a preference for NP2 attachment whilst NP1 attachment is preferred when encountering Saxon genitives (cf. example 8 earlier). This time, under a CLI-based account, only Spanish and possibly Italian (i.e., the less restrictive languages) would be expected to affect English (i.e., the more restrictive

language), but not the other way around. Yet, Dussias and Sagarra (2007) found evidence of attrition precisely in Spanish.

This is when Sorace's (2011, 2012, 2016) recent reworkings of the IH become relevant and congruent with Dussias and Sagarra's (2007) results. In line with what has been proposed to account for the overextension of overt pronouns in two null-subject languages (cf. § 3.2.2.2), computational complexity and processing demands provide a feasible explanation for the occurrence of L1 attrition in RC attachment resolution. Specifically, the fact that Spanish-English bilinguals may be less efficient than Spanish monolinguals at resolving ambiguous RC attachments as referring to the higher NP (i.e., the NP1), may be due to: (1) slower inhibition of the other referent (i.e., the NP2); (2) slower inhibition of the RC-antecedent mappings of the other language; (3) slower retrieval of information within the sentence (rather than the incremental integration of information therein, as in the case of overt pronouns). In other words, relying on the constituent that has been parsed last (i.e., the NP2) may be a way for bilinguals to cope with the increasing cognitive competition of their two languages – similar to when bilinguals rely on overt pronoun-subject antecedent mappings. Doing so provides relief from the processing demands of integrating different kinds of information (be it syntactic and pragmatic/contextual with pronouns, or syntactic, pragmatic and/or semantic in the case of RCs) in real time. In this light, the IH places more importance on individual differences (i.e., in working memory and executive functions), providing a plausible account of L1 attrition not only in the resolution of anaphoric dependencies, but also in RC attachment ambiguity resolution.

3.2.4 *Summary of the Literature and Aims of the Study*

The overview of studies provided in the present chapter shows that certain syntactic structures are more prone to attrition than others. The initial formulations of the Interface Hypothesis (from a mainly generativist perspective), discussed in § 3.2.1, accounted for the occurrence of attrition in structures that involve the coordination of information from more than one module (for instance, syntax and pragmatics) as opposed to narrowly syntactic structures. Specifically, the IH found corroborating evidence from different studies on the resolution of ambiguous pronouns, as reported in § 3.2.2. In these studies, (supposedly) due to crosslinguistic influence, a non-null subject language (i.e., English) would influence a null subject language (i.e., Italian), resulting in the overextension of the scope of overt pronouns to refer to subject antecedents. However, because overt pronoun overextension is also found in pairs of null-subject languages (Spanish-European Portuguese, Maya-Spanish and Italian-Sardinian, among others), more recent IH developments have identified computational complexity and processing demands as key explanatory factors, moving away from a predominantly CLI-based account. After reviewing evidence on bilingual relative clause attachment preferences in § 3.2.3, it has been noted that similar considerations seem to provide a plausible account for the occurrence of attrition in RC attachment ambiguity resolution as well. In sum, relying on overt pronouns/the more recently parsed constituent seems to be a plausible strategy for bilinguals to cope with the increasing difficulty of handling the two languages that are constantly active in their mind.

Given the evidence summarised above, the aim of the present study is to investigate the acquisition and the potential attrition of the resolution

preferences of (1) anaphora and (2) RC attachment ambiguity in late bilingual speakers of two different proficiencies (intermediate/advanced)^{6 above} in two different environments (L2 instruction in an L1 context/immersion in an L2 context).

3.2.4.1 Research Question

In particular, this study addresses the following question: are preferences in anaphora and RC attachment ambiguity resolution (1) equally acquirable in the L2 (i.e., Italian) *and* (2) equally prone to attrition in the L1 (i.e., English) for two groups of late bilingual speakers (i.e., lower proficiency classroom-based learners in an L1-speaking context and higher proficiency long-term residents in an L2-speaking context)?

3.2.4.2 Hypotheses and Predictions

The (preregistered^{5 above}) predictions for this study have been based on the earlier CLI-oriented formulation of the Interface Hypothesis (cf. § 3.2.1). Specifically, given that both the resolution of pronouns and RC attachment ambiguity involve the coordination of syntactic and discourse-based cues, and both structures are known to be resolved differently in different languages, the following is expected:

1. In L2 Italian,
 - a. both classroom learners and long-term residents should show ‘residual optionality’ in the resolution of ambiguous overt¹⁵ pronouns (cf. Belletti, Bennati and Sorace 2007) under the influence of L1 English – thus, overextending the scope of overt pronouns to refer to the

¹⁵ Null pronouns were also planned to be tested in L2 Italian at the time of preregistration. However, due to a fault with the item design – not comprising enough baseline null pronoun items – null pronoun items were subsequently excluded from the analysis (cf. § 3.3.2).

subject of the previous sentence. In ambiguous trials, where both NP1 and NP2 resolutions are possible, longer RTs are expected due to the activation of the preferred L1 reading and competition between analyses (cf. MacDonald, Pearlmutter and Seidenberg 1994; McRae, Spivey-Knowlton and Tanenhaus 1998)¹⁶. *Less proficient bilinguals (i.e., classroom learners) may be more affected by (L1-to-L2) transfer*¹⁷;

- b. similarly, in the resolution of ambiguous RC attachment, both bilingual groups should prefer low (i.e., NP2) attachment under the influence of L1 English – thus, with longer RTs on ambiguous trials than on baseline trials^{16 above}. *Again, these transfer effects may be more noticeable in less proficient bilinguals (i.e., classroom learners)*^{17 above}.

2. In L1English,

- a. because English instantiates the less restrictive option in the interpretation of overt pronouns (cf. Müller and Hulk 2001; see also § 3.2.2.2), L2 Italian (i.e., the more restrictive language) should exert no influence on the L1 – with no changes expected in either group's resolution preferences. Therefore, both groups should interpret overt pronominal subjects as referring to the subject of the previous sentence, reporting similar RTs on baseline and ambiguous trials;

¹⁶ There is evidence *against* competition during syntactic ambiguity resolution (e.g., Traxler, Pickering and Clifton 1998; van Gompel *et al.* 2005); however, this has primarily been found in monolingual research. Thus, in the bilingual context analysed in the present experiment, competition between two possible resolutions is hypothesised to yield longer RTs in contexts where 'residual' optionality (due to the strong activation of the preferred L1 reading) and 'emerging' optionality (due to the strong activation of the preferred L2 reading) are predicted (cf. Sorace 2005).

¹⁷ This asymmetry was not predicted at the time of preregistration, when the study had been thought of as comprising immersed and non-immersed bilinguals who would be matched on proficiency (see footnote 6 above).

- b. because, on the other hand, English instantiates the more restrictive option in the resolution of ambiguous RC attachment (cf. § 3.2.3.1), L2 Italian (i.e., the less restrictive language) should exert influence on L1 RC attachment resolution, resulting in higher preferences for high (i.e., NP1) attachment – consequently yielding longer RTs on ambiguous trials than on baseline trials, due to the activation of the preferred L2 reading and competition between analyses^{16 above}. Long-term residents may experience these effects more than classroom learners; cf. ‘emerging optionality’ (Sorace 2005)^{17 above}.

3.3 Methodology

3.3.1 *Participants*

The participants who took part in this experiment were the same ones who took part in the study investigating lexical attrition – see § 2.3.1.

3.3.2 *Materials*

To investigate the resolution of anaphora and RC-attachment ambiguities in both L1 English and L2 Italian, two self-paced reading (SPR) tasks were employed (one for each language). The experimental items used in the SPRs were designed by the author of this work on the basis of those in previous studies on anaphora resolution (e.g., Bonfieni 2018) and RC-attachment resolution (e.g., Dussias and Sagarra 2007). The items in each SPR included:

1. twelve target items with (overt) pronoun ambiguity (i.e., possibly resolved either towards the NP1 or towards the NP2);

2. twelve target items with RC attachment ambiguity (i.e., possibly resolved either high or low);
3. twelve baseline items with unambiguous (overt) pronoun resolution (i.e., half with forced NP1 resolutions, half with forced NP2 resolutions);
4. twelve baseline items with unambiguous RC attachment (i.e., half with forced high resolutions, half with forced low resolutions);
5. forty-eight (English)/sixty (Italian) filler items¹⁸.

Examples of target and baseline(-NP1/high) item pairs, respectively, are reported below for anaphora resolution (9-10) and RC attachment resolution (11-12) in both languages. In each pair, the English stimulus (b) is a literal translation of the Italian (a) (see Appendix C for all items employed).

Examples of ambiguous (i.e., target) stimuli for anaphora resolution:

- (9) a. La nipote / saluta / la nonna / sull'autobus. / Lei / è / davvero ansiosa.
 b. The granddaughter / greets / the grandmother / on the bus. / She / is / really anxious.

Examples of unambiguous (baseline-NP1) stimuli for anaphora resolution:

- (10) a. La nipote / saluta / il nonno / sull'autobus. / Lei / è / davvero ansiosa.
 b. The granddaughter / greets / the grandfather / on the bus. / She / is / really anxious.

Examples of ambiguous (i.e., target) stimuli for RC attachment resolution:

- (11) a. Giovanni / ha incontrato / il professore / del suo amico / che / viveva / in Germania.

¹⁸ The higher number of fillers in Italian was to account for twelve additional target items with ambiguous *null* pronouns initially included in the language. However, due to the potential resolution bias introduced by the lack of unambiguous null pronoun items, ambiguous null pronoun items were excluded from the final analysis.

- b. John / met / the professor / of his friend / that / was living / in Germany.

Examples of unambiguous (i.e., baseline-high) stimuli for RC attachment resolution:

- (12) a. Giovanni / ha incontrato / il professore / del suo amico / che / insegnava / in Germania.
 b. John / met / the professor / of his friend / who / was teaching / in Germany.

As can be seen from the examples above for anaphora resolution, in target items (9a) and (9b) the pronoun *lei* 'she' is ambiguous, as it could refer either to the NP1 *la nipote* 'the granddaughter' or to the NP2 *la nonna* 'the grandmother'. On the other hand, in baseline items (10a) and (10b) the pronoun *lei* 'she' should preferably refer to the NP1 *la nipote* 'the granddaughter' because of the gender of the antecedent. Forced resolutions such as these were counterbalanced throughout the items, so that half would be disambiguated towards the NP1 (as in the examples 10a-b above) and the other half would be disambiguated towards the NP2. Therefore, the possibility that a pronoun may refer to a third, unmentioned individual was not taken into account in the present experiment. Moreover, because the pronoun is in subject position of an independent sentence – thus, not in a structural relationship with potential antecedents (e.g., subject or object in a preceding clause) – its resolution is not related to syntax, as such, but rather discourse (more on this in § 3.5 interim discussion and § 5.2 limitations).

Turning to RC attachment resolution, in target items (11a) and (11b) the RC *che viveva in Germania* 'that was living in Germany' is also ambiguous, as it could be attached either high, to *il professore* 'the professor', or low, to *(i)l suo amico* 'his friend'. On the other hand, in baseline items (12a) and (12b)

the RC *che insegnava in Germania*/'who was teaching in Germany' should preferably be attached high, to *il professore*/'the professor', because of semantics – i.e., it is (more) likely for a professor (than more generally a friend) to be teaching (cf. counterarguments in § 3.5 and § 5.2). Forced resolutions such as these were also counterbalanced throughout the items, so that, in a similar fashion to the items for anaphora resolution, half of the ambiguous RCs would be attached high (as in the examples 12a-b above), and half would be attached low. Thus, in both anaphora and RC resolutions, the manipulation of ambiguity was not operated entirely within item: indeed, only one of the two possible disambiguations was forced in each item pair, as shown in baseline-NP1 (10) and baseline-high (12) stimuli above (more in § 3.5 and § 5.2).

Moreover, because six out of twelve ambiguous items contained combinations of inanimate/animate and non-human/human NPs (i.e., 'the toy of the little boy', 'the cat of the young lady', etc.), English that-RCs were counterbalanced with who-RCs where both NPs were animate and/or human.

3.3.3 Procedure

The same ethical approval and online data collection procedure as the ones described in § 2.3.3 for the lexical study apply. In the case of the SPR, participants completed the task among others first in one language and six days later in the other language. The order was counterbalanced across participants. Similar to when completing other tasks, participants were instructed to be in a quiet room, turn off any devices, and read carefully the instructions on the screen, as both their keyboard responses and RTs were being collected.

The SPR task consisted in reading sentences presented in chunks, such as (9-12) above, as they were presented on the screen using a stationary

window paradigm (Just, Carpenter and Woolley 1982). At the end of each sentence, participants were asked to indicate which NP the pronoun or RC referred to by pressing either 1 or 0. For instance, after reading sentence (9a) above, participants would be asked *Chi è ansioso/a?* ('Who is anxious?') and they would then be asked to press either 1, corresponding to *la nipote*/'the granddaughter', or 0, corresponding to *la nonna*/'the grandmother'. The experiment began after eight practice trials; participants were allowed to take a break only when instructed to do so on the screen, halfway through the task.

3.3.4 Design Measures and Predicted Outcomes

The dependent variables measured in the SPR task are preference (1 = NP1/high, 0 = NP2/low) and reaction time (RT). Two are the discrete independent variables – group (students, residents, L1 Italian/English controls) and condition (baseline-NP1/high, baseline-NP2/low, target) – and two are the continuous independent variables – age and working memory score.

Preference was planned to be analysed via two mixed-effects binomial logistic regression models (one for Italian, one for English) for anaphora resolution, and via two models of the same kind for RC attachment ambiguity resolution. The following outcomes were predicted (cf. § 3.2.4.2):

1. For anaphora resolution,
 - a. in Italian, a significant interaction of group and condition was expected, with pronouns in target trials predicted to be significantly more likely to be resolved as referring to the NP1 than pronouns in baseline-NP2 trials for both bilingual groups (perhaps to a greater extent for university students) – due to the influence of English – as opposed to L1 Italian controls;

- b. in English, only a main effect of condition was expected, with no significant interaction or main effect of group – given that all groups should perform similarly across conditions, since English already instantiates the less restrictive option in the interpretation of pronouns (i.e., no attrition predicted).
2. For RC attachment ambiguity resolution,
- a. in Italian, a significant interaction of group and condition was expected, with RCs in target trials predicted to be significantly more likely to be attached low than RCs in baseline-high trials for both bilingual groups (perhaps to a greater extent for university students) – due to the influence of English – as opposed to L1 Italian controls;
 - b. in English, a significant interaction of group and condition was also expected, with RCs in target trials predicted to be significantly more likely to be attached high than RCs in baseline-low trials for both bilingual groups (perhaps to a greater extent for residents) given that Italian instantiates the less restrictive option in the resolution of RCs (i.e., attrition predicted) – as opposed to L1 English controls.

RTs were planned to be analysed via two linear mixed-effects models (one for Italian, one for English) and via two models of the same kind for RC attachment ambiguity resolution. The following outcomes were predicted (cf. § 3.2.4.2):

1. For anaphora resolution,
- a. in Italian, a significant interaction of group and condition was expected, with RTs in target trials predicted to be significantly longer than RTs in baseline-NP2 trials for both bilingual groups (perhaps to a greater extent for university students) due to the activation of the

preferred L1 reading and competition between analyses – as opposed to L1 Italian controls;

- b. in English, only a main effect of condition was expected, with no significant interaction or main effect of group – given that all groups should perform similarly across conditions, since English already instantiates the less restrictive option in the interpretation of pronouns (i.e., no attrition predicted).

2. For RC attachment ambiguity resolution,

- a. in Italian, a significant interaction of group and condition was expected, with RTs in target trials predicted to be significantly longer than RTs in baseline-high trials for both bilingual groups (perhaps to a greater extent for university students) – due to the activation of the preferred L1 reading and competition between analyses – as opposed to L1 Italian controls;
- b. in English, a significant interaction of group and condition was also expected, with RTs in target trials predicted to be significantly longer than RTs in baseline-low trials for both bilingual groups (perhaps to a greater extent for residents) due to the activation of the preferred L2 reading and competition between analyses (i.e., attrition predicted) – as opposed to L1 English controls.

3.4 Results

Before analysing preferences and RTs in both anaphora and RC attachment ambiguity, trials with extreme RTs above 3000 milliseconds (indicating lack of concentration) and below 300 milliseconds (reflecting non-intentional responses) were excluded (cf. Ratcliff 1993), amounting to 15% of trials in

English and 12% of trials in Italian. The data were then analysed on the open-source, R-based software Jamovi (The jamovi project 2021) using the General Analyses for Linear Models (GAMLj) module (Gallucci 2019). Preferences were analysed through mixed-effects binomial logistic regressions, and residualised¹⁹ RTs were analysed by means of linear mixed-effects models. Following Barr *et al.* (2013), a maximal random effects structure was used, with random intercepts and slopes included for participants (subjectID) and items (itemID) given that all items were seen in all different conditions. In cases of convergence difficulties, random correlations were removed, with the model complexity being reduced stepwise excluding terms that accounted for the least variance first (see Appendix D for full details of all models).

3.4.1 Anaphora Resolution

To begin, mean percent preferences of all groups in the resolution of English and Italian anaphora are reported on Table 4. The table also includes the results of one-tailed one-sample Wilcoxon signed-rank tests, carried out to check whether groups' preference means were significantly different from chance level (50%) in the expected direction for each condition.

¹⁹ RTs were residualised on R (R Core Team 2022) using word length – i.e., number of letters per segment (cf. Marinis 2010) – to account for individual variation between participants.

Table 4. Mean percent preferences in English and Italian anaphora resolution

	University students			Long-term residents			L1 controls		
	NP1	NP2	<i>p</i>	NP1	NP2	<i>p</i>	NP1	NP2	<i>p</i>
English									
Baseline NP1	97.5%	2.5%	***	99%	1%	***	97%	3%	***
Baseline NP2	2.5%	97.5%	***	1%	99%	***	3%	97%	***
Target	55.5%	44.5%	*	53%	47%		57%	43%	**
Italian									
Baseline NP1	94.5%	5.5%	***	99%	1%	***	99%	1%	***
Baseline NP2	7%	93%	***	3%	97%	***	1%	99%	***
Target	43%	57%		42%	58%		41%	59%	***

Note. 'L1 controls' refers to English monolinguals in the English self-paced reading task and Italian monolinguals in the Italian task, respectively. Asterisks indicate significant difference in the expected direction from chance level (50%) on one-tailed one-sample Wilcoxon signed-rank tests of means: * = $p < .05$, ** = $p < .01$, *** = $p < .001$.

On Table 4 it is interesting to note that whilst clear NP1 preferences show in the resolution of ambiguous target trials for L1 English controls (with a mean 57% preference for NP1 resolutions in said trials), the significance of the same NP1 preference is lower in the case of university students (namely, 55.5%). In the same context, long-term residents perform roughly at chance level (53%). By contrast, in Italian resolutions, the three groups seem to perform rather similarly, reporting comparable rates of NP2 preference in ambiguous target trials (i.e., 59% for L1 Italian controls, 58% for residents, and 57% for students). Although the differences in the level of significance for each group's NP1 preference are not evidence, *per se*, of a difference across groups, these results are discussed more in detail in § 3.5, together with the results of the model analyses reported below, against the initial predictions.

To predict participants' preference (1 = NP1, 0 = NP2) across trials, two logistic mixed models were fitted, one for each language. The two models included the contrast-coded fixed-effect predictor variables group (students, L1 English/Italian controls, residents), condition (baseline NP1, baseline NP2, target) and the interaction of group and condition. The models also included

varying intercepts and slopes for participants and items. The main effects plots are illustrated in Figure 14 (for English) and Figure 15 (for Italian), with key main effects and interactions for each model discussed here.

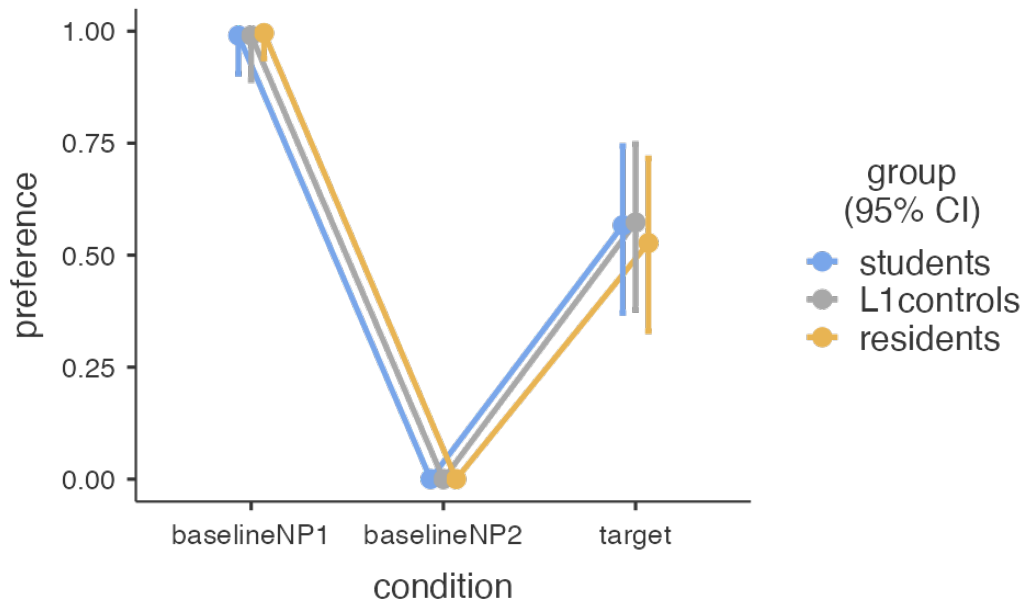


Figure 14. Preference (1 = NP1, 0 = NP2) in different conditions of the English self-paced reading task for students, residents and L1 (English) controls. Error bars = 95% confidence interval (CI).

In English, only a significant main effect of condition, $\chi^2(2) = 35.65, p < .001$, was found. Bonferroni adjusted post-hoc analyses showed that, across groups, pronouns in baseline NP1 trials were significantly more likely to be resolved as referring to the NP1 than pronouns in both baseline NP2 trials (OR = $1.20e+6, p < .001$) and target trials (OR = 108, $p < .001$). By contrast, pronouns in baseline NP2 trials were significantly less likely to be resolved as referring to the NP1 than pronouns in target trials (OR = $9.07e-5, p < .001$).

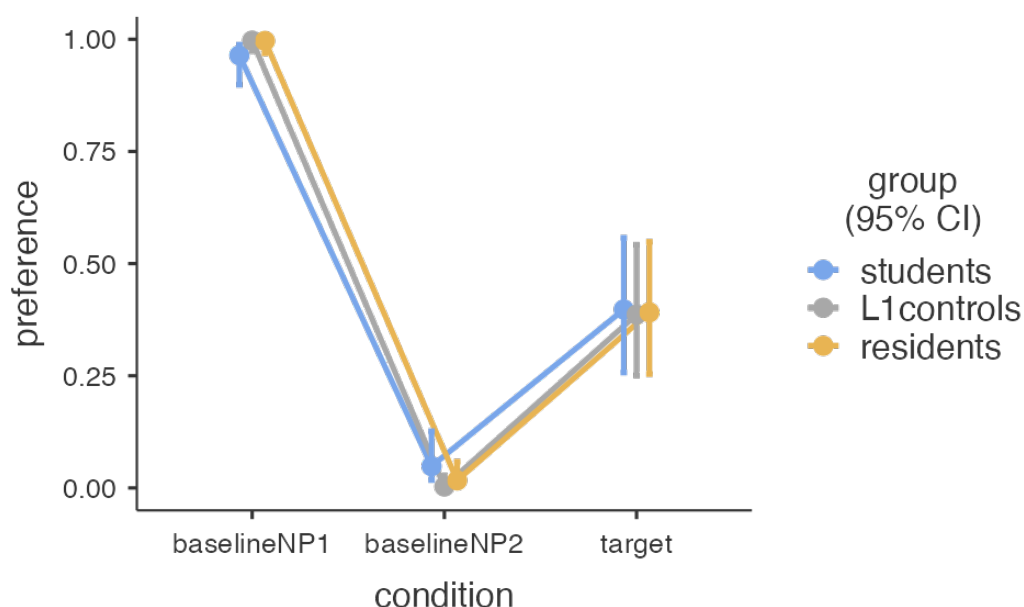


Figure 15. Preference (1 = NP1, 0 = NP2) in different conditions of the Italian self-paced reading task for students, residents and L1 (Italian) controls. Error bars = 95% confidence interval (CI).

On the other hand, in Italian, a significant main effect of condition, $\chi^2(2) = 113.16$, $p < .001$, as well as a significant interaction of condition and group, $\chi^2(4) = 16.9$, $p = 0.002$, were found. Bonferroni adjusted post-hoc analyses revealed that pronouns in baseline NP1 trials were significantly more likely to be resolved as referring to the NP1 than pronouns in baseline NP2 trials, for Italian L1 controls (OR: 96918.62, $p < .001$), residents (OR: 15515.40, $p < .001$) and students (OR: 529.14, $p < .001$). Pronouns in baseline NP1 trials were also significantly more likely to be resolved as referring to the NP1 than pronouns in target trials, for Italian L1 controls (OR: 505.75, $p < .001$), residents (OR: 411.00, $p < .001$) and students (OR: 40.73, $p < .001$). By contrast, pronouns in baseline NP2 trials were significantly less likely to be resolved as referring to the NP1 than pronouns in target trials, for Italian L1 controls (OR: 0.005, $p < .001$), residents (OR: 0.03, $p < .001$) and students (OR: 0.08, $p < .001$). The interaction can thus be explained by the different

OR magnitudes, greater for L1 controls than residents and students in the first two comparisons, and lower for L1 controls than residents and students in the latter.

To predict participants' (residualised) RT across trials, four linear mixed models were fitted, two in each language – specifically, one to analyse precritical segments 1-4, and one for critical and postcritical segments 5-7²⁰. On the one hand, the precritical segments were analysed to ensure that there were no differences in RT on the different regions of different conditions for different groups pre-critically. On the other hand, the postcritical segments were analysed to uncover where, precisely, differences in RT (if any) would be found. The four models included the contrast-coded fixed-effect predictor variables group (students, L1 English/Italian controls, residents), condition (baseline NP1, baseline NP2, target), region (1, 2, 3, 4 or 5, 6, 7) and their interactions. The models also included age and working memory score as covariates (previously decorrelated on R; R Core Team 2022), as well as varying intercepts and slopes for participants and items. Due to single fit of the models, random slopes were removed for both participants and items (which accounted for least variance) and only varying intercepts were retained. The main effects plots are illustrated in Figure 16 (for English) and Figure 17 (for Italian). Before each figure, an example is reported to illustrate which word(s) within a stimulus each region refers to. Given that, as expected, no significant differences were found in the precritical analyses, the key main effects and interactions discussed here are those for models analysing critical and postcritical segments (with full model details included in Appendix D).

²⁰ Contrary to the preregistered analyses, separate models were fitted for different languages for simpler outputs and interpretation. Moreover, although not included in the initial preregistration, it was necessary to add the variable region in the analyses in order to detect at what point, critically or post-critically, processing costs would show if they occurred.

Ambiguous (i.e., Target) Stimulus Example in English (Anaphora Resolution)

The little girl / calls / the young lady / on the phone. / She / is / very polite.

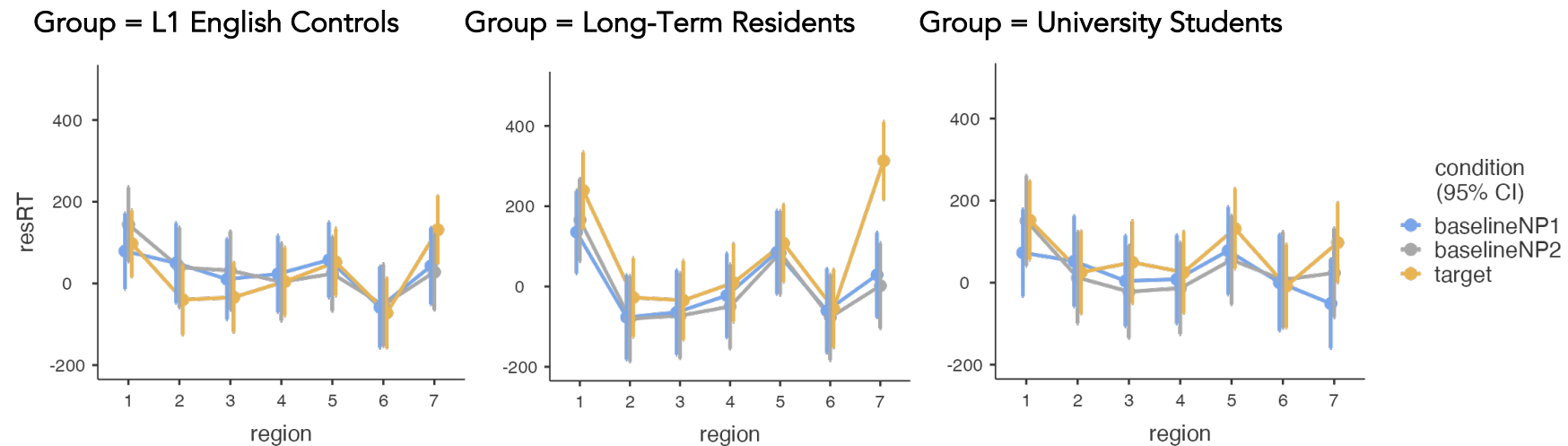


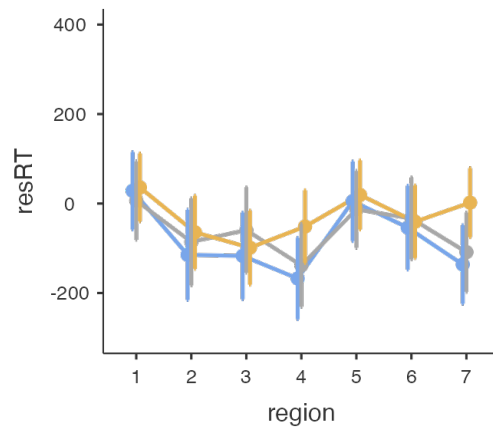
Figure 16. Residualised RT in precritical regions (1-4) and critical/postcritical regions (5-7) for different conditions of the English self-paced reading task for L1 English controls, long-term residents in Italy and university students in the UK. Error bars = 95% confidence interval (CI).

Ambiguous (i.e., Target) Stimulus Example in Italian (Anaphora Resolution)

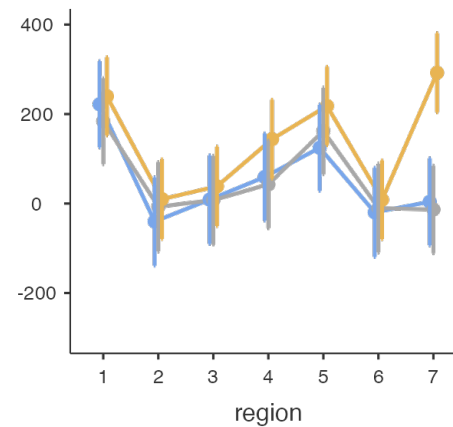
La bambina / chiama / la ragazza / al telefono. / Lei / è / molto educata.



Group = L1 Italian Controls



Group = Long-Term Residents



Group = University Students

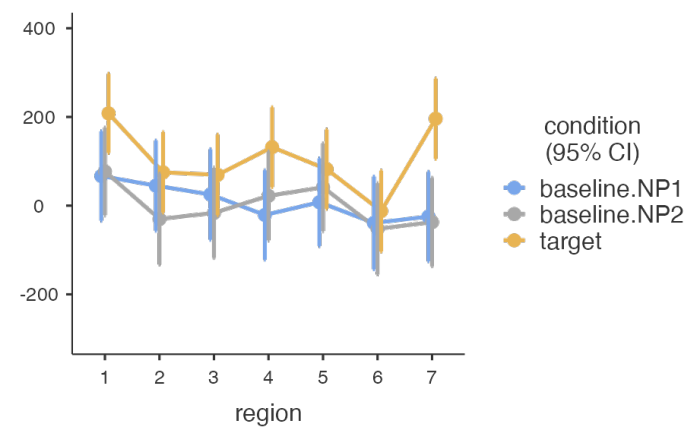


Figure 17. Residualised RT in precritical regions (1-4) and critical/postcritical regions (5-7) for different conditions of the Italian self-paced reading task for L1 Italian controls, long-term residents in Italy and university students in the UK. Error bars = 95% confidence interval (CI).

In English RT analyses a significant three-way interaction between group, region and condition, $F(8, 3831.4) = 2.67, p = .006$, was found. Specifically, Bonferroni adjusted post-hoc analyses showed that, within groups, RTs for the post-critical region 6 in ambiguous (i.e., target) trials were significantly shorter than region 7 target RTs for both L1 English controls, $t(3831) = -6.03, p < .001$, and long-term residents, $t(3831) = -12.13, p < .001$, but not for university students, $t(3846) = -2.95, p = 1.00$. Further, RTs for the critical region 5 in target trials were also shorter than region 7 target RTs for long-term residents, $t(3824) = -6.92, p < .001$, whilst this was not the case for either L1 English controls, $t(3830) = -79.66, p = 1.00$, or university students, $t(3849) = 0.90, p = 1.00$. The significant three-way interaction can thus be explained by the fact that region 7 target RTs differed from target RTs in both regions 5 and 6 only for long-term residents, and that where L1 controls also showed shorter RTs in region 6 than in region 7 on ambiguous trials, the mean difference was greater for residents (-372.36 ms) than for controls (-197.68 ms). Neither age nor working memory score were significant predictors in the analysis (both $ps > .05$).

In Italian RT analyses, on the other hand, the three-way interaction between group, region and condition, $F(8, 4668.6) = 1.15, p = .323$, was not significant, while significant two-ways interactions between region and condition, $F(4, 4669.2) = 18.33, p < .001$, group and region, $F(4, 4672.2) = 8.04, p < .001$, as well as group and condition, $F(4, 4682.1) = 3.16, p = .013$, were found. Firstly, Bonferroni adjusted post-hoc analyses revealed that, across groups, RTs were significantly longer in region 5 than in region 6 on both ambiguous trials, $t(4675) = 6.78, p < .001$, and NP2 baseline trials, $t(4665) = 3.82, p = 0.005$, but not on NP1 baseline trials, $t(4677) = 3.16, p = 0.057$. RTs were also significantly longer in region 5 than in region 7 on both

NP1 trials, $t(4671) = 4.07$, $p = 0.002$, and NP2 trials, $t(4663) = 4.94$, $p < .001$, while they were significantly shorter than in region 7 on ambiguous trials, $t(4671) = -3.33$, $p = .031$. RTs in region 6 were also significantly shorter than in region 7 on ambiguous trials, $t(4676) = -9.86$, $p < .001$, whilst no significant difference was found between RTs in regions 6 and 7 on NP1 baseline trials, $t(4673) = 0.70$, $p = 1.00$, or on NP2 baseline trials, $t(4665) = 0.93$, $p = 1.00$. The interaction can be explained by the fact that on ambiguous trials region 7 yielded longer RTs than regions 5 or 6; by contrast, on baseline NP1 trials it was in region 5 that RTs were longer than in region 7, and on baseline NP2 trials RTs were longer in region 5 than both in regions 6 and 7. Secondly, across conditions, Bonferroni adjusted post-hoc tests showed that long-term residents' RTs were significantly longer in region 5 than in both regions 6, $t(4663.3) = 7.96$, $p < .001$, and 7, $t(4660.0) = 3.40$, $p = .025$, whilst their RTs in region 6 were significantly shorter than in region 7, $t(4662.4) = -4.57$, $p < .001$. This was not the case for the other two groups, whose RTs did not differ across regions (all $ps > .05$), apart from L1 Italian controls' RTs being significantly longer in region 5 than in region 7, $t(4681.9) = 4.04$, $p = .002$. In this case, the fact that there were more significant differences between regions for residents but not for the other two groups may explain the interaction. Thirdly, across regions, Bonferroni adjusted post-hoc tests revealed that RTs did not differ between baseline NP1 and NP2 trials for any group (all $ps > .05$). Moreover, whilst L1 Italian controls' RTs did not differ between baseline NP1 trials and ambiguous trials or between baseline NP2 trials and ambiguous trials (both $ps > .05$), they did for the other two groups. Specifically, RTs differed between baseline NP1 trials and ambiguous trials for both university students, $t(179.7) = -4.78$, $p < .001$, and long-term residents, $t(118.0) = -6.26$, $p < .001$. RTs also differed between NP2 trials and ambiguous

trials for both students, $t(169.2) = -4.74$, $p < .001$, and residents, $t(118.3) = -5.79$, $p < .001$. The interaction here was possibly given by the fact that when bilinguals reported RT differences between conditions, as opposed to L1 Italian controls, the difference was greater for residents than students both when comparing baseline NP1 trials to ambiguous trials (respectively, -132.24 vs. -111.36 ms) and baseline NP2 trials to ambiguous trials (-122.28 ms vs. -109.86 ms). Lastly, neither age nor working memory score were significant predictors in the analysis (both $ps > .05$).

3.4.2 RC Attachment Ambiguity Resolution

Mean percent preferences of all groups in the resolution of English and Italian anaphora are reported on Table 5. Similar to Table 4, Table 5 also includes the results of one-tailed one-sample Wilcoxon signed-rank tests, carried out to check whether groups' preference means were significantly different from chance level (50%) in the expected direction for each condition.

Table 5. Mean percent preferences in English and Italian relative clause attachment resolution

	University students			Long-term residents			L1 controls		
	High	Low	<i>p</i>	High	Low	<i>p</i>	High	Low	<i>p</i>
English									
Baseline high	97%	3%	***	96%	4%	***	83%	17%	***
Baseline low	19%	81%	***	13%	87%	***	20%	80%	***
Target	66%	34%	***	59%	41%	**	56%	44%	
Italian									
Baseline high	90%	10%	***	94%	6%	***	96%	4%	***
Baseline low	21%	79%	***	15%	85%	***	27%	73%	***
Target	59%	41%		67%	33%		74%	26%	***

Note. L1 controls are English monolinguals in the English self-paced reading task and Italian monolinguals in the Italian task, respectively. Asterisks indicate significant difference in the expected direction from chance level (50%) on one-tailed one-sample Wilcoxon signed-rank tests of means: * = $p < .05$, ** = $p < .01$, *** = $p < .001$.

As can be seen from Table 5, L1 (English) controls' preferred resolution in target items was high attachment in 56% of the cases, a surprising finding which went against the initial predictions for L1 controls based on plenty of evidence in the literature in favour of the Late Closure principle in English (cf. § 3.2.3.1) – notice also the lack of significance on the one-tailed signed-rank test for low attachment reported on the table. If L1 controls themselves resolve RC attachment ambiguity high, then high attachment resolutions for bilinguals may neither be indicative of the predicted attrition in the L1 nor of the potential acquisition of L2 syntactic resolution patterns (or of the subsequent lack of predicted residual optionality). For this reason, the items were scrutinised for the presence of potential biases giving rise to high attachment biases. In her work, Fernández (2003, 10-11) points towards a possible bias for high attachment through the inclusion of non-human terms (including inanimate objects as well as animals) as the *first* NP in an 'NP-of-NP' construction. In the items employed in the present study, said bias was potentially present in 6 items out of 12 (i.e., 50% of items) for each condition, in both languages – e.g., in items (1a) 'Peter saw *the pet* of the little girl that was running around the room' and (4a) 'The maid observed *the toy* of the little boy that was lying on the bed'. Therefore, a 'human' factor with two levels – i.e., human (+) and non-human (-) – comprising inanimate objects and animals, was added to the analyses. Revised mean percent preferences of all groups in English and Italian anaphora resolution are reported on Table 6, with separate percentages reported for human and non-human referents in each of the conditions.

Table 6. Revised mean percent preferences in English and Italian relative clause attachment resolution, including separate percentages for human and non-human referents.

	University students			Long-term residents			L1 controls		
	High	Low	<i>p</i>	High	Low	<i>p</i>	High	Low	<i>p</i>
English									
Human									
Baseline high	93.5%	6.5%	***	90%	10%	***	80%	20%	***
Baseline low	26%	74%	***	14.5%	85.5%	***	23.5%	76.5%	***
Target	52.5%	47.5%		50%	50%		49%	51%	
Non-human									
Baseline high	99%	1%	***	99%	1%	***	85%	15%	***
Baseline low	4%	96%	***	10%	90%	***	12%	88%	***
Target	79%	21%	***	71%	29%	***	64%	36%	
Italian									
Human									
Baseline high	74%	26%	***	82%	18%	***	91%	9%	***
Baseline low	18.5%	81.5%	***	17%	83%	***	28%	72%	***
Target	43%	57%		50%	50%		57%	43%	*
Non-human									
Baseline high	97%	3%	***	100%	0%	***	98%	2%	***
Baseline low	25%	75%	***	12%	88%	***	23%	77%	***
Target	73.5%	26.5%		82%	18%		89%	11%	***

Note. L1 controls are English monolinguals in the English self-paced reading task and Italian monolinguals in the Italian task, respectively. Asterisks indicate significant difference in the expected direction from chance level (50%) on one-tailed one-sample Wilcoxon signed-rank tests of means: * = $p < .05$, ** = $p < .01$, *** = $p < .001$.

As can be seen from Table 6, none of the groups showed significant low attachment preferences on English human target trials, as all groups performed roughly at chance level (with a mean 51% low attachment preference for L1 English controls, 50% for residents and 47.5% for students). By contrast, a clear bias for high attachment preference was reported in English non-human target trials (with a mean 64% high attachment preference for L1 English controls, 71% for residents, and 79% for students). Likewise, a clear bias for high attachment preference was reported in Italian non-human target trials (with a mean 57% for L1 Italian controls, 82% for residents, and 73.5% for students). However, whilst L1 Italian controls reported a significant high attachment preference in human target trials as well (57%), the bilingual groups did not (with a mean 50% high attachment preference for residents,

and 43% for students). These results, together with the results of the model analyses reported below, are discussed more in detail against the initial predictions in § 3.5.

To predict participants' preference (1 = high, 0 = low) across trials, two logistic mixed models were fitted, one for each language. The two models included the contrast-coded fixed-effect predictor variables group (students, L1 English/Italian controls, residents), condition (baseline NP1, baseline NP2, target), human (+/-), and their interactions. The models also included varying intercepts and slopes for participants and items. The main effects plots are illustrated in Figure 18 (for English) and Figure 19 (for Italian), with key main effects and interactions for each model discussed here.

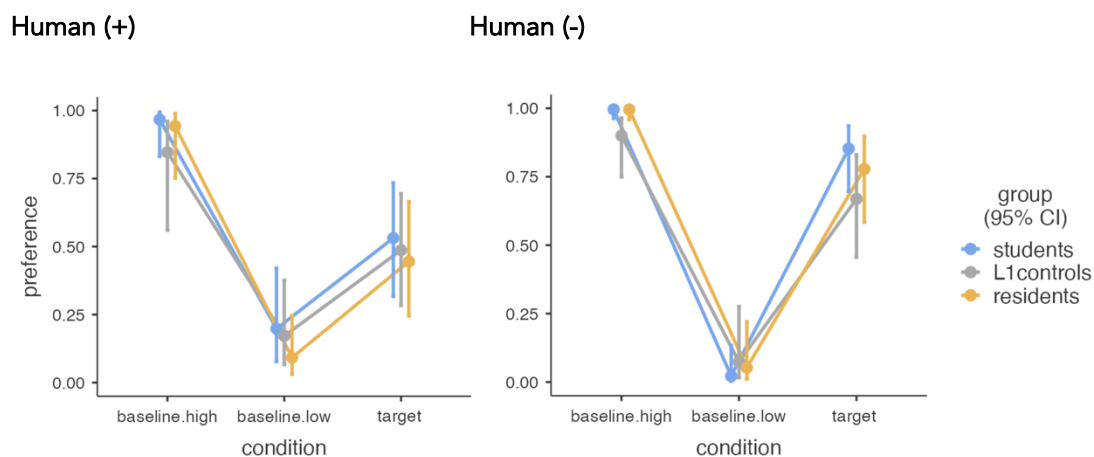


Figure 18. Preference (1 = high, 0 = low) in different conditions of the English self-paced reading task for students, residents and L1 (English) controls, on trials including human and non-human referents. Error bars = 95% confidence interval (CI).

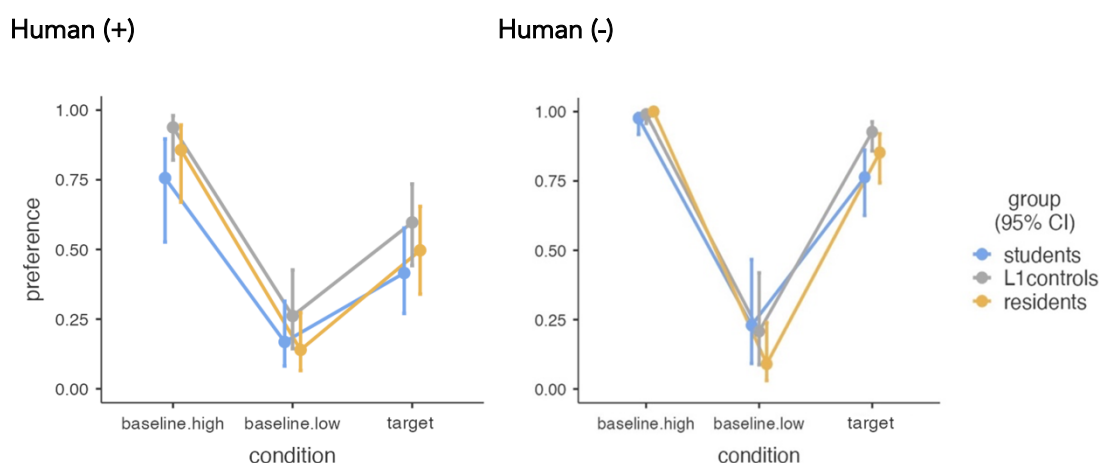


Figure 19. Preference (1 = high, 0 = low) in different conditions of the Italian self-paced reading task for students, residents and L1 (Italian) controls, on trials including human and non-human referents. Error bars = 95% confidence interval (CI).

In English, significant interactions between human and condition, $\chi^2(2) = 8.08$, $p = .018$, as well as group and condition, $\chi^2(4) = 21.15$, $p < .001$, were found. Bonferroni adjusted post-hoc analyses revealed that, in the case of non-human referents, RCs in baseline high trials were significantly more likely to be attached high than RCs in both ambiguous target trials, OR: 21.33, $p < .001$, and in baseline low trials, OR: 1595.44, $p < .001$. RCs in baseline low trials were, on the other hand, significantly less likely to be attached high than RCs in ambiguous trials, OR: 0.01, $p < .001$. The same was also true in the case of human referents, with RCs in baseline high trials being significantly more likely to be attached high than RCs in both ambiguous target trials, OR: 14.51, $p = .009$, and in baseline low trials, OR: 79.80, $p < .001$. RCs in baseline low trials were also significantly less likely to be attached high than RCs in ambiguous trials, OR: .050, $p < .001$. It is likely that the differences in OR magnitudes within the same comparisons between human and non-human referents, greater for the latter than the former, can explain the interaction. Further, across human and non-human referents, RCs in baseline high trials

were significantly more likely to be attached high than in ambiguous trials for both students, OR: 31.29, $p < .001$, and residents, OR: 34.19, $p < .001$, but not for L1 English controls, OR: 5.09, $p = .074$. RCs in baseline high trials were also significantly more likely attached high than RCs in baseline low trials for all groups: students, OR: 1074.92, $p < .001$, residents, OR: 766.04, $p < .001$, and controls, OR: 55.16, $p < .001$. Similarly, RCs in baseline low trials were significantly less likely to be attached high than RCs in ambiguous trials for all groups: students, OR: 0.03, $p < .001$, residents, OR: .045, $p < .001$, and controls, OR: .092, $p < .001$. Once again, the interaction can be explained by the differences in OR magnitudes, greater for students and residents than controls in the first two cases, and greater for controls than the other two groups in the last case.

In Italian, on the other hand, only a significant interaction between condition and human, $\chi^2(2) = 10.92$, $p = .004$, was found. Specifically, Bonferroni adjusted post-hoc comparisons showed that, in the case of human referents, RCs in baseline high trials were significantly more likely to be attached high than both RCs in ambiguous trials, OR: 6.46, $p < .001$, and RCs in baseline low trials, OR: 28.92, $p < .001$. This was not found in the case of non-human referents (both $ps > .05$). By contrast, RCs in baseline low trials were significantly less likely to be attached high than RCs in ambiguous trials both in the case of human referents, OR: 0.22, $p < .001$, and non-human referents, OR: 0.03, $p < .001$. The interaction can therefore be explained by the fact that the first two comparisons were only significant in the case of human referents, and that in the latter comparison the OR magnitude was greater in the case of human referents than non-human referents.

To predict participants' (residualised) RT across trials, four linear mixed models were fitted, two in each language – specifically, one to analyse

precritical segments 1-5, and one for critical and postcritical segments 6-7²⁰ above. Firstly, the precritical segments were analysed to ensure that there were no precritical differences in RT on the different regions of different conditions for the three groups between trials with human and non-human referents. Secondly, the postcritical segments were analysed to uncover where, precisely, differences in RT (if any) would be found. The four models included the contrast-coded fixed-effect predictor variables group (students, L1 English/Italian controls, residents), condition (baseline NP1, baseline NP2, target), region (1, 2, 3, 4, 5 or 6,7) and their interactions. The models also included age and working memory score as covariates (previously decorrelated on R; R Core Team 2022), as well as varying intercepts and slopes for participants and items. Due to single fit of the models, random slopes were removed for both participants and items (which accounted for least variance) and only varying intercepts were retained. The main effects plots are illustrated in Figures 20 and 21 (for English and Italian human referents, respectively) and Figures 22 and 23 (again, for English and Italian non-human referents). Before each figure, an example is reported to illustrate which word(s) within a stimulus each region refers to. Given that, as expected, no significant differences of relevance were found in the precritical analyses, the key main effects and interactions discussed here are those for models analysing critical and postcritical segments (with full model details included in Appendix D).

Human (+)

Ambiguous (i.e., Target) Stimulus Example in English (RC Attachment Ambiguity Resolution)

John / met / the professor / of his friend / that / was living / in Germany.

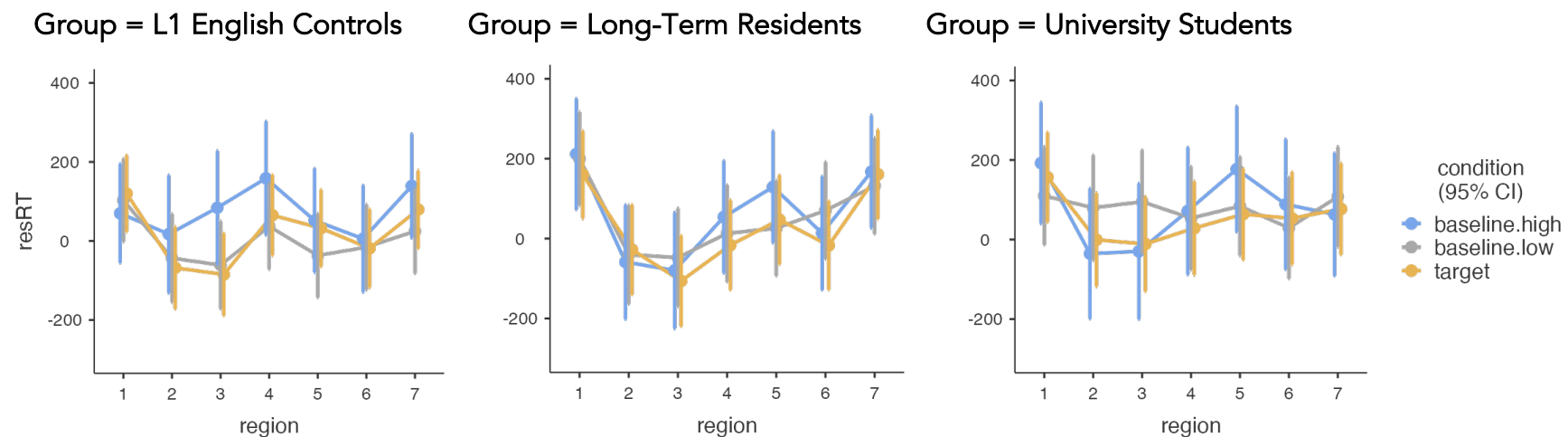
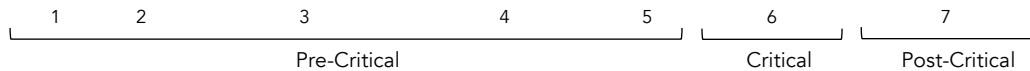


Figure 20. Residualised RT in precritical regions (1-5) and critical/postcritical regions (6-7) for different conditions of the English self-paced reading task for L1 English controls, long-term residents in Italy and university students in the UK (human referents only). Error bars = 95% confidence interval (CI).

Human (+)

Ambiguous (i.e., Target) Stimulus Example in Italian (RC Attachment Ambiguity Resolution)

Giovanni / ha incontrato / il professore / del suo amico / che / viveva / in Germania.

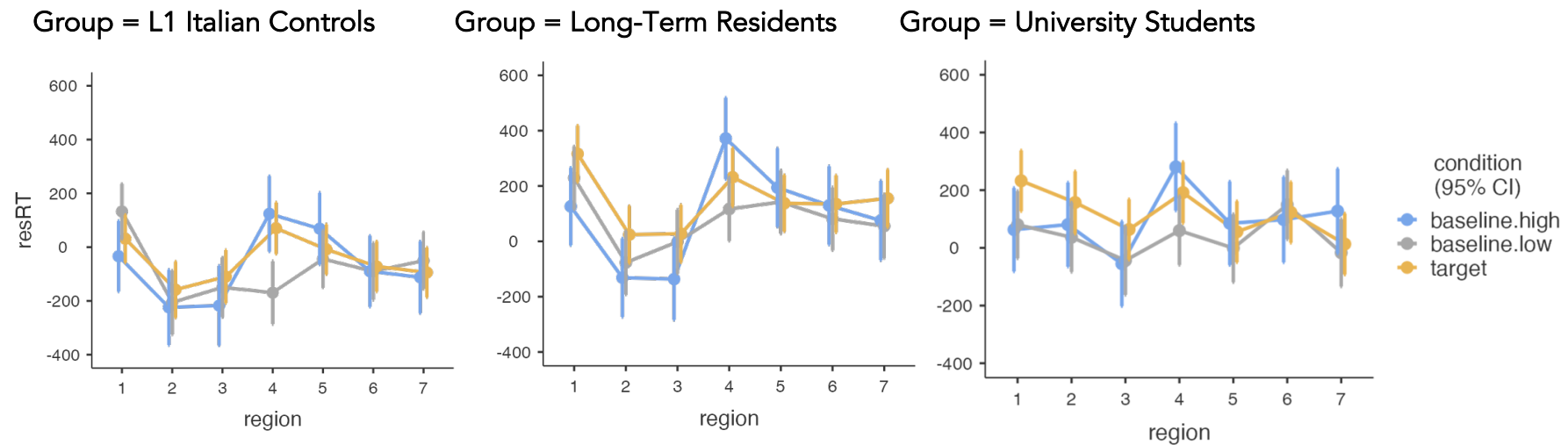
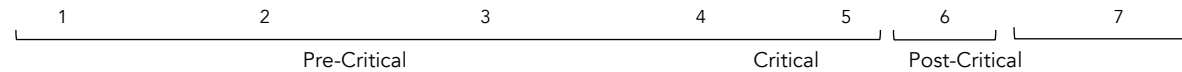


Figure 21. Residualised RT in precritical regions (1-5) and critical/postcritical regions (6-7) for different conditions of the Italian self-paced reading task for L1 Italian controls, long-term residents in Italy and university students in the UK (human referents only). Error bars = 95% confidence interval (CI).

Human (-)

Ambiguous (i.e., Target) Stimulus Example in English (RC Attachment Ambiguity Resolution)

Peter / saw / the pet / of the little girl / that / was running / around the room.

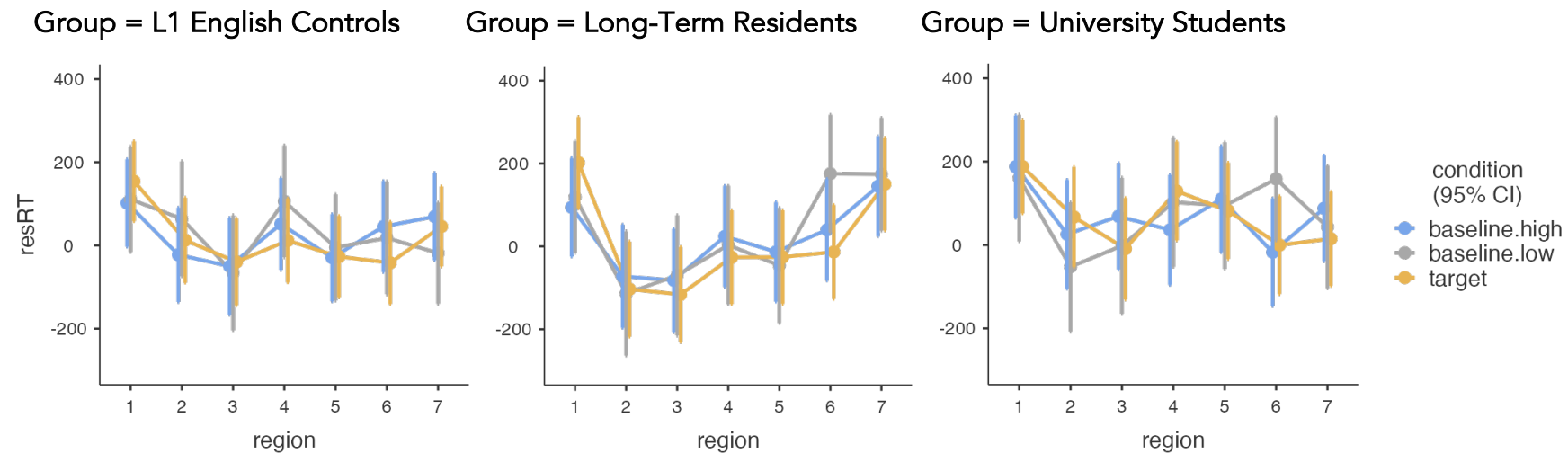


Figure 22. Residualised RT in precritical regions (1-5) and critical/postcritical regions (6-7) for different conditions of the English self-paced reading task for L1 English controls, long-term residents in Italy and university students in the UK (non-human referents only). Error bars=95% confidence interval (CI).

Human (-)

Ambiguous (i.e., Target) Stimulus Example in Italian (RC Attachment Ambiguity Resolution)

Pietro / ha visto / il coniglio / della bambina / che / correva / in sala.

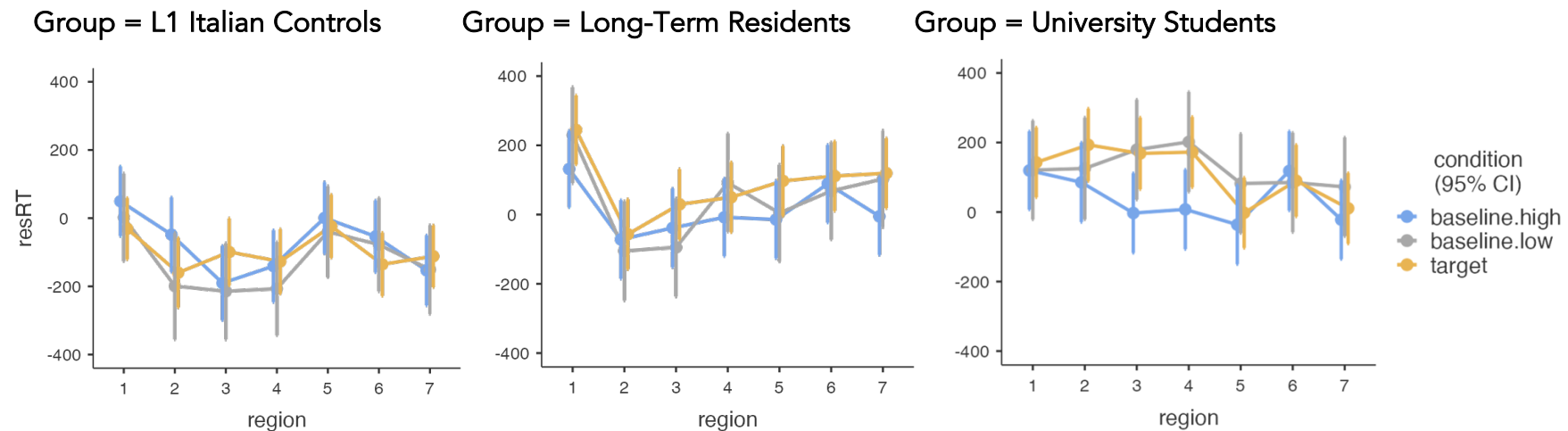


Figure 23. Residualised RT in precritical regions (1-5) and critical/postcritical regions (6-7) for different conditions of the Italian self-paced reading task for L1 Italian controls, long-term residents in Italy and university students in the UK (non-human referents only). Error bars = 95% confidence interval (CI).

In English RT analyses the only significant interaction found was between condition and region, $F(2, 2646) = 4.07$, $p = .017$. Specifically, Bonferroni adjusted post-hoc analyses showed that, across groups, for human and non-human referents alike, RTs in region 6 were significantly shorter than RTs in region 7 on ambiguous target items, $t(2648.6) = -5.49$, $p < .001$, though not on NP1 or NP2 baseline trials (both $ps > .05$). The differences across conditions can thus explain the interaction. Neither age nor working memory score were significant predictors in the analysis (both $ps > .05$).

In Italian RT analyses, no significant interaction was found (all $ps > .05$) while significant main effects of group, $F(2, 77) = 6.20$, $p = .003$, and region, $F(1, 3227.8) = 10.14$, $p = .001$, were found. Bonferroni adjusted post-hoc analyses revealed that, overall, students reported longer RTs than L1 controls, $t(77.3) = 3.09$, $p = .008$, whilst RTs between L1 controls and residents, or students and residents, did not differ significantly (both $ps > .05$). Bonferroni adjusted post-hoc analyses also revealed that, across groups and conditions, for human and non-human referents alike, RTs were significantly longer in region 6 than in region 7, $t(3228) = 3.18$, $p = .001$. Once again, neither age nor working memory score were significant predictors in the analysis (both $ps > .05$).

3.5 Interim Discussion

The aim of this second study was to investigate L2 acquisition and L1 attrition jointly in the resolution of two potentially ambiguous structures – i.e., anaphoric pronouns and relative clauses – for British students of Italian at UK universities and British long-term residents in Italy. The predictions were in line with those of the earlier CLI-based account of Sorace and Filiaci's (2006)

Interface Hypothesis. L1 attrition – i.e. emerging L1 optionality – was expected to be found in the resolution of relative clauses for long-term residents, but not for university students; no attrition was expected for either group in L1 anaphora resolution. In L2 Italian, the influence of L1 English was expected to manifest as residual optionality in the resolution of both structures – namely, through the overextension of ambiguous overt pronouns as referring to subject antecedents, as well as through an increase in low attachment resolutions for ambiguous RCs. Residual optionality in L2 Italian was ultimately deemed more likely to occur for university students than long-term residents.

To begin with, contrary to the initial predictions, the results of the SPR showed that neither bilingual group is affected by L1 attrition in the resolution of ambiguous RCs. Specifically, after controlling for the high attachment resolution bias introduced by the inclusion of non-human antecedents in NP1 position (as suggested in Fernández 2003, 10-11), there were no significant differences across the two bilingual groups and the L1 English control group in the likelihood of attaching RCs high (versus low) on ambiguous target items. Indeed, it seems that all three groups performed similarly (around chance level) on the task. RT results further revealed a similar performance across the three groups, as all reported longer RTs in the critical region than in the post-critical region on ambiguous target trials. Nonetheless, some evidence of L1 attrition is found in the resolution of ambiguous pronouns. To begin, long-term residents' subject antecedent (i.e., NP1) preferences were not significantly above chance (53%), as opposed to both L1 English controls (55.5%) and university students (57%). Although it should be noted that no significant differences were found across the three groups in the likelihood of NP1 (versus NP2) resolutions, the initial differences in the level of significance

reported above seem to suggest that long-term residents' NP1 preferences may at least be starting to weaken. Moreover, RT data revealed that region 7 yielded longer RTs (only) for long-term residents on ambiguous target trials. Taken together, these results therefore seem to suggest that *emerging* optionality may be found in the resolution of so-called 'interface' structures, for long-term residents who are highly-proficient in the L2, even when the L1 is the less restrictive language (as in the case of English, with obligatory overt pronouns). Whilst unexpected, these findings are not necessarily surprising when considering the latest reformulations of the IH (e.g., Sorace 2011, 2012, 2016). Indeed, whilst CLI may explain some instances of L1 attrition, it is not a necessary condition for attrition to take place (cf. earlier discussion on the overextension of overt pronouns in two null-subject languages, § 3.2.2.2). Thus, it seems plausible to suggest that the competition of the two options available in the bilingual mind gives rise to indeterminate preferences and longer RTs for (highly proficient) bilinguals who have long been living in an L2 country in the resolution of ambiguous pronouns – compared to L1 speakers who are not fluent in other languages as well as classroom-instructed (and also less proficient) bilinguals in their L1 environment. The fact that RCs do not seem to be affected by attrition in the L1 in the present study may be a consequence of the bias introduced with the inclusion of non-human referents, which halved the number of ambiguous items of interest presented to each participant, as well as introducing a semantic disambiguating factor – possibly less taxing, cognitively speaking, than having to integrate pragmatic/contextual information in real time when resolving pronouns.

Turning to the results of the L2 SPR, the initial predictions are partially confirmed. Specifically, in the case of L2 Italian anaphora resolution, ambiguous pronouns were resolved as preferably referring to object

antecedents in a similar fashion across the three groups. However, whilst the likelihood of preferably choosing NP1/NP2 referents for ambiguous pronouns was similar across the three groups, RT data analyses revealed that for both bilingual groups, but not for monolinguals, ambiguous trials yielded significantly longer RTs than the other two types of baseline trials. This finding can be taken to suggest that when residual optionality does not show in preference, it may still be present in RTs (with longer processing times required by bilingual groups when compared to L1 controls). Finally, in the case of L2 RC ambiguity resolution, it seems that after controlling for (non)human bias, high attachment preferences were found for L1 controls (57%), low attachment preferences were found for students (57%), while residents' preferences were at chance level (50%). Although the likelihood of choosing NP1/NP2 did not differ significantly across groups between human and non-human referents, students reported overall longer RTs than L1 Italian controls (while there were no significant RT differences between residents and Italians, or between the two bilingual groups). These findings can thus be taken to suggest that residual optionality in the L2 is still present in both bilingual groups, especially as confirmed in RT data analyses, and to an even greater extent in the case of university students, as predicted. It is important to note that a(nother) potential confound in the resolution of RCs is given, in Italian, by the possibility of interpreting some of the items as 'pseudo-relatives' (PRs), which may affect stimuli with a 'perceptual' verb (e.g., *see, hear, feel*) or 'quasi-perceptual' verb (e.g., *photograph, film, record*) in the main clause (cf. Grillo and Costa 2014). In brief, PRs are string identical to RCs, but their structure and interpretation is different: for instance, in a sentence such as 'Ho visto la figlia del postino che correva', lit. 'I saw the daughter of the postman that was running', the only possible subject for the embedded

verb is 'la figlia'/'the daughter' – with a corresponding Acc-ing Small Clause in English being 'I saw the daughter of the postman running'. According to Grillo and Costa's (2014, 176-178) PR-first Hypothesis, when they are available, PR parsings are universally preferred to RC parsings, all else being equal. In the present study, PR parsings were available in at least three out of the twelve verbs presented in the SPR task – i.e., 'vedere'/'to see', 'osservare'/'to observe', 'notare'/'to notice' – therefore favouring high attachment. Together with the inclusion of non-human referents and disambiguation through semantics (rather than grammatical gender, as in the case of pronoun baseline items), the availability of PR parsings in Italian constitute a source of bias for L1 Italian controls and (possibly) both bilingual groups when resolving RCs. This highlights the importance of ensuring the use of maximally controlled, unbiased items, in order to avoid confounds of the kind. This is also true of the items employed in the present study for the resolution of anaphora, where the ambiguous had to be resolved (i) as referring to *either* the NP1 *or* the NP2 in (ii) the *preceding* sentence – therefore, excluding (i) the possibility of referring to a *third, unmentioned* individual and ignoring (ii) the *structural* relationship of the pronoun in relation to its potential antecedents. Lastly, the fact that ambiguities, in the resolution of both anaphora and RC attachment ambiguities, were not entirely manipulated within items (with each pair of items containing either a baseline-NP1/high or a baseline-NP2/low resolution, but not both) reduced statistical power and the possibility of finding significant effects due to increased variance. All of these factors should therefore be controlled in future research.

In brief, some evidence of L1 attrition was found with regards to the resolution of ambiguous overt pronouns for long-term residents, but not for students; at the same time, both groups seemed to have acquired L2

anaphoric resolution preferences, with residual optionality showing up in both bilingual groups' RTs. By contrast, no evidence of L1 attrition was found in the case of RC attachment resolution for either bilingual group, while residual L2 optionality was found for both bilingual groups, and to a greater extent for classroom-instructed, lower proficiency bilinguals, in both preference and RTs.

Prosodic Attrition

4.1 Introduction

This chapter presents the third language domain under investigation – that is, prosody. Firstly, a general introduction to the study of intonation is provided, reviewing theoretical and experimental accounts of cross-linguistic differences in sentence stress patterns. Particular attention is paid to the phenomenon of contextual ‘deaccenting’ (Ladd 1980, 2008), a way to manipulate sentence stress to express information structure, which is found to differ across languages – thus representing a prime candidate as potential *locus* of attrition in L1 prosody. Unlike the widely-documented cases of lexical and syntactic attrition, discussed in Chapters 2 and 3, evidence of prosodic attrition is scarce, as outlined in the present chapter. A special focus is placed on the works by Mennen (2004) and van Maastricht, Krahmer and Swerts (2016) into bidirectional intonational transfer, upon which the experimental work carried out for this thesis is built. The methodology and results of the present study are then presented and finally discussed.

4.2 Background

4.2.1 *Universalist vs. Phonological Approaches to Intonation*

According to Ladd (2001, 1380-1381), the study of intonation, which comprises melody, sentence stress and phrasing, has long been analysed from two different perspectives. The first approach, referred to as ‘universalist’, looks at intonation and its sub-components as being peripheral to language – i.e., dependant on physical properties of the mechanism which

governs speech production – thus being separate from aspects of language such as phonology or syntax (cf., among others, Lieberman 1967; Bolinger 1978; Fujisaki 1983). The second approach, instead, described as ‘phonological’, considers intonation as part of phonology, thus allowing possible typological generalisations (cf. Bruce 1977; Pierrehumbert 1980; Beckman 1986). As further pointed out by Ladd (2008, 222), however, the differences that emerge by considering comparable sentences in different languages, specifically with regards to sentence stress patterns, make it reasonable to suggest that there are, indeed, language-specific (and structure-dependent) principles guiding sentence stress. A brief discussion of different views on sentence stress thus follows, after which some of the above-mentioned cross-linguistic differences are presented, with specific reference to English and Italian (i.e., the two languages which this thesis focuses on).

4.2.1.1 Normal/Contrastive Stress vs. Highlighting

As mentioned briefly in the previous section, a universalist account would hold that sentence stress, as part of intonation, does not change across languages. This view, initially taken by Bolinger (1958, 1972), also known as the ‘highlighting’ view, posits that any word can be focused or highlighted by pitch accents to signal its prominence in the discourse (i.e., when signalling newness, contrast or special informativeness). This is explicitly in contrast to earlier views on sentence stress (cf. Chomsky and Halle’s 1968 Nuclear Stress Rule) which proposed that, by rule, one word in each sentence gets assigned primary stress, or ‘normal’ stress, while contrast or emphasis are signalled by ‘contrastive stress’ (i.e., variations from normal stress). According to the highlighting view, pitch accents are not assigned by rule, but rather by extra-linguistic factors which are context dependent. In the late 1970s, the two

views were brought together by the 'Focus-to-Accent' (FTA) approach (Ladd 1980, among others).

4.2.1.2 The Focus-to-Accent Approach

As explained by Ladd (2008, 217-223), the FTA approach represents a useful compromise between the earlier normal stress view and the later highlighting view. Specifically, it builds on the notion of 'focus' in generative syntax and semantics (cf. Chomsky 1971; Jackendoff 1972), distinguishing it from the phonetic/phonological notion of 'accent'. In the FTA view, focus can apply to chunks of sentences which are larger than individual words, such as an entire constituent. To put it in Ladd's (2008, 218) words: 'in a hierarchical syntactic structure, focus can "project" up the tree from an accented word to a higher node that dominates an entire constituent, with the result that the entire constituent is treated as focused'. In short, the FTA approach brings both earlier views on sentence stress together, in that it re-interprets (1) normal stress as 'broad' focus on the whole sentence and (2) contrastive stress as 'narrow' focus, whilst (3) allowing focus to occur on constituents of any size. Most notably, this view posits that there are grammatical principles guiding certain aspects of sentence stress, specifically those specifying the location of prominence when the focus is placed on larger constituents – thus, accommodating narrow focus on single words, and allowing for unmarked patterns which specify the location of accent when broad focus is placed on whole constituents or sentences (Ladd 2008, 219).

The FTA approach has very different predictions from those of the highlighting view, specifically with regards to cross-language comparisons. Indeed, whilst the highlighting view would argue that the relation between accent and focus is part of some universal – indeed, highlighting – function,

the FTA suggests that there are language-specific rules and principles guiding broad focus, on the basis of the existence of focus projection, as previously mentioned (Ladd 2008, 221-223). Cross-linguistic analyses of sentence stress data further point towards the inadequacy of a universal highlighting theory on empirical grounds.

4.2.2 Cross-Linguistic Differences in Sentence Stress

Some of the contexts in which some languages differ with regards to sentence stress are different types of questions (i.e., yes-no questions vs. WH-questions), deaccenting, indefinite pronouns, semantic weight, and in the case of predicates vs. arguments (cf. Ladd 2008, Ch.6). This section mainly deals with deaccenting, a context in which differences between English and Italian, specifically, have been noted.

4.2.2.1 Contextual Deaccenting

The absence of a pitch accent on a word repeated or mentioned within the same context, which may otherwise be expected to be accented, is known as 'deaccenting' (Bolinger 1972; Ladd 1980; Swerts, Krahmer and Avesani 2002). Specifically, a correspondence between 'information structure' (e.g., Halliday 1967; Bolinger 1972) and deaccentuation has been reported in Germanic languages (e.g., Nooteboom and Terken 1982; Horne 1990; Hirschberg 1993). This is theoretically in line with the highlighting view discussed in the previous section, whereby only new or important elements in a sentence are accented. However, cross-linguistic evidence has in fact shown that Romance languages, such as Catalan and Spanish (e.g., Cruttenden 1993), Italian and Romanian (e.g., Ladd 2008), and French (Gussenhoven 2004), resist

deaccentuation. Consider the English example (13a), of which (13b) is the equivalent Italian translation, taken from Ladd (2008):

(13a) I bought her a bottle of WHISKY, but it turns out she doesn't LIKE whisky.

(13b) Le ho comprato una bottiglia di WHISKY, ma alla fine non le piace il WHISKY.

Whilst (13a) shows how the second occurrence of the word 'whisky' fails to bear the main accent in English, as the word has previously been mentioned, (13b) clearly illustrates how, in Italian, the same word can in fact be accented twice. Another interesting example, in Italian, reported by Ladd (2008, 233) is taken from the context of the so-called *Tangentopoli* scandal of the early 1990s. Whilst commenting on the investigations into bribery and corruption related to the scandal, former Italian President Scalfaro said:

(14) [le inchieste] servono a mettere a POSTO cose andate fuori POSTO
lit. [the investigations] serve to put to place things gone out of place

Similar to (13b), example (14) also shows how Italian resists deaccentuation. Indeed, in order to maintain the rhetorical parallelism shown in (14), an idiomatic translation in English needs to allow for deaccenting, resulting in a naturally sounding utterance (15b) - as opposed to (15a) which, preserving the Italian prominence pattern, sounds odder:

(15) a. The investigations are helping to put back in ORDER things that have got out of ORDER.

- b. The investigations are helping to put BACK in order things that have got OUT of order.

However, as Ladd (2008, 233) reports, Italian (as well as other languages resisting deaccenting) can still shift away the accent from its default position in specific cases: for example, in explicit metalinguistic corrections, such as in *Non ho detto CASA Bianca, ho detto COSA Bianca* (I didn't say white HOUSE, I said white THING), or with non-finite verb forms, predicate nouns and adjective phrases – e.g., *Non È intelligente* (He's NOT intelligent). Of interest are also some syntactic restrictions as to how deaccenting works in Italian: for instance, the fact that deaccenting cannot affect only part of a phrase, and modification of lexical stress is also not permitted. Moreover, certain morphosyntactic strategies, such as right dislocation, can also be employed to achieve similar intonation effects (cf. Ladd 2008, 234-236). On the basis of the cross-linguistic differences reported in sentence stress, Vallduví (1991, 295) distinguishes between [+plastic] and [-plastic] languages. Under Vallduví's view, in [+plastic] languages (such as English) sentence stress patterns can be modified to express information structure, whereas in [-plastic] languages (such as Italian) information structure is expressed through syntactic structures (i.e. right-dislocation, clefting, fronting etc.). It is difficult to reconcile such a view with a universalist highlighting approach to sentence stress.

4.2.2.2 Experimental Evidence

The differences in sentence stress patterns have also been documented experimentally. A case in point comes from a series of experiments by Swerts, Krahmer and Avesani (2002), showing that languages such as Dutch and Italian differ in terms of accent patterns with regards to (1) their distribution,

(2) their perceived gradient differences, and (3) their functional validity to reconstruct prior dialogue context. Specifically, their research provides evidence for the existence of a correspondence between information status and accent patterns in Dutch, and the absence of such a close connection in Italian. The study is reviewed here below as it has inspired the methodology used in later studies discussed in this chapter.

In Swerts, Krahmer and Avesani (2002), data was elicited (semi)spontaneously through a simple dialogue game played by four Dutch pairs of speakers and four Italian pairs. The game consisted in the alignment of figures by two players separated by a screen. Both players had an identical set of eight cards, with each card showing a specific geometrical figure in a particular colour. Four of their cards were put on a stack in front of the players and four in a row before them, with the four cards in player A's stack being the same four cards in B's row, and vice-versa. Both players received a piece of paper with the numbers one through eight, and in the course of the game they would fill the blanks after each number, ultimately generating an identical ordered list of geometrical figures on the paper (see bird's eye view on the starting situation of the game in Figure 24). In the game, participants took turn giving each other instructions to select a card with a specific geometrical figure. The instruction-giver (e.g., A) started by describing the figure on top of their own stack (e.g., 'a blue square') and would then put it after number one on their own list. Participant B would listen to A and remove the same figure, by also placing it after number one on their own list. Participants then switched turns and it would be time for B to describe the figure on top of their own stack and place it after number two in their list, prompting A to do the same. The game continued this way and ended when players had no cards left. There were no winners or losers, and after completing a game, both

participants started again with new cards, for a total of eight times (cf. full game description in Swerts, Krahmer and Avesani 2002, 633- 636).

Initial set-up

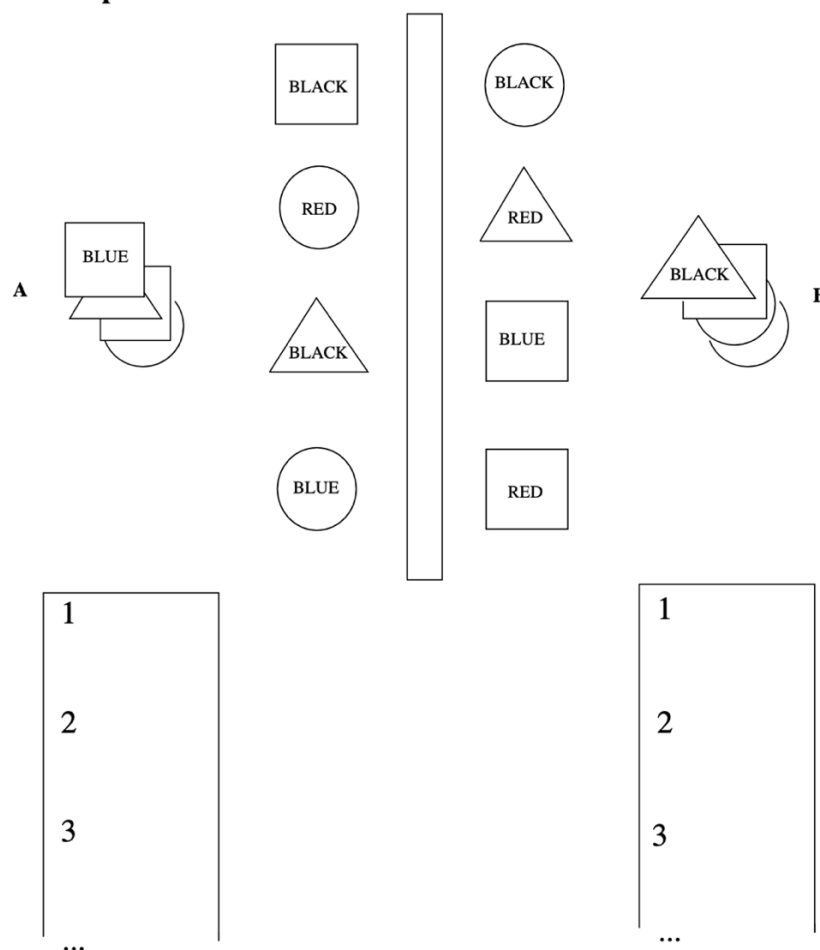


Figure 24. Initial set up in Swerts, Krahmer and Avesani's (2002) game, where A and B are the two participants in the dialogue game with four cards in front of them each, from Swerts, Krahmer and Avesani (2002, 634).

The data obtained allowed an unambiguous operationalisation of the contexts. Speakers described their figures using only one noun phrase (NP) which consisted of colour and figure properties (i.e., 'blue triangle'). Properties could be new (N), when mentioned in the first turn of the current dialogue; given (G), when mentioned in the previous turn; or contrastive (C), when the object described in the previous turn had a different value for the

relevant property. The possible contexts were therefore four: NN, CC, CG, GC. The results of the distributional analysis in Dutch showed that in the NN context, both words were always accented. When, instead, one item was given and one was contrasted (i.e., CG or GC), the contrasted item was always accented, while the given item was deaccented. In the CC case, half of the speakers accented both words, whereas the other half only accented the noun. The Italian data, on the other hand, showed that given information was not deaccented, as in Dutch; both words were in fact accented. These findings seemed to suggest that accent distribution does not provide clues about information status in Italian, unlike Dutch.

Since the Italians in their experiment did not seem to mark context through presence/absence of accent, the second experiment in Swerts, Krahmer and Avesani (2002) explored whether listeners perceived any differences in the degree of prominence between the various accents. For Dutch speakers, it investigated whether there were emphatic differences between newness and contrastive accents. The task consisted of listening to pairs of phrases containing two words each, and then indicating which of the two had the most prominent first word – and, in a subsequent trial, indicating which of the two phrases had the most prominent second word. In their results, Dutch single contrastive accents were always judged as most prominent, whereas words referring to given information uniformly scored lowest on prominence (near zero). The no contrast/all new and double contrast cases scored around chance level (50%). In Italian, by contrast, the picture was less clear: the correlation between prominence and information status was only true for the first word in a phrase; for the second word, there seemed to be no relation between perceived prominence and information status.

The third and final study in Swerts, Krahmer and Avesani (2002) ultimately examined whether listeners were able to reconstruct dialogue history based on prosodic cues. In their task, listeners were to guess the information in the utterance preceding the one they were given as input. The stimuli used were the same Dutch and Italian target utterances collected in the first production experiment. Their data showed that, in Dutch, both the overall distribution and speaker-specific results were significantly different from chance; however, this was not the case in Italian. The overall results for the Italian data also significantly different from the overall results for Dutch. In conclusion, Italian listeners, as opposed to the Dutch, were not able to reconstruct the prior dialogue based on prosodic properties of the current utterance.

Ultimately, according to Swerts, Krahmer and Avesani (2002, 650-653), Dutch and Italian differed completely with regards to accent patterns inside NPs. In Dutch, accent patterns are used to mark information status, with new and contrastive information generally being accented, while given information is deaccented. Newness and contrastive accents seem phonetically different, with contrastive accents being more emphatic. Moreover, listeners seem to be able to reconstruct the prior dialogue utterance on the basis of prosodic properties of the current utterance. In Italian, on the other hand, both the adjective and the noun are always accented, regardless of information status. Given accents are distinguished from newness accents, but only for the first word in NPs. Finally, listeners are also not capable of reconstructing prior dialogue utterances on the basis of prosodic cues of the current utterance. An explanation put forward by the authors to account for the differences between the two languages is that Italian, being a non-plastic language (cf. Vallduví 1991; § 4.2.2.1), has other ways, besides prosody, of marking information

status (e.g., freer word order), and that information status can also be conveyed by non-verbal cues (e.g., through eyebrow movements or head nods).

4.2.3 Sentence Stress Patterns in Bilinguals and Potential Attriters

The literature reviewed so far shows that there are differences in sentence stress patterns across languages. The question of which sentence stress patterns bilingual speakers adopt in cases where intonation differs between their two languages is thus of particular interest to the present thesis. Although scarce, the evidence reviewed in this section shows that bidirectional transfer effects have indeed been found in intonation (i.e., from the L1 to the L2, and vice-versa, from the L2 to the L1) for bilingual speakers whose two languages differ with regards to sentence stress patterns.

4.2.3.1 L1-to-L2 Intonational Transfer Effects

An example of evidence of intonational transfer from the L1 to the L2 is the study by Swerts and Zerbian (2010), which focused on information status marking and the signalling of list continuation or finality in L1 Zulu and L1 English in South Africa, as well as in the L2 English spoken by L1 Zulu speakers. Typologically speaking this comparison is of interest, given that (African tone languages such as) Zulu differs substantially from English in their word prosody and intonation system (see Lanham 1960 for a thorough description of the Nguni languages, of which Zulu is one). Moreover, Swerts and Zerbian's (2010) work is innovative in that they included L2 proficiency level as a factor in a prosodic study, similar to other L2 acquisition research subfields (e.g., Imai, Walley and Flege 2005; Foote 2010). Swerts and Zerbian (2010) used a production experiment inspired by the one in Swerts, Krahmer and Avesani

(2002), detailed in § 4.2.2.2, where participants needed to describe coloured pictures presented to them in a row by means of a PowerPoint presentation. The pictures elicited adjective-noun phrases (e.g., *yellow house*), with focus on either the adjective or the noun of the phrase depending on the condition. Specifically, in their ‘weak contrast’ condition, the target picture appeared last (i.e., fifth) after four pictures, of which pictures three and four were similar to the target in either colour or object. By contrast, in their ‘strong contrast’ condition, all five pictures in a row were similar with regards to one aspect (i.e., either object or colour) and the target picture differed in the other feature from the preceding pictures. Therefore, the latter condition had contrast built up over five pictures, making it more evident to the participants. The last condition was called ‘corrective contrast’: it elicited a correction focus on either the adjective or the object as the participants saw an incorrect combination of object and colour, and were asked to correct it (cf. Figure 25 below). Participants’ recordings were then analysed perceptually by expert judges via a forced-choice paradigm. Specifically, judges were asked to determine which of the two words was prominent (i.e., first word, second word, or neither) and whether sentence melody changed at the end of the utterance (i.e., by going up, down, or staying level). Importantly, the acoustic cue used for the phonetic implementation of prominence was left unspecified by the judges (cf. later methodological discussion in § 4.2.3.3). Given that only judgments regarding prominence are directly relevant to the present discussion, the results of the analyses for final melodic contour are not commented on below.

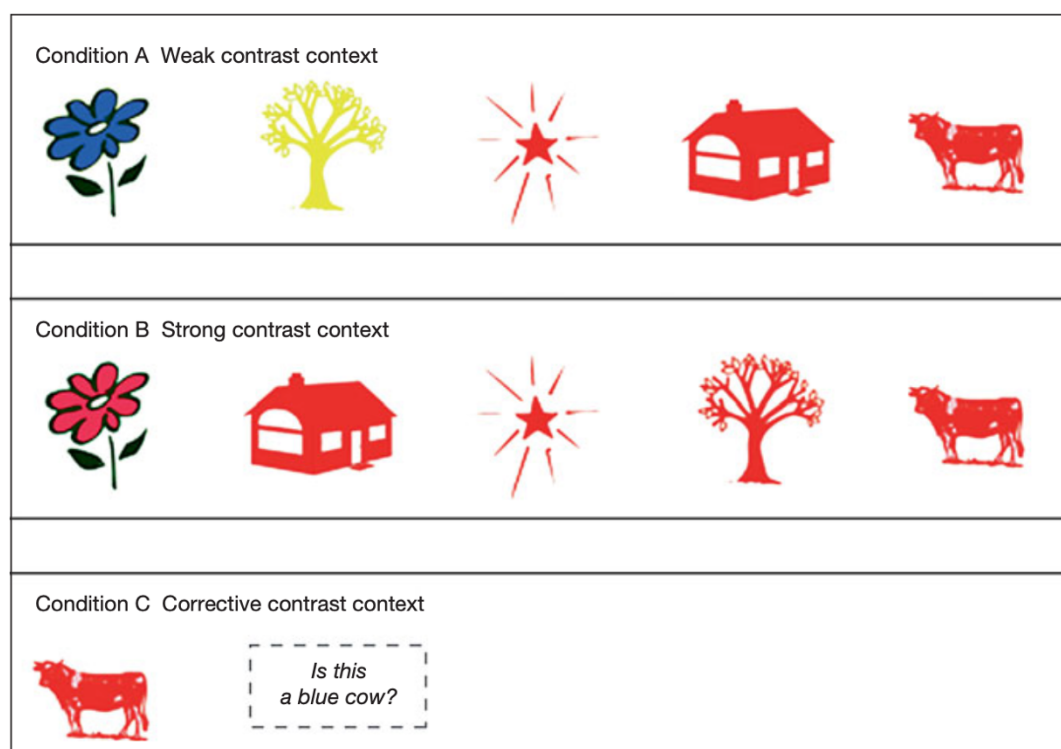


Figure 25. Three contrast conditions in Swerts and Zerbian (2010), eliciting different types of contrastive focus through the description of a series of pictures (target item is the final item in conditions A and B, and the only item in condition C), from Swerts and Zerbian (2010, 134).

Interestingly, the findings of Swerts and Zerbian's (2010) study showed that L1 Zulu highly proficient L2 English speakers produced intonation patterns that were similar to those of L1 English speakers, using pitch accents to mark focus. By contrast, lower proficiency bilinguals did not use pitch accents to mark focus – which is different from what L1 English speakers would do, but similar to what is commonly done in their L1 (i.e., Zulu).

A later study by Reichle and Birdsong (2014) examined event-related potentials (ERPs) in the production of semi-spontaneous sentences in varying focus conditions by twelve L1 and twenty-four L2 speakers of French, reporting similar results to Swerts and Zerbian's (2010) findings. In Reichle and Birdsong's (2014) study, too, proficiency levels were included as a possible modulating factor in prosodic transfer. Their findings revealed that (1) nouns

receiving contrastive focus showed increased anterior negativity in the ERP signal in comparison to informational focus for both L1 and L2 speakers, and that (2) the degree of the negativity effect was modulated, for L2 speakers, by L2 proficiency levels. Specifically, after dividing their twenty-four learners into two proficiency groups (on the basis of the average of their self-reported language skills), the researchers found no significant effect of focus condition in low-proficiency learners, as opposed to high-proficiency learners – suggesting, once again, that higher L2 proficiency levels are associated with a lower degree of L1-to-L2 prosodic transfer.

4.2.3.2 L2-to-L1 Transfer as Evidence of Intonational Attrition

The interesting yet underexamined phenomenon, central to the present thesis, is that intonational transfer can indeed take place not only from the L1 to the L2, but also from the L2 to the L1 – that is, bidirectionally. Limited corroborating evidence in this direction comes from two pieces of research: an early study by Mennen (2004), and a later study by van Maastricht, Krahmer and Swerts (2016), reviewed in turn below.

The research carried out by Mennen (2004) explored whether highly proficient L1 Dutch-L2 Greek speakers were able to produce the correct alignment of the prenuclear rise in their L2 Greek, as well as whether they were able to maintain the correct alignment patterns of the prenuclear rise in L1 Dutch. Mennen's (2004) results revealed that the production of F0 (fundamental frequency) was inaccurate, for both languages, in four out of five participants tested. Specifically, in L2 Greek peak alignment was produced as early as that of an L1 Dutch control group (within the accented vowel), and much later compared to an L1 Greek control group (whose peak realisation was in the following vowel); at the same time, the realisation of a comparable

rise in L1 Dutch was also affected, as the four speakers partially neutralised the peak timing differences between Dutch statements with long and short vowels in the accented syllable of the test word. Only one of the five participants was able to produce significant differences in peak alignment in all material sets between languages. The reason for this was attributed by Mennen (2004, 560) to the fact that the ‘most successful learner’ (in her words) had been exposed to the L2 far earlier than the other participants (i.e., when she was fifteen years old, as opposed to twenty/twenty-five years of age) – yet, the possibility that other factors may have potentially contributed to this outcome was not ruled out either.

Although fascinating, the results of Mennen’s (2004) study came from the investigation of a very small sample made up of (only) highly proficient L2 bilinguals. Moreover, the study looked at phonetic, rather than grammatical, aspects of prosody – consequently, the extent to which Mennen’s findings could be generalised was undetermined. Therefore, in a more recent study, van Maastricht, Krahmer and Swerts (2016) examined bidirectional intonational transfer through the use of a large participant sample (made up of 124 speakers in total), and by examining prosody in a functional context. Their study specifically looked at intonation patterns in L1 Dutch and L1 Spanish controls, alongside L1 Dutch learners of L2 Spanish and L1 Spanish learners of L2 Dutch (further split into two groups each: a less proficient group and a more proficient group). Given that the two languages are known to use different prosodic cues to mark information status, it was assumed that these prosodic differences would lead to transfer from the L1 to the L2 for both groups, and particularly more so for less proficient learners. At the same time, transfer from the L2 to the L1 was deemed unlikely to occur, due to both the differences between the use of prosody tested in van Maastricht, Krahmer and

Swerts's (2016) study and the one by Mennen (2004), and the fact that the participants employed by van Maastricht and colleagues were university students with lower L2 proficiency than Mennen's learners (who had at least twelve years of L2 experience). The picture-naming task employed in the study to elicit adjective-noun phrases was very similar to the ones used in Swerts, Krahmer and Avesani (2002) and Swerts and Zerbian (2010), described in the previous paragraphs. Here, the target picture was always the fourth image (out of five presented in a row), such as the *blue donkey* in Figure 26 below, corresponding to an NP in their 'contrastive/contrastive' condition – that is, whose adjective and noun both differed from the previous NP (e.g., a *pink broom*, in the picture). The other conditions were 'given/given' (e.g., *blue donkey* preceded by *blue donkey*), 'contrastive/given' (e.g., *blue donkey* preceded by *red donkey*) and 'given/contrastive' (e.g., *blue donkey* preceded by *blue broom*).

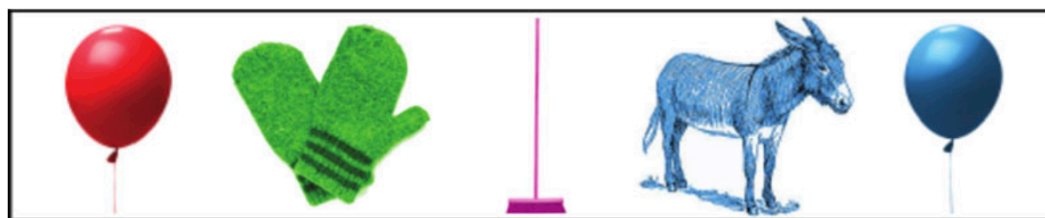


Figure 26. Example of an experimental item sequence in van Maastricht, Krahmer and Swerts (2016), where the fourth item is the target item (here, a blue donkey) differing in both adjective and noun from the previous item (a pink broom), from van Maastricht, Krahmer and Swerts (2016, 12).

The researchers performed acoustic analyses separately for pitch accents and boundary tones – because only the former aspect is directly relevant to the experiment carried out for this thesis, the latter is not discussed in the present section. In particular, van Maastricht, Krahmer and Swerts' (2016) results

revealed, firstly, that L1-to-L2 prosodic transfer occurred for pitch accents, similar to Swert and Zerbian's (2010) study. It also seemed that, despite L1-to-L2 transfer evidence, L2 learners were acquiring L2 characteristic patterns. The extent to which transfer took place also seemed to be modulated by L2 proficiency levels, with increasing L2 proficiency corresponding to more L2-like intonation patterns, in line with the findings discussed earlier (i.e., Swerts and Zerbian 2010; Reichle and Birdsong 2014). Last but certainly not least, both L2 Dutch and L2 Spanish learners transferred pitch accent features from their L2 to their L1. This was unexpected, as noted by van Maastricht, Krahmer and Swerts (2016, 28-29), especially when considering the differences between their participants and those in Mennen (2004). Specifically, their participants were less proficient, and used their L2 sporadically (mainly in the classroom or with distant relatives), being more L1 dominant than Mennen's participants. Moreover, whilst her participants had extensive L2 experience (ranging from twelve to thirty-five years), most of the participants in the study by van Maastricht and colleagues only started learning the L2 during their studies (which were either in progress or almost finished), not exceeding six years of L2 experience at most.

In sum, although Mennen (2004) and van Maastricht, Krahmer and Swerts (2016) looked at different aspects of intonation – the former investigating the timing of a nonfinal or prenuclear rise in intonation phonetically, and the latter examining the functional use of prominence patterns phonologically – they both constitute the only evidence of L1 prosodic attrition to date.

4.2.4 Summary of the Literature and Aims of the Study

Overall, the experimental evidence reviewed here points to the fact that intonational transfer can occur in speakers whose two languages have been found to differ with regards to intonation (cf. §§ 4.2.1-4.2.2). Specifically, not only can prosodic transfer occur from the L1 to the L2 (as argued in §4.2.3.1), but evidence of transfer, although limited, has also been reported from the L2 to the L1, with L2 proficiency modulating the degree of transfer experienced (as shown in §4.2.3.2). Because only one study to date has explicitly looked at L2-to-L1 prosodic transfer in grammatical – rather than phonetic – aspects of intonation (i.e., van Maastricht, Krahmer and Swerts 2016), which constitute the optimal environment for attrition to occur, further research is required to determine the extent to which these findings are more widely applicable.

Given the evidence summarised above, the aim of the present study is to investigate L2 acquisition and possible L1 attrition in sentence stress patterns for late bilingual speakers of two different proficiencies (intermediate/advanced)⁶ above in two different environments (L2 instruction in an L1 context/immersion in an L2 context).

4.2.4.1 Research Question

This study particularly aims to answer the following question: to what extent do L2 proficiency (and immersion in an L2-speaking country) affect how bilingual speakers produce relative prominence on the second noun phrase, following the production of a sequence of two noun phrases, to reflect the repetition of either the first or the second word, in L1 English and L2 Italian?

4.2.4.2 Hypotheses and Predictions

On the basis of the reported differences in sentence stress patterns between Germanic and Romance languages (§§ 4.2.1-4.2.2), L1 English control speakers should be judged as having adjusted relative prominence on the second noun phrase to reflect repetition, as opposed to L1 Italian controls. For the bilingual speakers, the following has been predicted on the basis of the reported evidence of bidirectional intonational transfer (§§ 4.2.3.1-4.2.3.2):

1. in L2 Italian, on the one hand, classroom learners are more likely to show L1-to-L2 transfer than long-term residents, producing responses with relative prominence which is likely to reflect repeated material (cf. Swerts and Zerbian 2010; Reichle and Birdsong 2014);
2. in L1 English, on the other hand, long-term residents are more likely to show L2-to-L1 transfer than classroom learners, producing responses with relative prominence which is unlikely to reflect repetition (cf. Mennen 2004; van Maastricht, Krahmer and Swerts 2016).

4.3 Methodology

4.3.1 *Participants*

Only a subset of the participants reported in § 2.3.1 was able to take part in this study – the characteristics of those whose recordings were analysed (cf. § 4.3.3) are reported in Table 7.

Table 7. Characteristics of the participants taking part in the prosody study

Characteristic	University students	Long-term residents	L1 English controls	L1 Italian controls
Number of participants	19	26	25	22
Born in	UK	UK	UK	Italy
Living in	UK	Italy	UK	Italy
L1	English	English	English	Italian
L2	Italian	Italian	N/A	N/A
Gender ^a	♀=18	♀=20	♀=14	♀=19
	♂=1	♂=6	♂=11	♂=3
	♀=0	♀=0	♀=0	♀=0
Age (years)	M=22.1	M=44.7	M=27.6	M=28.7
	σ=1	σ=14.2	σ=6.2	σ=8.3
Age of L2 acquisition (years)	M=17.5	M=23.7	N/A	N/A
	σ=1.4	σ=8.1		
Length of residence in L2 country (years) ^b	M=0.1	M=20.9	N/A	N/A
	σ=0.3	σ=14.1		
L2 proficiency score ^c	M=37.2	M=70.3	N/A	N/A
	σ=25.5	σ=16.7		
Working memory score (number recalled) ^d	M=47.5	M=49.3	M=46	M=48.1
	σ=10.5	σ=8.3	σ=10.6	σ=5.6

^aGender is reported as follows: ♀ (female), ♂ (male), ♀ (other/non-binary). ^bTwo university students both reported spending one year in Italy prior to testing; hence, mean (M) and standard deviation (σ) have been reported for students as well as long-term residents' length of residence. ^cL2 proficiency scored as N words correctly identified as being Italian words – 2*N of non-words wrongly identified as Italian words (out of 90 words). ^dWorking memory score measured as the number of correctly recalled to-be-remembered words (out of 60).

4.3.2 Materials

To investigate sentence stress patterns in both L1 English and L2 Italian, two picture-naming tasks (PNTs) were employed (one for each language). The PNTs were designed on the basis of the tasks employed in previous research (i.e., Swerts, Krahmer and Avesani 2002; Swerts and Zerbian 2010; van Maastricht, Krahmer and Swerts 2016), taking pictures from the Multilingual Picture (Multipic) database by Duñabeitia *et al.* (2022). Specifically,

participants were presented with pairs of items depicting four possible referents (i.e., dragon/flower/pumpkin/tiger – *drago/fiore/zucca/tigre*) in four possible colours (i.e., blue/green/red/yellow – *blu/verde/rosso/giallo*) – see Appendix E. The different combinations of pairs of colours/items were presented in a fully randomised order (cf. later discussion in §§ 4.4.-4.5) in three conditions (an example of which is illustrated in Figure 27):

1. contrastive/contrastive (CC), where both the adjective and the noun of the target NP were unmentioned in the description of the preceding NP – e.g., a blue dragon preceded by a red pumpkin (32 item pairs in total);
2. contrastive/given (CG), where the first word of the target NP (i.e., the adjective in English, the noun in Italian) contrasted with the first word of the preceding NP, but the second word was the same – e.g., a blue flower preceded by a red flower in English, or *un fiore giallo* preceded by *un drago giallo* (16 item pairs in total, always matched by gender in Italian);
3. given/contrastive (GC), where the second word of the target NP (i.e., the noun in English, the adjective in Italian) contrasted with the second word of the preceding NP, but the first one was the same – e.g., a yellow flower preceded by a yellow pumpkin in English, or *una zucca gialla* preceded by *una zucca rossa* in Italian (16 item pairs in total, gender-matched in Italian).

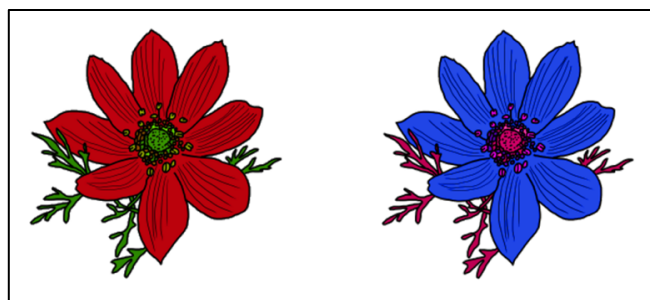


Figure 27. Example of a contrastive/given (CG) pair in English: a blue flower (target item) preceded by a red flower, eliciting the response '(a) red flower (and a) blue flower'. The same item pair is an example of a given/contrastive (GC) pair in Italian, as it elicits the response '(un) fiore rosso (e un) fiore blu'.

4.3.3 Procedure

The same ethical approval and online data collection procedure as the ones described in § 2.3.3 for the lexical study apply. As in the case of the SPR (cf. § 3.3.3), participants completed the PNT among other tasks first in one language and six days later in the other language. The order was counterbalanced across participants. Similar to when they were completing the other tasks, participants were instructed to be in a quiet room, turn off any devices, and read carefully the instructions on the screen, while their voice was being recorded throughout the task.

The PNT consisted in describing the colour and noun of the items appearing on the screen in pairs, by saying them out loud – e.g., by saying ‘(a) red flower (and a) blue flower’ (as for the example in Figure 27). Pairs of items were presented in turn, and participants were instructed to press next only after having described the item on the screen. The experiment began after nine practice trials, and participants were allowed to take a break halfway through the task when prompted to do so (if they wished).

4.3.3.1 Expert Judgments and Data Reduction

Originally, all PNT recordings were to be submitted to three local judges at the University of Edinburgh – one of the experts would judge all recordings, whilst the other two would judge recordings in one language each for validation. In particular, the experts were to judge categorically whether relative prominence on the second noun phrase was produced as having been adjusted or not. Trials where experts may be unsure of their judgments were to be flagged by them to be later reconciled. Because of speakers’ individual variability in the way they approached the task, with one known problem being list intonation, the acoustic cue used for the phonetic implementation

of relative prominence (i.e., intensity, duration of the focused constituent, increased F0, deaccenting, etc.) would be left unspecified by the judges. Having two sets of expert judgments for each language was thought to mediate the known difficulty in judging the recordings objectively.

However, there were a number of unforeseen difficulties involving the nature of the task as well as issues of practical nature. Firstly, over half of the recordings presented acoustic cues degraded by hesitations and increasing speech rates. On the one hand, hesitations were especially noticeable in the case of the Italian task, where university students in particular had issues of gender selection as well as gender agreement. On the other hand, in both languages, many participants tended to settle into a pattern as the task went on: either their speech rates gradually increased, or participants fell into list intonation. Instead of discarding a large amount of data, recordings where acoustic cues were degraded by hesitations, increasing speech rates or list intonation were retained, and judges were forced to make a binary decision on whether relative prominence was adjusted or not (as explained earlier). This way, only four recordings in total were deemed unusable – due to them being either incomplete or of poor audio quality – and were excluded from the analysis. Lastly, given the restrictions imposed due to the COVID-19 pandemic, not all local judges could be recruited as originally planned. The recordings were hence judged by only one local expert at the University of Edinburgh, and a second expert at Radboud University Nijmegen was later asked to judge 50% of the English recordings for validation. As it goes beyond the scope of the present chapter, a detailed discussion of (dis)agreement percentage and judgment reconciliation is included in Appendix F. Two separate analyses were carried out in English, each using one of two sets of judgments (i.e., from the first judge only vs. reconciled judgments together

with those from the second judge where reconciliation was not possible). Because the results of the two analyses in English are overall similar (see Appendix F for full details), for reasons of coherence § 4.4 reports the results of the analyses with judgments from the first expert, for both English and Italian.

4.3.4 Design Measures and Predicted Outcomes

The dependent variable measured in this task is relative prominence (1 = judged as having been adjusted to reflect repetition, 0 = judged as not having been adjusted). The discrete independent variables are condition (CC, CG, GC) and group (students, residents, L1 controls – the latter indicating the L1 English control group in the English task, and the L1 Italian control group in the Italian task, respectively).

Relative prominence was planned to be analysed through two mixed-effects binomial logistic regressions, one for English and one for Italian. For both models, a significant interaction of group and condition was predicted. Specifically, in English, the likelihood of relative prominence being judged as having been adjusted was predicted not to differ between L1 English controls and university students, whilst long-term residents should be significantly less likely to be judged as having adjusted prominence than both of the other two groups. This was expected in line with the evidence of L2-to-L1 intonational transfer reported in highly proficient L2 speakers (§§ 4.2.3.1-4.2.3.2). On the other hand, in Italian, the likelihood of relative prominence being judged as having been adjusted was predicted not to differ between L1 Italian controls and long-term residents, whilst university students should be significantly more likely to be judged as having adjusted prominence than both of the

other two groups. This was expected in line with the evidence of L1-to-L2 transfer reported for L2 speakers of lower proficiency (§§ 4.2.3.1-4.2.3.2).

4.4 Results

Table 7 below reports the mean percentage of trials where relative prominence was judged as adjusted (PA) or not adjusted (PNA) for different conditions in each language.

Table 7. Mean percentage of trials where relative prominence was judged as adjusted/not adjusted in the English and Italian picture-naming tasks

	University students		Long-term residents		L1 controls	
	PA	PNA	PA	PNA	PA	PNA
English						
CC	19.2%	80.8%	15.4%	84.6%	19.6%	80.4%
CG	87.3%	12.7%	89.6%	10.4%	92.2%	7.8%
GC	17.9%	80.1%	14%	86%	17.3%	82.7%
Italian						
CC	2.4%	97.6%	0.4%	99.6%	0.7%	99.3%
CG	35.4%	64.6%	10.1%	89.9%	0.5%	99.5%
GC	0.3%	99.7%	0.2%	99.8%	0%	100%

Note. PA = prominence (judged as) adjusted; PNA = prominence (judged as) not adjusted. CC = contrastive/contrastive; CG = contrastive/given; GC = given/contrastive. L1 controls are English monolinguals in the English picture-naming task and Italian monolinguals in the Italian task, respectively.

The results on Table 7 clearly show that, in English, lower percentages of prominence judged as adjusted were reported (to a similar degree) on CC and GC items than on CG items for L1 controls (respectively, 19.6% and 17.3% versus 92.2%). This was expected given that the difference between CC and GC items (e.g., 'GREEN TIGER' vs. 'green TIGER') is both phonetically more subtle and possibly of a different phonological status than the difference involved in the CG trials (e.g., 'GREEN tiger'), where the possible prominence patterns are arguably categorically distinct. In Italian, on the other hand, low percentages of prominence judged as adjusted were reported on all items for

L1 controls (respectively, 0.7%, 0.5%, and 0%, for CC, CG, and GC items). This was also expected given that prominence patterns are not commonly adjusted for repeated material in Italian. However, the percentages of prominence being judged as adjusted on CC and GC English trials were unexpectedly higher than those on the same trials in Italian, for all groups alike. Further investigations revealed that on most of these trials, the adjustment of prominence was triggered by an unforeseen complication arisen due to the experimental design (as later discussed in detail in § 4.4.2).

4.4.1 Confirmatory Analyses for Prominence Adjustment

To investigate the likelihood that relative prominence would be judged as having been adjusted (1) as opposed to not having been adjusted (0) across groups and conditions, two binary logistic mixed models²¹ were fitted, one in English and one in Italian. The models included the contrast-coded fixed-effect predictor variables group (students, L1 English/Italian controls, residents), condition (CC, CG, GC) and the interaction of group and condition. Varying intercepts and slopes for participants and items were initially included for all models; however, due to single fits for the two models in English, random slopes were removed (as they accounted for least variance), and only varying intercepts were retained in those cases. The main effects plots are illustrated in Figure 28 (for English) and Figure 29 (for Italian), with key main effects and interactions for each model discussed here (see Appendix G for full model details).

²¹ Different from the preregistered analysis (which included only one model with language as a predictor), separate models were needed to analyse relative prominence in each language, given that not all participants completed the task in both languages – i.e., L1 Italian controls completed the task in Italian, and L1 English controls completed the task in English.

In English, only a significant main effect of condition, $\chi^2(2) = 1000.83$, $p < .001$, was found. Bonferroni corrected post-hoc analyses showed that, across groups, relative prominence was significantly more likely to be judged as having been adjusted in CG trials than in GC trials ($OR = 62.52$, $p < .001$), and significantly less likely to be judged as having been adjusted in CC trials than in CG trials ($OR = 0.02$, $p < .001$). By contrast, the likelihood of prominence being judged as having been adjusted did not differ significantly between CC trials and GC trials ($OR = 1.13$, $p = 0.7$).

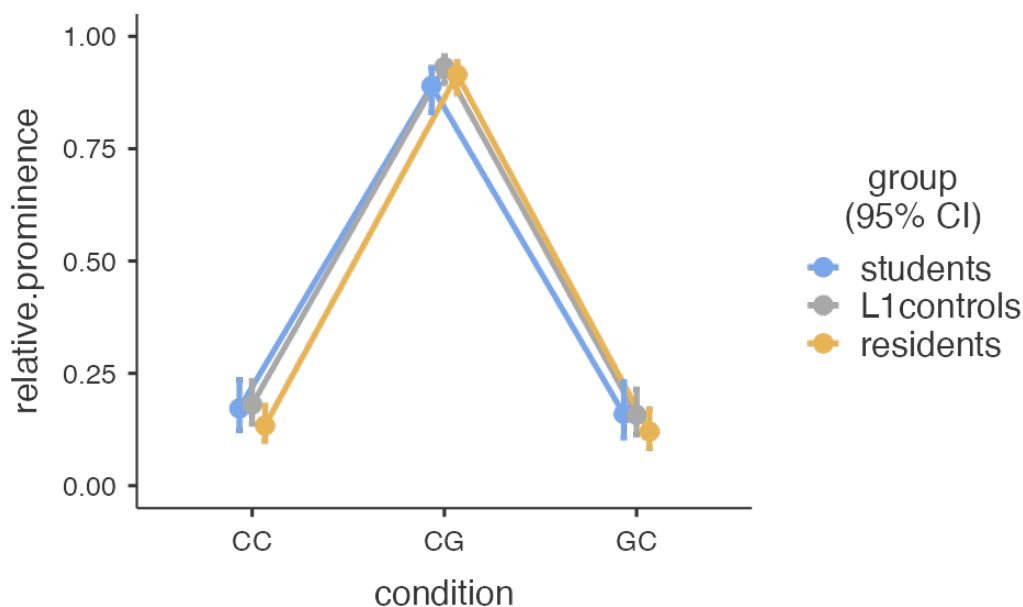


Figure 28. Relative prominence (1 = judged as adjusted, 0 = judged as not adjusted) in the contrastive/contrastive (CC), contrastive/given (CG) and given/contrastive (GC) conditions of the English picture-naming task for students, residents and L1 (English) controls. Error bars = 95% confidence interval (CI).

In Italian, on the other hand, a significant main effect of condition, $\chi^2(2) = 7.37$, $p = .025$, as well as a significant interaction between group and condition, $\chi^2(4) = 20.47$, $p < .001$, were found. In particular, Bonferroni post-hoc analyses revealed that the likelihood of relative prominence being judged as having been adjusted did not differ across groups on CC or GC trials (all

$ps > .05$). By contrast, whilst on CG trials the likelihood of relative prominence being judged as adjusted did not differ between long-term residents and L1 Italian controls ($OR = 27.46$, $p = .070$), university students were significantly more likely to be judged as having adjusted prominence than both L1 Italian controls ($OR = 366.39$, $p < .001$) and long-term residents ($OR = 13.34$, $p = .016$) – thus giving rise to the significant interaction.

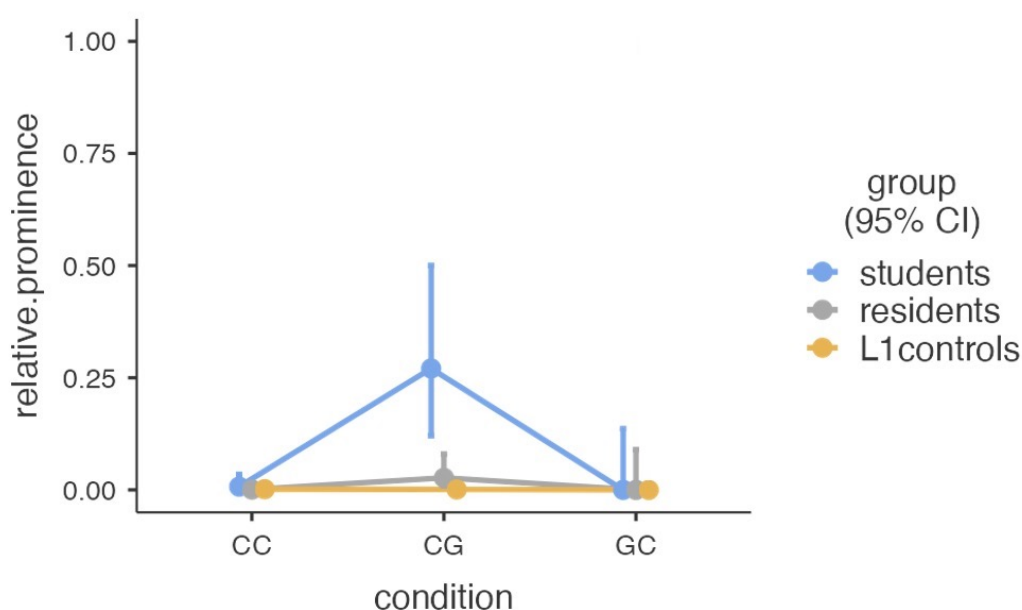


Figure 29. Relative prominence (1 = judged as adjusted, 0 = judged as not adjusted) in the contrastive/contrastive (CC), contrastive/given (CG) and given/contrastive (GC) conditions of the Italian picture-naming task for students, residents and L1 (Italian) controls. Error bars = 95% confidence interval (CI).

4.4.2 Exploratory Analyses for Cross-Pair Prominence Adjustment

As seen on Table 7, percentages of prominence being judged as adjusted on CC and GC English trials were unexpectedly higher than those on the same trials in Italian, for all groups alike. This is due to an unforeseen complication arisen as a consequence of the full randomisation of items operated in the experiment. Specifically, cases which may trigger the adjustment of

prominence across item pairs were not controlled for in the experiment – i.e., the second instance of two identical nouns in adjacent item pairs, such as ‘flower’ in the sequence [RED DRAGON, GREEN FLOWER] + [BLUE PUMPKIN, YELLOW flower]. In fact, the randomisation operated in the presentation of item pairs made it so that different participants had a different number of opportunities in which cross-pair prominence adjustment might be triggered. Although this may be regarded as a methodological flaw (as discussed later in §§ 4.5 and 5.2), such a context allowed for further exploration of the results, by comparing the proportion of judgments also in the uncontrolled cases that potentially elicited cross-pair prominence adjustment across items. The percentages for cross-pair prominence adjustment in English are reported on Table 8 below – where CC, CG and GC refer to the second of the two item pairs, and where only the second noun of the second item pair is relevant for the analysis.

Table 8. Mean percentage of trials where relative prominence was judged as adjusted/not adjusted in cases with potential for cross-pair adjustment in the English picture-naming task

	University students			Long-term residents			L1 English controls		
	N	PA	PNA	N	PA	PNA	N	PA	PNA
CC	109	62%	38%	164	56%	44%	175	65%	35%
CG	56	86%	14%	90	96%	4%	90	92%	8%
GC	55	69%	31%	82	44%	56%	89	61%	39%

Note. N = total number of cases with potential for cross-pair adjustment per group in each condition. PA = prominence (judged as) adjusted; PNA = prominence (judged as) not adjusted. CC = contrastive/contrastive; CG = contrastive/given; GC = given/contrastive. CC, CG and GC refer to the second of the two item pairs, and only the second noun of the second item pair is relevant for the analysis.

As can be seen from Table 8, on CG trials – where the adjustment of prominence is expected by definition – prominence was more often judged as having been adjusted than not for all groups. By contrast, interesting differences can be noted across groups in the other two conditions. Of

specific interest to the aim of this L1 attrition study is the fact that, on both CC and GC items, the percentage of relative prominence judged as adjusted was reportedly lower for long-term residents than for L1 English controls. On the other hand, similar percentages of prominence judged as being adjusted were reported for students and L1 English controls. Specifically, the percentage of prominence judged as adjusted was 56% for residents, 62% for students and 65% for L1 controls on CC items with potential for cross-pair prominence adjustment. On GC items with the same potential, the percentage was only 44% for residents, but 69% for students and 61% for L1 controls. These results, alongside those from the confirmatory analyses reported earlier, are discussed below.

4.5 Interim Discussion

The aim of this third study was to investigate L2 acquisition and L1 attrition jointly in the way prominence is, or is not, adjusted for repetition, for British students of Italian at UK universities and British long-term residents in Italy. The predictions were based off previous theoretical and experimental work in the field. Specifically, whilst in L2 Italian university students were expected to be more likely to show L1-to-L2 transfer than long-term residents – with prominence in L2 Italian being more likely to be judged as adjusted (to account for repeated material), contrary to what is common in L1 Italian (Swerts and Zerbian 2010; Reichle and Birdsong 2014). The opposite was expected to happen in L1 English, with L2-to-L1 transfer deemed to be more likely for long-term residents than university students – i.e., with prominence in L1 English being less likely to be adjusted, contrary to what is common in L1 English (cf. Mennen 2004; van Maastricht, Krahmer and Swerts 2016).

The results of the confirmatory analyses partially confirmed the above-mentioned predictions. In particular, whilst on CC and GC trials the three groups (namely, university students, long-term residents and L1 Italian controls) performed similarly (i.e., they were mostly judged as not adjusting prominence), on CG trials university students – but not long-term residents – were significantly more likely to be judged as having adjusted prominence than L1 Italian controls (and even long-term residents). These results can be taken to suggest that whilst L1-to-L2 transfer is (still) taking place for university students (whose L2 proficiency is lower), no evidence of L1-to-L2 transfer is present in the case of long-term residents (whose L2 proficiency is higher), with their prominence production being judged as equal to that of L1 Italian controls. This is in line with the reported modulating effect of L2 proficiency in L1-to-L2 transfer by Swerts and Zerbian (2010) and Reichle and Birdsong (2014). However, it is also important to point out that the percentage of CG trials where students were judged as having adjusted prominence was only 35.4% – in other words, in 64.6% of the cases their prominence was judged as not adjusted. By contrast, the percentages of prominence judged as not adjusted were much lower for long-term residents and L1 Italian controls on CG trials (i.e., 89.9% and 99.5%, respectively). Still, the fact that for students the percentage was above chance level (i.e., 50%) seems to indicate that they are in the process of acquiring L2 prominence patterns, although they may not be performing as L1 speakers of the language, or as highly proficient/immersed L2 speakers. This is an interesting result, as it seems to be indicative of the fact that L2 prominence patterns can be learned even in classroom settings, where they are not usually taught explicitly. Importantly, these findings are of theoretical significance in relation to the properties of the two languages examined – i.e, English, which allows deaccentuation, and

Italian, which resists deaccentuation (as discussed in § 4.2.2.1). From the perspective of a transitional stage in the shift from L1 English to L2 Italian, the discrepancies between the two experimental groups can thus be explained as long-term residents (i.e., more proficient, immersed L2 speakers) seem to have fully acquired the prominence patterns of their L2, while university students (i.e., less proficient, classroom-based L2 learners) are (only) partly relying on the prominence patterns of their L1.

On the other hand, the results of the planned analyses in L1 English did not lend support to the initial predictions. The three groups of university students, long-term residents and L1 English controls were found to perform similarly across conditions, no matter which set of judgments was used. In other words, no evidence of L1 attrition (or L2-to-L1 intonational transfer) was found for either bilingual group, with all groups being more likely to adjust prominence for repetition on CG trials, and less likely to do so on CC and GC trials. This is not in line with what was found in Mennen (2004), where residents who had been residing in an L2 country for twelve to thirty-five years were found to show signs of L2-to-L1 intonational transfer – or even in van Maastricht, Krahmer and Swerts (2016), whose participants were classroom-based learners who had been studying the L2 for six years at most, with some signs of L2-to-L1 transfer still being found for their prosody.

However, the fact that the item pair presentation, in the present study, was fully randomised gave rise, for different participants, to different numbers of instances where prominence adjustment may be triggered across item pairs. Specifically, this happened in the second instance of two identical nouns in adjacent item pairs, such as ‘flower’ in the sequence [RED DRAGON, GREEN FLOWER] + [BLUE PUMPKIN, YELLOW flower] – even where it was not expected initially (i.e., on CC and GC trials, where prominence adjustment

percentages were, indeed, unexpectedly higher in English than in Italian across groups; cf. Table 7). Exploratory analyses were therefore carried out to compare percentages of cross-pair prominence adjustment across items, showing that percentages of relative prominence judged as adjusted were lower for long-term residents than for L1 English controls on both CC and GC trials with potential for cross-pair prominence adjustment. On GC items specifically, it was only on 44% of trials that long-term residents' production of prominence was judged as having been adjusted, as opposed to 56% of cases where prominence was judged as not adjusted. For L1 English controls the percentage of relative prominence judged as adjusted on GC trials was, by contrast, higher at 61%, with prominence judged as not adjusted in 39% of the trials. This seems to be indicative of the fact that some form of L2-to-L1 transfer is taking place for long-term residents, since prominence adjustment is triggered to a lesser extent for them than for L1 English controls across item pairs. The reason why some evidence of intonational attrition may be found in these contexts, but not on CG trials, is possibly due to participants being less aware of the aim of the task across trials than within trials – resulting in more natural prominence production on their behalf. Hence, it seems reasonable to suggest that future studies explicitly control for instances where prominence adjustment may be triggered across item pairs.

On the whole, evidence of L1-to-L2 intonational transfer was found for university students, but not long-term residents, where and as expected; by contrast, evidence of L2-to-L1 transfer was not found, where expected, for either group, yet some signs thereof were reported for long-term residents, but not for university students, in contexts which had not been controlled for explicitly in the initial design of the experiment.

Discussion

This chapter discusses the results of the experiments presented in Chapters 2, 3, and 4 jointly against the main overarching questions, hypotheses and predictions of the thesis (§ 1.2.1). The limitations of these studies, as well as the limitations of the thesis as a whole, are addressed, and the implications of the findings for L1 attrition research within and across the three domains examined are discussed. Lastly, suggestions for future research are provided.

5.1 Summary of the Findings

For ease of reference, Table 9 below summarises whether evidence of L1 attrition and L2 acquisition was found across the three domains (i.e., the lexicon, syntax and prosody) in the two bilingual groups examined (i.e., British university students of Italian and British long-term residents in Italy).

Table 9. Summary of evidence of L1 attrition and L2 acquisition found in the lexicon, syntax and prosody for British university students of Italian and British long-term residents in Italy

	Lexicon		Syntax		Prosody	
	L1 attrition	L2 acquisition	L1 attrition	L2 acquisition	L1 attrition	L2 acquisition
Students	✓	✓	X	✓	X	✓
Residents	✓	✓	✓	✓	?	✓

Note. ✓ = some evidence; X = no evidence; ? = supplementary evidence.

5.1.1 L1 Attrition in Different Bilingual Speakers

The first RQ this thesis sought to answer was whether evidence of L1 attrition would be found in different groups of late L2 speakers – and, if found, whether attrition would manifest itself differently in the two groups. The main prediction, given that ‘every bilingual is an attriter’ (Schmid and Köpke 2017b,

764) was that attrition would indeed be found in both groups, although to different extents. As can be seen from Table 9 above, this turned out to be the case: the evidence of L1 attrition found for students was much more limited, as it only affected the lexicon, whilst syntax (and, arguably, prosody to some extent) was also affected in long-term residents. Furthermore, even within the lexicon, where both groups experienced interference from the L2 when retrieving words in their L1, a slight difference between the two groups was observed, with long-term residents showing a greater degree of interference than students (cf. Figure 10 in § 2.4). This evidence seems to suggest, as expected, that long-term residents do experience more attrition than university students.

Although accuracy in the lexicon was also thought to be affected in long-term residents, along with RTs, this was not the case: on trials where interference was expected to occur, residents' lexical accuracy rate was largely similar to that of students. Looking at syntax, pronoun resolution preferences seemed to begin to be affected by attrition for long-term residents (cf. Table 4 in § 3.4.1), yet they failed to reach significance on the regression analyses (cf. Figure 14 in § 3.4.1). Still, ambiguous resolution trials yielded significantly longer RTs in the last region for long-term residents, but not for university students or L1 English controls (cf. Figure 16 in § 3.4.1). Both pieces of evidence seem to suggest that, even for highly proficient/immersed L2 speakers, attrition does not necessarily affect accuracy/preference alongside RTs, but may in some cases manifest only in terms of slow-down effects – e.g., in the retrieval of the correct L1 word, and in the resolution of ambiguous pronominal forms. This ultimately lends support to the idea, originally advanced for syntax but seemingly applicable to the lexicon as well, that

attrition may not affect knowledge itself, but rather the way in which knowledge is accessed in real time (Sorace 2011).

5.1.2 L1 Attrition in Different Language Domains

The second RQ this thesis wished to address was whether L1 attrition would affect the three separate language domains under investigation (i.e., the lexicon, syntax and prosody) at the same time – and whether, within syntax in particular, the resolution of different structures (i.e., pronouns and relative clauses) would be affected to a similar extent.

The first prediction was that L1 attrition would be found in all three domains, though not for all groups of speakers. As can be seen from Table 9 above, some evidence of attrition was found in all domains, and to different extents for the different groups. However, whilst the evidence of L1 attrition was clear in the lexicon (for both students and residents; cf. Figure 10 in § 2.4), and in syntax (for residents only; cf. Table 4 and Figure 16 in § 3.4.1), in the case of prosody the evidence was mixed. The confirmatory analyses carried out according to plan did not reveal prosodic attrition where it was expected – i.e., on trials where the adjustment of prominence was expected to be triggered to a lesser degree for residents than L1 English controls or students (cf. Figure 28 in § 4.4). Further exploratory analyses did find some evidence of attrition – i.e., in cases where the adjustment of prominence was indeed triggered to a lesser extent for residents than L1 English controls or students due to the full randomisation of the item pairs presented (cf. Table 8 in § 4.4). These findings seem to suggest that the lexicon is affected by L1 attrition early, even in classroom-based learners of moderate L2 proficiency, expanding on the claims by Linck, Kroll and Sunderman (2009), who highlighted the permeability of the lexicon to L1 attrition early on (in their

case, however, in L2 immersion settings). At the same time, these findings seem to suggest that evidence of attrition in syntax (and possibly prosody) takes higher L2 proficiency and/or L2 immersion settings to manifest (see § 5.2 Limitations).

Focusing on syntax, the second prediction in RQ2 was based on the argument by Chamorro, Sturt and Sorace (2016) that attrition constitutes a selective process affecting only certain structures. In the specific case of the present study, within the syntactic domain, the resolution of relative clauses, but not that of pronouns, was expected to be affected by L1 attrition in English under a CLI-based account of Sorace and Filiaci's (2006) Interface Hypothesis. Because, according to this account, it is the language instantiating the less restrictive option that affects the more restrictive language (cf. Müller and Hulk 2001), no changes were expected in L1 anaphora resolution, given that English already instantiates the less restrictive option in the interpretation of overt pronouns (i.e., a subject interpretation). On the other hand, L1 attrition was expected in the resolution of RC attachment ambiguity, given that English instantiates the more restrictive option in the resolution of RC attachment ambiguity – with Norman genitives preferably referring to the NP2 due to the availability of Saxon genitives to convey an NP1 interpretation (cf. de Vincenzi and Job 1993) – whilst Italian is less restrictive (see §§ 3.2.2-3.2.3 for more details). The results of this study did report selective syntactic changes in the L1 of long-term residents, though not in the expected direction: indeed, it was in the resolution of anaphora, and not of RC attachment ambiguity, that evidence of L1 attrition was found, in RTs and, arguably to some extent (cf. § 3.4.1), in preferences. These findings cannot be accounted for in terms of CLI, as initially predicted, but rather corroborate the idea that L1 attrition may result from the competition

of the two options available in the bilingual mind which give rise to indeterminate preferences and longer RTs. This is more in line with more recent claims by Sorace (2011, 2012, 2016) which highlight the centrality of computational complexity and processing demands in the overextension of the scope of overt pronouns for bilinguals of two non-null subject languages (where this would not be expected; cf. § 3.2.3.2). Ultimately, this constitutes supports for the idea that attrition is not necessarily due to CLI (i.e. the direct influence of the L2 on the L1) and, therefore, that the terms ‘attrition’ and ‘CLI’ are not synonymous – as the former indicates an broad phenomenon, whilst the latter indicates (only) one of its possible causes. As argued earlier in § 3.5, the absence of L1 attrition in RC attachment, on the other hand, may have been due to the non-controlled inclusion of non-human referents, which halved the number of ambiguous items of interest, and introduced a semantic disambiguating factor that was potentially less cognitively taxing than the integration of pragmatic/contextual factors in the real-time resolution of anaphoric ambiguities (see § 5.2 Limitations).

5.1.3 The Relationship between L1 Attrition and L2 Acquisition

The third and last RQ investigated by this thesis addressed the overall relationship between late L2 acquisition and L1 attrition. Specifically, according to some views (cf. Figure 2 in § 1.1.1.2), there seems to be an inverse relationship between the L1 and the L2 (Cherciov 2011). Therefore, the main prediction was that, within each domain, higher L2 accuracy/more similar preferences to Italian controls and faster processing speeds would be likely to correspond to lower L1 accuracy/more dissimilar preferences from English controls and slower processing speeds.

The results of this thesis in this regard (cf. Table 9 above) partly corroborated the predictions. Indeed, the predictions are met with regards to the lexicon, where residents (with higher L2 proficiency) report higher degrees of L1 attrition than students (with lower L2 proficiency, though still affected) when retrieving L1 words. Further, with regards to syntax, some evidence of L1 attrition was only found for long-term residents, whilst both groups of bilinguals seemed to have acquired L2 anaphoric resolution preferences – with similar preferences, yet with slower processing speeds, to those of Italian controls. By contrast, no evidence of L1 attrition was found in the case of RC attachment resolution, while residual L2 optionality was present in both groups (and to a greater degree in university students). The results within the prosodic domain, finally, are not as straight-forward. The confirmatory analyses revealed no L1 attrition for either students or long-term residents, even when both groups seemed to have begun acquiring (in the case of students), or even have fully acquired (in the case of residents) L2 prosodic patterns. Nonetheless, some evidence of L1 attrition was found for long-term residents in the exploratory analyses, requiring further investigation due to the uncontrolled environment in which said attrition was found. All in all, these results seem to indicate that a negative relationship between the two languages exists, at least conclusively with regards to some domains, for the most proficient speakers.

5.2 Limitations

Before stating the implications of the findings in this thesis, different limitations need to be acknowledged – starting from the methodological

issues in each of the experiments presented, to then discuss the more general limitations of the research carried out for this thesis as a whole.

Firstly, with regards to the lexical attrition study, the results of the verbal fluency task could not be analysed due to recording issues, consequently meaning that a direct comparison of L2 acquisition and L1 attrition within lexical production could not be operated. Although the results of the translation-recognition task do seem to indicate that lexical attrition, in comprehension, is experienced by both bilingual groups, and to a slightly greater extent in long-term residents, being able to scrutinise whether production data matched comprehension data would have been informative.

Secondly, looking at the methodology of the syntactic attrition study, some issues need to be flagged. To begin with, in anaphora resolution the pronoun was presented in subject position of an independent sentence, thus not being in a structural relationship with its potential antecedents which were also limited to only two previously mentioned entities in the preceding sentence (i.e., NP1 or NP2). It would thus be interesting to know whether similar results could be found in the investigation of anaphora ambiguity (a) within the same sentence and (b) with more than two antecedents available as potential referents. Moreover, the fact that not enough baseline null pronoun items were employed in the study resulted in the exclusion of L2 null pronoun resolution from the analysis. Although the main focus of this thesis was to investigate L1 attrition (i.e., within anaphora resolution, the attrition of overt pronouns in English), it would have been useful to know whether L2 resolution preferences for other type of pronoun available in Italian (i.e., the null pronoun) were similar to those of Italian controls, or rather influenced by English resolution preferences for either bilingual group. Further, in RC attachment ambiguity resolution, the bias introduced with the inclusion of

non-human referents resulted in the halving of the ambiguous items of interest, potentially leading to the lack of L1 attrition found in this respect. Another potential confound, relevant for L2 RC resolution, was also identified in the inclusion of (quasi)perceptual verbs, allowing PR readings to become available and biasing towards high attachment. Further, the fact that some of the baseline items did not completely disambiguate the attachment as they relied on semantics (rather than grammatical gender, as in the case of baseline items in anaphora resolution) could also be seen as a methodological limitation. Additionally, in the resolution of anaphora and RC attachment ambiguities, statistical power was reduced due to the fact that for each target item there was only one disambiguated version (either a baseline-NP1/high item, or a baseline-NP2/low item). Manipulating entirely within items would have therefore increased statistical power.

Thirdly, in the prosodic attrition study, using expert judgments enabled a broader analysis of prominence adjustment (and lack thereof) perceptually; however, the phonetic details of prominence remain, to date, under-investigated and, consequently, poorly understood. The last important point to be highlighted with regards to the methodology of the prosodic study is that the full randomisation of the item pair presentation gave rise, for each participant, to different numbers of occasions in which prominence adjustment may (or may not) be triggered across item pairs. Although this context allowed for further explorations of L1 attrition within the prosodic domain, it had not been implemented in the original study design.

More general limitations concern, firstly, the very same type of comparison operated in this thesis. Specifically, some scholars have, in the past, warned against trying to quantitatively compare attrition in different linguistic systems due to the lack of an agreed-upon 'measuring stick' (Schmid

and Köpke 2009, 212). Indeed, a purely quantitative comparison across domains could not be achieved in the present work as a result of different measures being collected within each domain; however, the quantitative results within each domain could still be discussed qualitatively against each other (see § 5.1 above). A further general limitation in the methodology of this thesis is that data on participants' quantity and quality of English input and/or output was not taken into consideration. Evidence of L1 attrition was found in all of the studies carried out for this thesis, but the impact of the above-mentioned factors on the degree of attrition found in English could not be explored. The last, and perhaps wider limitation surrounding this thesis is found in the historical period in which the research was carried out. Unfortunately, the COVID-19 pandemic forced a complete reconfiguration of the original project proposal² above: some of the further consequences of this were that participant recruitment and, subsequently, data collection could only be carried out online – resulting in further disruption of the original plans made for this research. With regards to data collection, in some cases data could not be saved successfully (e.g., for the verbal-fluency tasks, as mentioned earlier). Further, it was not possible to recruit participants whose L2 proficiency was matched albeit living in two different environments (i.e., students in an L1-speaking context, and residents in an L2-speaking context). The main consequence of this is that whilst L1 attrition is found in more domains, as well as to a larger extent, in the case of long-term residents, whether this is likely to be due to their higher L2 proficiency, to the fact that they are immersed in an L2-speaking environment, or both, cannot be claimed conclusively on the basis of the present work.

5.3 Implications

In spite of the above-mentioned limitations, the findings of the investigation of L1 attrition within late L2 acquisition carried out for the present thesis have important implications for academic research on the attrition and acquisition of languages, as well as for the wider non-academic population.

First of all, the evidence found in this work strongly suggests that attrition constitutes a selective process of L1 change, which in most cases affects access to knowledge – i.e., processing speed – and only in rare cases knowledge itself – i.e., accuracy and/or preferences (cf. Sorace 2011; see also § 5.1 above). This is important, given that, in conjunction with evidence of L1 attrition reversal in other studies (e.g., Chamorro, Sorace and Sturt 2016), it emphasises the fact that an L1 may undergo changes that are not drastic or permanent, but rather temporary and reversible. For instance, in the case of long-term residents undergoing attrition while living in an L2-speaking environment, these changes are likely to be reversed, at least to some extent, upon returning to the L1-speaking environment. The fact that some evidence of (lexical) attrition is found in classroom-based university students of an L2 as well, also points to the fact that the learning of an L2, not necessarily to the most proficient of levels, may inevitably bring selective (and, again, temporary) changes in some (more restricted) aspects of the L1. Although most of the literature has traditionally investigated attrition in long-term residents who are usually highly proficient in the L2, these findings highlight that attrition may be a general consequence of bilingualism for *all* bilingual speakers, albeit to different extents. The fact that these findings point to attrition as a general consequence of bilingualism is additionally evidenced by the fact that, in some cases (e.g., syntax), crosslinguistic accounts cannot

explain the occurrence of attrition. By contrast, the hypothesis that bilinguals may be less efficient than monolinguals due to less cognitive resources being available (e.g., in the resolution of ambiguous pronominal forms) seems to be a better explanation (cf. Sorace 2011, 2012, 2016). Nonetheless, this is not to say that crosslinguistic influence never plays a role in L1 attrition, but rather that L1 attrition may, in some cases, be present even in the absence of CLI, due to sub-optimal cognitive resource allocation for some bilinguals – possibly, those whose L2 is more active, thus less easily inhibited (cf. Green 1986, 1998). Lastly, the findings of this research add to the body of knowledge in L1 attrition by evidencing how different language domains can, indeed, be affected at the same time; however, this is more likely to be the case only in highly-proficient, immersed bilinguals.

Following from the above, the wider implication for the wider non-academic community is that, despite what the term ‘attrition’ may convey – according to the Cambridge English Dictionary (2022) ‘gradually making something weaker and destroying it’ – no aspect of the L1 is destroyed or even lost. In line with the evidence, attrition constitutes a by-product of bilingualism: it is nothing to be ashamed of, nor is it something to fight; rather, it is a common phenomenon that all L2 speakers should be aware of as they may, sooner or later, be affected by it. In fact, the data in this thesis seem to suggest that the occurrence of attrition may be desirable, as a successful sign of L2 acquisition – given that more proficient bilinguals, who live abroad, report more L1 attrition than classroom-based university learners.

5.4 Recommendations for Future Research

On the basis of the findings and limitations of this thesis, the following recommendations can be made for future research investigating L1 attrition in late bilingualism. Firstly, in order to disentangle the effects of L2 proficiency from those of immersion, bilingual groups of similar proficiency levels in different environments (i.e., immersed vs. non-immersed) could be compared. Further factors that future studies should control for in the investigation of L1 attrition (specifically for English, but also other languages) are the quantity and quality of L1 (and possibly L2) input and output, to determine the impact these factors have on the degree of attrition found.

With regards to the methodology employed in L1 attrition studies, a combination of comprehension and production tasks is recommended to examine whether attrition affects both of these aspects to the same extent, within the same domain. In the examination of attrition across domains, future work could specifically investigate language areas which have not been considered here (e.g., morphology, semantics), to see whether these are also affected in long-term residents in an L2 environment – and not affected, or possibly affected to a lesser extent, in bilinguals in their L1 environment. Longitudinal studies on L1 attrition are also needed, to investigate the earliest point at which some evidence of L1 attrition can be found – notice that the university students here were not as proficient as the long-term residents, but also not complete beginners – and to what extent attrition effects can be reversed for long-term residents who return to an L1-speaking environment.

Lastly, the potential functional relationship between L1 attrition and L2 acquisition highlighted in the present study should further be investigated, as there may be some (still poorly understood) linguistic and cognitive

reconfiguration that allows a number of adult L2 learners to become more fully bilingual than others. This would require looking at L1-L2 relationships in the same individuals, accounting for individual variation in a methodologically insightful way, and – as this thesis has done for the very first time – looking at L1-L2 relationships across different linguistic domains.

Conclusions

This thesis examined the occurrence of L1 attrition (i.e., selective changes in real-time L1 comprehension and production), alongside L2 acquisition, in three separate language areas (i.e., the lexicon, syntax, and prosody) of two types of late bilingual speakers (i.e., British university students of Italian in the UK, and British long-term residents in Italy).

A similar type of L1 attrition was reported in the speed of L1 word retrieval for both groups on a translation-recognition task, with residents showing moderately higher degrees of attrition than students. In syntax, L1 attrition was found in the speed (and to some extent in preferences) of anaphora resolution on a self-paced reading task, only for residents; no evidence of L1 attrition was found in the resolution of ambiguous relative clauses on the same task. Whilst confirmatory analyses showed no prosodic attrition evidence on a picture-naming task, the exploration of an uncontrolled context revealed potential signs of prosodic attrition, again only for residents.

Overall, the results of this thesis show that L1 attrition does not only affect highly-proficient immersed bilinguals, but also classroom-based learners with moderate degrees of L2 proficiency. However, the extent to which the two groups are affected by L1 attrition is different, with attrition manifesting in more domains, and to a greater extent, in the former group of bilinguals – thus pointing to the existence of a seemingly inverse relationship between the L2 and the L1. In some cases, it is unlikely that the attrition reported results from crosslinguistic influence; it is rather a by-product of the cognitive efforts of handling two languages in one mind. These results thus indicate that L1 attrition is a natural consequence of bilingualism: after all, ‘a bilingual is not the sum of two monolinguals’ (Grosjean 1989).

Appendix A: Materials (Lexical Attrition)

Materials Used in the Translation-Recognition Task

1. Distractors Used in 'No' Trials

LN = Lexical Neighbour Distractor

TN = Translation Neighbour Distractor

S = Semantic Distractor

	Italian	English	Related (+)			Unrelated (-)		
			LN+	TN+	S+	LN-	TN-	S-
1	albero	tree	amber	spree	leaves	norms	hirer	agenda
2	paese	country	peas	counter	flag	dots	printer	isle
3	vita	life	veto	knife	birth	boar	cloth	beach
4	fango	mud	tango	mood	sludge	cubes	myth	locker
5	cielo	sky	coil	spy	cloud	heel	bolt	farms

First Language Attrition in Late Bilingualism

6	uovo	egg	woe	edge	butter	soy	path	dishes
7	lago	lake	lag	lace	pond	tub	zinc	guns
8	pesce	fish	pest	dish	shark	heap	mice	ropes
9	regina	queen	regime	spleen	royalty	spaces	polity	sparrow
10	sedia	chair	media	hair	bench	cases	cabs	lakes
11	osso	bone	cross	bean	muscle	speed	cork	passes
12	braccio	arm	breach	army	leg	cheese	rule	arm
13	barca	ship	bars	shape	cruise	gate	beach	summit
14	forbici	scissors	orbit	singers	paper	yacht	comrade	light
15	mosca	fly	mask	flea	insect	deer	cigar	flames
16	neve	snow	novel	snout	blizzard	lunch	laces	mulberry
17	risata	laughter	satire	lighter	joke	clerks	dealers	nest
18	estate	summer	state	supper	heatwave	power	embassy	pumpkins

19	amore	love	moral	glove	affection	doors	otter	illnesses
20	libro	book	library	back	pages	article	life	sound
21	miele	honey	mile	kidney	bee	tips	donors	fork
22	scarpa	shoe	scarf	oboe	feet	highs	whim	trip
23	vento	wind	inventor	wand	breeze	humanist	judo	pearl
24	cibo	food	city	fool	meal	week	salad	grid
25	dito	finger	digit	stinger	knuckle	colon	mailman	jingles
26	cuore	heart	cure	heat	lung	echo	port	oven
27	cena	dinner	scene	digger	snack	sport	heiress	lynch
28	dente	tooth	dent	tool	lips	bully	lane	pier
29	stanza	room	stance	rum	furniture	soccer	hob	infection
30	amico	friend	animal	fiend	acquaintance	houses	vapor	microbiology
31	forno	oven	fort	oxen	stove	toys	typo	swans
32	farina	flour	marina	flower	cake	meters	easter	coat

First Language Attrition in Late Bilingualism

33	cane	dog	cannon	dot	collar	banana	hut	tribes
34	chiave	key	chair	knee	lanyard	birds	mate	cowgate
35	luce	light	luck	knight	bulb	root	romans	moth
36	matita	pencil	mat	penny	eraser	fog	intake	messes
37	ghiaccio	ice	geek	ace	freezer	knob	ion	offender
38	vestito	dress	investor	dream	shirt	attorney	mouth	dairy
39	tazza	cup	taps	cap	saucer	turbo	egg	seaman
40	soldi	money	salt	moon	cash	legs	beer	tool
41	palla	ball	palace	wall	sphere	nurses	hill	organs
42	freddo	cold	fraud	coal	cooler	sorts	sand	fluids
43	sangue	blood	sand	blade	vein	disc	metro	rays
44	testa	head	test	hen	skill	unit	lad	falls
45	letto	bed	lecture	bell	blanket	degrees	nurse	shields
46	vino	wine	vinyl	wife	cocktail	proxy	sale	calories

47	porta	door	porter	doom	entrance	accent	jeans	wildlife
48	cipolla	onion	chip	union	pepper	duke	video	rounds
49	ruota	wheel	route	wheat	rim	album	tyres	cot
50	oro	gold	organ	golf	silver	minds	fruit	threat
51	ponte	bridge	pony	bride	pier	herd	cakes	fare
52	salute	health	salary	hearth	sickness	abbey	strife	civilian
53	carne	meat	carnival	mate	beef	stranger	fame	corn
54	tempo	time	temp	lime	clock	womb	rats	crowd
55	latte	milk	plate	mink	yogurt	mouse	scum	alleys
56	mondo	world	mode	work	planet	ring	year	scenes
57	cavallo	horse	cavalier	hose	cowboy	bracelet	spec	choirs
58	anima	soul	anime	soil	spirit	dunes	roof	memory
59	canzone	song	canvas	son	music	socket	sir	needs
60	mare	sea	margin	tea	boat	tongue	gap	duty

2. Items Used in 'Yes' Trials

	Italian	English
1	motori	engines
2	casa	home
3	modo	way
4	succo	juice
5	campi	fields
6	baci	kisses
7	fuga	escape
8	fiume	river
9	rumore	noise
10	cuori	hearts
11	aste	poles
12	allarme	warning
13	ditta	firm
14	fulmini	thunders
15	firme	signatures
16	marcia	gear
17	favole	fairytale
18	moglie	wife
19	libro	book
20	morte	death

21	ombre	shadows
22	veleno	poison
23	carne	meat
24	arma	weapon
25	petto	chest
26	donna	woman
27	cima	top
28	bivio	crossroads
29	lingue	tongues
30	lotta	fight
31	sfide	challenges
32	scarpe	shoes
33	onde	waves
34	scheda	form
35	mano	hand
36	vicolo	alley
37	genitore	parent
38	preside	principal
39	pugni	fists
40	cielo	sky
41	bosco	forest
42	sogni	dreams

43	festa	party
44	spesa	shopping
45	mostra	exhibition
46	acque	waters
47	leggi	rules
48	carceri	prisons
49	banco	desk
50	giochi	games
51	reato	crime
52	gente	folk
53	esito	outcome
54	anno	year
55	frase	sentence
56	vita	life
57	ascolto	listening
58	fonte	source
59	disegni	drawings
60	sera	evening

Appendix B: Inferential Statistics (Lexical Attrition)

Translation Recognition Task

1. Mixed Effects Binomial Logistic Regression Model for Accuracy

Model Info

Info	Value	Comment
Model Type	Logistic	Model for binary y
Call	glm	accuracy ~ 1 + group + condition + condition:group + (1 itemID) + (1 subjectID)
Link function	Logit	Log of the odd of y=1 over y=0
Direction	$P(y=1)/P(y=0)$	$P(\text{accuracy} = 1) / P(\text{accuracy} = 0)$
Distribution	Binomial	Dichotomous event distribution of y
LogLikel.	-1311.770	Unconditional Log-Likelihood
-2*LogLikel.	2623.540	Unconditional absolute deviance
Deviance	2040.451	Conditional relative deviance
R-squared	0.585	Marginal
R-squared	0.858	Conditional
AIC	2655.540	Less is better
BIC	2763.747	Less is better
Residual DF	6377.000	
Chi-squared/DF	0.644	Overdispersion indicator
Converged	yes	

Model Info

Info	Value	Comment
Optimizer	bobyqa	

Fixed Effect Omnibus tests

	X ²	df	p
group	0.407	1.00	0.523
condition	47.619	6.00	< .001
condition * group	43.850	6.00	< .001

Post Hoc Comparisons - condition * group

Comparison							
condition	group	condition	group	exp(B)	SE	z	p _{bonferroni}
LN-	residents	- S-	residents	0.54988	0.71115	-0.4624	1.000
LN-	residents	- S+	residents	26.90421	25.20989	3.5136	0.040
LN-	residents	- TN-	residents	7.16e-7	2.16e-5	-0.4682	1.000
LN-	residents	- TN+	residents	7.86842	7.55734	2.1478	1.000
LN-	residents	- yes	residents	11.17918	10.24075	2.6353	0.765

Post Hoc Comparisons - condition * group

Comparison				exp(B)	SE	z	P _{bonferroni}
condition	group	condition	group				
LN-	students	- LN-	residents	0.74605	0.71343	-0.3064	1.000
LN-	students	- LN+	residents	3.25233	3.00558	1.2762	1.000
LN-	students	- S-	residents	0.41024	0.51106	-0.7152	1.000
LN-	students	- S-	students	0.72304	0.81040	-0.2893	1.000
LN-	students	- S+	residents	20.07181	17.53155	3.4339	0.054
LN-	students	- S+	students	43.41377	37.03605	4.4201	< .001
LN-	students	- TN-	residents	5.34e-7	1.61e-5	-0.4779	1.000
LN-	students	- TN-	students	2.15243	2.06857	0.7977	1.000
LN-	students	- TN+	residents	5.87021	5.27270	1.9705	1.000
LN-	students	- TN+	students	7.15590	6.29696	2.2364	1.000
LN-	students	- yes	residents	8.34019	7.10797	2.4888	1.000
LN-	students	- yes	students	74.59559	62.34093	5.1597	< .001
LN+	residents	- LN-	residents	0.22939	0.22601	-1.4944	1.000
LN+	residents	- S-	residents	0.12614	0.14188	-1.8406	1.000
LN+	residents	- S+	residents	6.17151	4.25496	2.6397	0.755
LN+	residents	- TN-	residents	1.64e-7	4.96e-6	-0.5170	1.000
LN+	residents	- TN+	residents	1.80492	1.30094	0.8193	1.000
LN+	residents	- yes	residents	2.56437	1.69713	1.4229	1.000
LN+	students	- LN-	residents	0.20861	0.20607	-1.5866	1.000
LN+	students	- LN-	students	0.27962	0.25365	-1.4048	1.000
LN+	students	- LN+	residents	0.90941	0.49287	-0.1752	1.000

Post Hoc Comparisons - condition * group

Comparison					exp(B)	SE	z	P _{bonferroni}
condition	group	condition	group					
LN+	students	- S-	residents	0.11471	0.12933	-1.9206	1.000	
LN+	students	- S-	students	0.20218	0.19941	-1.6208	1.000	
LN+	students	- S+	residents	5.61244	3.89285	2.4870	1.000	
LN+	students	- S+	students	12.13927	8.10409	3.7395	0.017	
LN+	students	- TN-	residents	1.49e-7	4.51e-6	-0.5201	1.000	
LN+	students	- TN-	students	0.60186	0.48101	-0.6353	1.000	
LN+	students	- TN+	residents	1.64142	1.18888	0.6842	1.000	
LN+	students	- TN+	students	2.00092	1.40414	0.9884	1.000	
LN+	students	- yes	residents	2.33207	1.55462	1.2702	1.000	
LN+	students	- yes	students	20.85827	13.45701	4.7085	< .001	
S-	residents	- TN-	residents	1.30e-6	3.93e-5	-0.4483	1.000	
S-	residents	- TN+	residents	14.30921	15.79006	2.4114	1.000	
S-	residents	- yes	residents	20.33003	22.00903	2.7823	0.491	
S-	students	- LN-	residents	1.03182	1.22458	0.0264	1.000	
S-	students	- LN+	residents	4.49813	4.50937	1.4999	1.000	
S-	students	- S-	residents	0.56738	0.62593	-0.5137	1.000	
S-	students	- S+	residents	27.76025	26.52632	3.4782	0.046	
S-	students	- TN-	residents	7.38e-7	2.23e-5	-0.4671	1.000	
S-	students	- TN-	students	2.97691	3.03114	1.0714	1.000	
S-	students	- TN+	residents	8.11878	7.93686	2.1422	1.000	
S-	students	- TN+	students	9.89695	9.51135	2.3852	1.000	

Post Hoc Comparisons - condition * group

Comparison				exp(B)	SE	z	P _{bonferroni}
condition	group	condition	group				
S-	students	- yes	residents	11.53488	10.84828	2.6001	0.848
S-	students	- yes	students	103.16922	95.52696	5.0073	< .001
S+	residents	- S-	residents	0.02044	0.02221	-3.5795	0.031
S+	residents	- TN-	residents	2.66e-8	8.04e-7	-0.5772	1.000
S+	residents	- TN+	residents	0.29246	0.19129	-1.8796	1.000
S+	residents	- yes	residents	0.41552	0.23969	-1.5225	1.000
S+	students	- LN-	residents	0.01718	0.01612	-4.3313	0.001
S+	students	- LN+	residents	0.07491	0.05177	-3.7501	0.016
S+	students	- S-	residents	0.00945	0.01029	-4.2802	0.002
S+	students	- S-	students	0.01665	0.01561	-4.3696	0.001
S+	students	- S+	residents	0.46234	0.15965	-2.2342	1.000
S+	students	- TN-	residents	1.23e-8	3.72e-7	-0.6028	1.000
S+	students	- TN-	students	0.04958	0.03664	-4.0647	0.004
S+	students	- TN+	residents	0.13522	0.08868	-3.0508	0.208
S+	students	- TN+	students	0.16483	0.10379	-2.8631	0.382
S+	students	- yes	residents	0.19211	0.11028	-2.8737	0.369
S+	students	- yes	students	1.71825	0.93958	0.9899	1.000
TN-	residents	- yes	residents	1.56e+7	4.72e+8	0.5482	1.000
TN-	students	- LN-	residents	0.34661	0.35949	-1.0216	1.000
TN-	students	- LN+	residents	1.51101	1.23701	0.5042	1.000
TN-	students	- S-	residents	0.19059	0.22058	-1.4323	1.000

Post Hoc Comparisons - condition * group

Comparison				exp(B)	SE	z	p _{bonferroni}
condition	group	condition	group				
TN-	students	- S+	residents	9.32520	7.11086	2.9280	0.310
TN-	students	- TN-	residents	2.48e-7	7.50e-6	-0.5033	1.000
TN-	students	- TN+	residents	2.72725	2.15199	1.2715	1.000
TN-	students	- yes	residents	3.87479	2.86353	1.8328	1.000
TN-	students	- yes	students	34.65652	24.94985	4.9248	< .001
TN+	residents	- TN-	residents	9.10e-8	2.75e-6	-0.5365	1.000
TN+	residents	- yes	residents	1.42076	0.88724	0.5624	1.000
TN+	students	- LN-	residents	0.10426	0.10042	-2.3472	1.000
TN+	students	- LN+	residents	0.45450	0.32902	-1.0893	1.000
TN+	students	- S-	residents	0.05733	0.06338	-2.5860	0.884
TN+	students	- S+	residents	2.80493	1.84511	1.5679	1.000
TN+	students	- TN-	residents	7.46e-8	2.25e-6	-0.5431	1.000
TN+	students	- TN-	students	0.30079	0.23118	-1.5631	1.000
TN+	students	- TN+	residents	0.82033	0.36358	-0.4468	1.000
TN+	students	- yes	residents	1.16550	0.73120	0.2441	1.000
TN+	students	- yes	students	10.42434	6.29812	3.8799	0.010
yes	students	- LN-	residents	0.01000	0.00921	-4.9987	< .001
yes	students	- LN+	residents	0.04360	0.02916	-4.6840	< .001
yes	students	- S-	residents	0.00550	0.00598	-4.7821	< .001
yes	students	- S+	residents	0.26907	0.15697	-2.2504	1.000
yes	students	- TN-	residents	7.16e-9	2.16e-7	-0.6207	1.000

Post Hoc Comparisons - condition * group

Comparison				exp(B)	SE	z	p _{bonferroni}
condition	group	condition	group				
yes	students	- TN+	residents	0.07869	0.04971	-4.0245	0.005
yes	students	- yes	residents	0.11181	0.02310	-10.6023	< .001

2. Linear Mixed Effects Model for RT

Model Info

Info	
Estimate	Linear mixed model fit by REML
Call	RT ~ 1 + group + condition + age + rspan_a + condition:group+(1 itemID)+(1 subjectID)
AIC	83703.9238
BIC	83724.4096
LogLikel.	-41779.8979
R-squared Marginal	0.0353
R-squared Conditional	0.2655
Converged	yes
Optimizer	bobyqa

Fixed Effect Omnibus tests

	F	Num df	Den df	p
group	0.0259	1	50.7	0.873
condition	13.0237	6	507.8	< .001
age	1.7577	1	49.8	0.191
rspan_a	0.9036	1	50.0	0.346
group * condition	3.7906	6	5578.1	< .001

Note. Satterthwaite method for degrees of freedom

Post Hoc Comparisons - condition * group

Comparison				Difference	SE	t	df	p_{bonferroni}
condition	group	condition	group					
LN-	residents	- S-	residents	-13.69	32.4	-0.4221	1379.4	1.000
LN-	residents	- S+	residents	-235.97	33.6	-7.0334	1433.5	< .001
LN-	residents	- TN-	residents	-49.19	32.3	-1.5224	1457.9	1.000
LN-	residents	- TN+	residents	-64.46	32.7	-1.9725	1452.9	1.000
LN-	residents	- yes	residents	4.31	26.9	0.1600	729.6	1.000
LN-	students	- LN-	residents	21.67	71.4	0.3035	67.4	1.000
LN-	students	- LN+	residents	-61.11	73.4	-0.8331	74.9	1.000
LN-	students	- S-	residents	7.98	73.3	0.1090	74.5	1.000
LN-	students	- S-	students	45.19	32.4	1.3952	1403.1	1.000

Post Hoc Comparisons - condition * group

Comparison					Difference	SE	t	df	p _{bonferroni}
condition	group	condition	group						
LN-	students	-	S+	residents	-214.30	73.7	-2.9059	76.5	0.436
LN-	students	-	S+	students	-130.02	34.2	-3.7993	1540.0	0.014
LN-	students	-	TN-	residents	-27.52	73.2	-0.3759	74.3	1.000
LN-	students	-	TN-	students	-3.21	32.5	-0.0990	1482.9	1.000
LN-	students	-	TN+	residents	-42.79	73.4	-0.5831	75.1	1.000
LN-	students	-	TN+	students	-46.82	32.8	-1.4295	1466.4	1.000
LN-	students	-	yes	residents	25.98	71.0	0.3660	65.7	1.000
LN-	students	-	yes	students	-21.13	27.3	-0.7740	770.8	1.000
LN+	residents	-	LN-	residents	82.78	32.6	2.5363	1374.7	1.000
LN+	residents	-	S-	residents	69.09	32.6	2.1164	1419.8	1.000
LN+	residents	-	S+	residents	-153.19	33.8	-4.5377	1471.9	< .001
LN+	residents	-	TN-	residents	33.59	32.5	1.0350	1547.6	1.000
LN+	residents	-	TN+	residents	18.32	32.9	0.5568	1494.7	1.000
LN+	residents	-	yes	residents	87.09	27.2	3.2016	763.1	0.130
LN+	students	-	LN-	residents	80.91	73.4	1.1030	74.9	1.000
LN+	students	-	LN-	students	59.24	32.7	1.8143	1415.5	1.000
LN+	students	-	LN+	residents	-1.87	71.6	-0.0261	68.2	1.000
LN+	students	-	S-	residents	67.22	73.4	0.9163	75.0	1.000
LN+	students	-	S-	students	104.43	32.6	3.2011	1452.7	0.127
LN+	students	-	S+	residents	-155.06	73.9	-2.0996	77.0	1.000
LN+	students	-	S+	students	-70.78	34.4	-2.0551	1587.2	1.000

Post Hoc Comparisons - condition * group

Comparison				Difference	SE	t	df	p _{bonferroni}	
condition	group	condition	group						
LN+	students	-	TN-	residents	31.73	73.3	0.4330	74.6	1.000
LN+	students	-	TN-	students	56.03	32.6	1.7190	1593.5	1.000
LN+	students	-	TN+	residents	16.45	73.5	0.2238	75.5	1.000
LN+	students	-	TN+	students	12.42	33.0	0.3764	1517.2	1.000
LN+	students	-	yes	residents	85.22	71.1	1.1987	66.1	1.000
LN+	students	-	yes	students	38.11	27.6	1.3820	810.4	1.000
S-	residents	-	TN-	residents	-35.50	32.2	-1.1008	1554.3	1.000
S-	residents	-	TN+	residents	-50.77	32.6	-1.5581	1562.0	1.000
S-	residents	-	yes	residents	18.00	27.0	0.6679	758.8	1.000
S-	students	-	LN-	residents	-23.52	73.2	-0.3212	74.4	1.000
S-	students	-	LN+	residents	-106.30	73.3	-1.4495	74.9	1.000
S-	students	-	S-	residents	-37.21	71.4	-0.5211	67.5	1.000
S-	students	-	S+	residents	-259.50	73.7	-3.5209	76.4	0.066
S-	students	-	TN-	residents	-72.71	73.1	-0.9941	74.1	1.000
S-	students	-	TN-	students	-48.41	32.4	-1.4963	1575.0	1.000
S-	students	-	TN+	residents	-87.99	73.3	-1.2000	74.8	1.000
S-	students	-	TN+	students	-92.02	32.6	-2.8200	1566.9	0.443
S-	students	-	yes	residents	-19.21	71.0	-0.2707	65.7	1.000
S-	students	-	yes	students	-66.32	27.3	-2.4325	794.9	1.000
S+	residents	-	S-	residents	222.29	33.5	6.6383	1524.4	< .001
S+	residents	-	TN-	residents	186.79	33.4	5.5852	1560.2	< .001

Post Hoc Comparisons - condition * group

Comparison				Difference	SE	t	df	p _{bonferroni}
condition	group	condition	group					
S+	residents	- TN+	residents	171.51	33.8	5.0738	1552.8	< .001
S+	residents	- yes	residents	240.29	28.3	8.4926	832.0	< .001
S+	students	- LN-	residents	151.69	74.1	2.0481	77.9	1.000
S+	students	- LN+	residents	68.91	74.2	0.9291	78.3	1.000
S+	students	- S-	residents	138.00	74.0	1.8641	77.7	1.000
S+	students	- S-	students	175.22	34.1	5.1351	1630.3	< .001
S+	students	- S+	residents	-84.28	72.6	-1.1604	72.2	1.000
S+	students	- TN-	residents	102.51	74.0	1.3849	77.7	1.000
S+	students	- TN-	students	126.81	34.3	3.7009	1661.9	0.020
S+	students	- TN+	residents	87.23	74.2	1.1756	78.4	1.000
S+	students	- TN+	students	83.20	34.5	2.4085	1640.3	1.000
S+	students	- yes	residents	156.00	71.8	2.1719	68.9	1.000
S+	students	- yes	students	108.89	29.4	3.7006	947.4	0.021
TN-	residents	- yes	residents	53.50	26.5	2.0173	899.3	1.000
TN-	students	- LN-	residents	24.88	73.3	0.3396	74.6	1.000
TN-	students	- LN+	residents	-57.90	73.3	-0.7896	74.8	1.000
TN-	students	- S-	residents	11.20	73.2	0.1528	74.5	1.000
TN-	students	- S+	residents	-211.09	73.8	-2.8616	76.6	0.494
TN-	students	- TN-	residents	-24.30	71.5	-0.3399	67.7	1.000
TN-	students	- TN+	residents	-39.58	73.4	-0.5395	75.0	1.000
TN-	students	- yes	residents	29.19	70.9	0.4117	65.5	1.000

Post Hoc Comparisons - condition * group

Comparison				Difference	SE	t	df	p _{bonferroni}	
condition	group	condition	group						
TN-	students	-	yes	students	-17.92	27.1	-0.6610	936.6	1.000
TN+	residents	-	TN-	residents	15.28	32.5	0.4706	1657.0	1.000
TN+	residents	-	yes	residents	68.77	27.1	2.5380	862.9	1.000
TN+	students	-	LN-	residents	68.49	73.4	0.9332	75.1	1.000
TN+	students	-	LN+	residents	-14.29	73.5	-0.1944	75.5	1.000
TN+	students	-	S-	residents	54.81	73.4	0.7471	75.0	1.000
TN+	students	-	S+	residents	-167.48	73.9	-2.2665	77.2	1.000
TN+	students	-	TN-	residents	19.31	73.3	0.2634	74.8	1.000
TN+	students	-	TN-	students	43.61	32.7	1.3328	1647.1	1.000
TN+	students	-	TN+	residents	4.03	71.7	0.0562	68.7	1.000
TN+	students	-	yes	residents	72.81	71.1	1.0240	66.2	1.000
TN+	students	-	yes	students	25.69	27.6	0.9310	886.3	1.000
yes	students	-	LN-	residents	42.80	71.1	0.6017	66.3	1.000
yes	students	-	LN+	residents	-39.98	71.2	-0.5612	66.7	1.000
yes	students	-	S-	residents	29.11	71.1	0.4093	66.3	1.000
yes	students	-	S+	residents	-193.17	71.6	-2.6963	68.2	0.803
yes	students	-	TN-	residents	-6.38	71.0	-0.0900	65.7	1.000
yes	students	-	TN+	residents	-21.66	71.2	-0.3042	66.6	1.000
yes	students	-	yes	residents	47.11	66.8	0.7048	51.8	1.000

Appendix C: Materials (Syntactic Attrition)

Materials Used in the Self-Paced Reading Task

1. Anaphora Resolution (English): Target (a) and Baseline (b) Items

1a. The little girl / calls / the young lady / on the phone. / She / is / very polite.

1b. The little girl / calls / the young man / on the phone. / She / is / very polite.

Who is polite?

a. The little girl

b. The young lady / the young man

2a. Martha / helps / Amelia / at the conference. / She / is / rather nice.

2b. Martin / helps / Amelia / at the conference. / She / is / rather nice.

Who is nice?

a. Martha / Martin

b. Amelia

3a. The granddaughter / greets / the grandmother / on the bus. / She / is / really anxious.

3b. The granddaughter / greets / the grandfather / on the bus. / She / is / really anxious.

Who is anxious?

a. The granddaughter

b. The grandmother / the grandfather

4a. Mary / praises / Lucy / for her work. / She / is / very kind.

4b. Mark / praises / Lucy / for her work. / She / is / very kind.

Who is kind?

a. Mary/ Mark

b. Lucy

5a. The actress / hugs / the queen / during the celebration. / She / is / rather happy.

5b. The actress / hugs / the king / during the celebration. / She / is / rather happy.

Who is happy?

- a. The actress
- b. The queen/ the king

6a. The waitress / notices / the old lady / at the restaurant. / She / is / really well-mannered.

6b. The waiter / notices / the old lady / at the restaurant. / She / is / really well-mannered.

Who is well-mannered?

- a. The waitress/ the waiter
- b. The old lady

7a. The little boy / recognises / the young man / at school. / He / is / very well-behaved.

7b. The little boy / recognises / the young girl / at school. / He / is / very well-behaved.

Who is well-behaved?

- a. The little boy
- b. The young man/ the young girl

8a. Peter / sees / George / in the afternoon. / He / is / rather tall.

8b. Penelope / sees / George / in the afternoon. / He / is / rather tall.

Who is tall?

- 8a. Peter/ Penelope
- 8b. George

9a. The priest / welcomes / the man / at church. / He / is / really pleased.

9b. The priest / welcomes / the woman / at church. / He / is / really pleased.

Who is pleased?

- a. The priest
- b. The man/ the woman

10a. The uncle / assists / the groom / at the wedding. / He / is / very calm.

10b. The auntie / assists / the groom / at the wedding. / He / is / very calm.

Who is calm?

- a. The uncle/ the auntie
- b. The groom

11a. Philip / visits / John / during the holidays. / He / is / rather cheerful.

11b. Philip / visits / Joanne / during the holidays. / He / is / rather cheerful.

Who is cheerful?

- a. Philip
- b. John/ Joanne

12a. The actor / touches / the old man / during the show. / He / is / really angry.

12b. The actress / touches / the old man / during the show. / He / is / really angry.

Who is angry?

- a. The actor/ the actress
- b. The old man

2. Anaphora Resolution (English): Filler Items

1. Martha / annoys / George / every time. / Martha / is / rather silly.

Who is annoyed every time?

- a. Martha
- b. George

2. George / annoys / Martha / every time. / Martha / is / rather silly.

Who is annoyed every time?

- a. George
- b. Martha

3. The wife / scolds / the old man / frequently. / The wife / is / very sorry.

Who is scolded frequently?

- a. The wife
- b. The old man

4. The old man / scolds / the wife / frequently. / The wife / is / very sorry.

Who is scolded frequently?

- a. The old man
- b. The wife

5. The actress / questions / the actor / about his past. / The actress / is / really curious.

Who is questioned about his past?

- a. The actress
- b. The actor

6. The actor / questions / the actress / about her past. / The actress / is / really curious.

Who is questioned about her past?

- a. The actor
- b. The actress

7. The little girl / entertains / Amelia / every day. / The little girl / is / rather sick.

Who is entertained every day?

- a. The little girl
- b. Amelia

8. Amelia / entertains / the little girl / every day. / The little girl / is / rather sick.

Who is entertained every day?

- a. Amelia
- b. The little girl

9. The nurse / congratulates / Mary / for her work. / The nurse / is / very funny.

Who is congratulated for her work?

- a. The nurse
- b. Mary

10. Mary/ congratulates / the nurse / for her work. / The nurse / is / very funny.

Who is congratulated for her work?

- a. Mary
- b. The nurse

11. The priest / admires / John / for his courage. / The priest / is / really pleased.

Who is admired for his courage?

- a. The priest
- b. John

12. John / admires / the priest / for his courage. / The priest / is / really pleased.

Who is admired for his courage?

- a. John
- b. The priest

13. The young man / runs / every morning. / Instead / the wife / swims / every evening.

Who runs every morning?

- a. The young man
- b. The wife

14. The wife / runs / every morning. / Instead / the young man / swims / every evening.

Who runs every morning?

- a. The wife
- b. The young man

15. The man / sleeps / frequently. / Instead / the woman / works out / all day.

Who sleeps frequently?

- a. The man
- b. The woman

16. The woman / sleeps / frequently. / Instead / the man / works out / all day.

Who sleeps frequently?

- a. The woman
- b. The man

17. The father / works / in the office. / Instead / the mother / stays / at home.

Who works in the office?

- a. The father
- b. The mother

18. The mother / works / in the office. / Instead / the father / stays / at home.

Who works in the office?

- a. The mother
- b. The father

19. Lucy / eats / home-cooked food. / Instead / Mark / hates / cooking.

Who eats home-cooked food?

- a. Lucy
- b. Mark

20. Mark / eats / home-cooked food. / Instead / Lucy / hates / cooking.

Who eats home-cooked food?

- a. Mark
- b. Lucy

21. John / speaks / four languages. / Instead / Stephen / knows / only English.

Who speaks four languages?

- a. John
- b. Stephen

22. Stephen / speaks / four languages. / Instead / John / knows / only English.

Who speaks four languages?

- a. Stephen
- b. John

23. The little girl / cries / about everything. / Instead / the little boy / screams / all the time.

Who cries about everything?

- a. The little girl
- b. The little boy

24. The little boy / cries / about everything. / Instead / the little girl / screams / all the time.

Who cries about everything?

- a. The little boy
- b. The little girl

3. *Anaphora Resolution (Italian): Target (a,b) and Baseline (c) Items*

(NB: Null pronoun items (a) were not analysed due to the potential bias induced by the imbalance in the number of baseline items.)

1a. La bambina / chiama / la ragazza / al telefono. / _ / È / molto educata.

1b. La bambina / chiama / la ragazza / al telefono. / Lei / è / molto educata.

1c. La bambina / chiama / il ragazzo / al telefono. / Lei / è / molto educata.

Chi è educato/a?

- a. La bambina
- b. La ragazza/ il ragazzo

2a. Marta / aiuta / Amelia / alla conferenza. / _ / È / piuttosto simpatica.

2b. Marta / aiuta / Amelia / alla conferenza. / Lei / è / piuttosto simpatica.

2c. Martino / aiuta / Amelia / alla conferenza. / Lei / è / piuttosto simpatica.

Chi è simpatico/a?

- a. Marta/ Martino
- b. Amelia

3a. La nipote / saluta / la nonna / sull'autobus. / _ / È / davvero ansiosa.

3b. La nipote / saluta / la nonna / sull'autobus. / Lei / è / davvero ansiosa.

3c. La nipote / saluta / il nonno / sull'autobus. / Lei / è / davvero ansiosa.

Chi è ansioso/a?

a. La nipote

b. La nonna/ il nonno

4a. Maria / loda / Lucia / per il lavoro svolto. / _ / È / molto gentile.

4b. Maria / loda / Lucia / per il lavoro svolto. / Lei / è / molto gentile.

4c. Marco / loda / Lucia / per il lavoro svolto. / Lei / è / molto gentile.

Chi è gentile?

a. Maria/ Marco

b. Lucia

5a. L'attrice / abbraccia / la regina / durante I festeggiamenti. / _ / È / piuttosto felice.

5b. L'attrice / abbraccia / la regina / durante I festeggiamenti. / Lei / è / piuttosto felice.

5c. L'attrice / abbraccia / il re/ durante I festeggiamenti. / Lei / è / piuttosto felice.

Chi è felice?

a. L'attrice

b. La regina/ il re

6a. La cameriera / nota / l'anziana / al ristorante. / _ / È / davvero garbata.

6b. La cameriera / nota / l'anziana / al ristorante. / Lei / è / davvero garbata.

6c. Il cameriere / nota / l'anziana / al ristorante. / Lei / è / davvero garbata.

Chi è garbato/a?

a. La cameriera/ il cameriere

b. L'anziana

7a. Il bambino / riconosce / il ragazzo / a scuola. / _ / È / molto beneducato.

7b. Il bambino / riconosce / il ragazzo / a scuola. / Lui / è / molto beneducato.

7c. Il bambino / riconosce / la ragazza / a scuola. / Lui / è / molto beneducato.

Chi è beneducato/a?

a. Il bambino

b. Il ragazzo/ la ragazza

8a. Pietro / vede / Giorgio / nel pomeriggio. / _ / È / piuttosto alto.

8b. Pietro / vede / Giorgio / nel pomeriggio. / Lui / è / piuttosto alto.

8c. Penelope / vede / Giorgio / nel pomeriggio. / Lui / è / piuttosto alto.

Chi è alto/a?

a. Pietro/ Penelope

b. Giorgio

9a. Il prete / accoglie / l'uomo / in chiesa. / _ / È / davvero soddisfatto.

9b. Il prete / accoglie / l'uomo / in chiesa. / Lui / è / davvero soddisfatto.

9c. Il prete / accoglie / la donna / in chiesa. / Lui / è / davvero soddisfatto.

Chi è soddisfatto/a?

a. Il prete

b. L'uomo/ la donna

10a. Lo zio / assiste / lo sposo / al matrimonio. / _ / È / molto calmo.

10b. Lo zio / assiste / lo sposo / al matrimonio. / Lui / è / molto calmo.

10c. La zia / assiste / lo sposo / al matrimonio. / Lui / è / molto calmo.

Chi è calmo/a?

a. Lo zio/ la zia

b. Lo sposo

11a. Filippo / visita / Giovanni / durante le vacanze. / _ / È / piuttosto contento.

11b. Filippo / visita / Giovanni / durante le vacanze. / Lui / è / piuttosto contento.

11c. Filippo / visita / Giovanna / durante le vacanze. / Lui / è / piuttosto contento.

Chi è contento/a?

a. Filippo

b. Giovanni/ Giovanna

12a. L'attore / tocca / l'anziano / durante lo spettacolo. / _ / È / davvero arrabbiato.

12b. L'attore / tocca / l'anziano / durante lo spettacolo. / Lui / è / davvero arrabbiato.

12c. L'attrice/ tocca / l'anziano / durante lo spettacolo. / Lui / è / davvero arrabbiato.

Chi è arrabbiato/a?

- a. L'attore/ l'attrice
- b. L'anziano

4. Anaphora Resolution (Italian): Filler Items

1. Marta / infastidisce / Giorgio / ogni volta. / Marta / è / piuttosto sciocca.

Chi viene infastidito/a?

- a. Marta
- b. Giorgio

2. Giorgio / infastidisce / Marta / ogni volta. / Marta / è / piuttosto sciocca.

Chi viene infastidito/a?

- a. Marta
- b. Giorgio

3. Giorgio / infastidisce / Marta / ogni volta. / Giorgio / è / piuttosto sciocco.

Chi viene infastidito/a?

- a. Marta
- b. Giorgio

4. La moglie / rimprovera / l'anziano / frequentemente. / La moglie / è / molto dispiaciuta.

Chi viene rimproverato/a?

- a. La moglie
- b. L'anziano

5. L'anziano / rimprovera / la moglie / frequentemente. / La moglie / è / molto dispiaciuta.

Chi viene rimproverato/a?

- a. La moglie
- b. L'anziano

6. La moglie / rimprovera / l'anziano / frequentemente. / L'anziano / è / molto dispiaciuto.

Chi viene rimproverato/a?

- a. La moglie
- b. L'anziano

7. L'attrice / interroga / l'attore / sul suo passato. / L'attrice / è / davvero curiosa.

Chi viene interrogato/a?

- a. L'attrice
- b. L'attore

8. L'attore / interroga / l'attrice / sul suo passato. / L'attrice / è / davvero curiosa.

Chi viene interrogato/a?

- a. L'attrice
- b. L'attore

9. L'attore / interroga / l'attrice / sul suo passato. / L'attore / è / davvero curioso.

Chi viene interrogato/a?

- a. L'attore
- b. L'attrice

10. La bambina / intrattiene / Amelia / ogni giorno. / La bambina / è / piuttosto malata.

Chi viene intrattenuto/a?

- a. La bambina
- b. Amelia

11. Amelia / intrattiene / la bambina / ogni giorno. / La bambina / è / piuttosto malata.

Chi viene intrattenuto/a?

- a. La bambina
- b. Amelia

12. La bambina / intrattiene / Amelia / ogni giorno. / Amelia / è / piuttosto malata.

Chi viene intrattenuto/a?

- a. La bambina
- b. Amelia

13. L'infermiere / congratula / Maria / per il lavoro svolto. / L'infermiere / è / molto simpatico.

Chi viene congratulato/a?

- a. L'infermiere
- b. Maria

14. Maria / congratula / l'infermiere / per il lavoro svolto. / L'infermiere / è / molto simpatico.

Chi viene congratulato/a?

- a. L'infermiere
- b. Maria

15. Maria / congratula / l'infermiere / per il lavoro svolto. / Maria / è / molto simpatica.

Chi viene congratulato/a?

- a. L'infermiere
- b. Maria

16. Il prete / ammira / Gianni / per il suo coraggio. / Il prete / è / davvero soddisfatto.

Chi viene ammirato/a?

- a. Il prete
- b. Gianni

17. Gianni / ammira / il prete / per il suo coraggio. / Il prete / è / davvero soddisfatto.

Chi viene ammirato/a?

- a. Il prete
- b. Gianni

18. Il prete / ammira / Gianni / per il suo coraggio. / Gianni / è / davvero soddisfatto.

Chi viene ammirato/a?

- a. Il prete
- b. Gianni

19. Il ragazzo / corre / ogni mattina. / Invece / la moglie / nuota / ogni sera.

Chi corre ogni mattina?

- a. Il ragazzo
- b. La moglie

20. La moglie / corre / ogni mattina. / Invece / il ragazzo / nuota / ogni sera.

Chi corre ogni mattina?

- a. Il ragazzo
- b. La moglie

21. Il ragazzo / corre / ogni mattina. / Invece / la moglie / nuota / ogni sera.

Chi nuota ogni sera?

- a. Il ragazzo
- b. La moglie

22. L'uomo / dorme / di frequente. / Invece / la donna / si allena / tutto il giorno.

Chi dorme di frequente?

- a. L'uomo
- b. La donna

23. La donna / dorme / di frequente. / Invece / l'uomo / si allena / tutto il giorno.

Chi dorme di frequente?

- a. L'uomo
- b. La donna

24. La donna / dorme / di frequente. / Invece / l'uomo / si allena / tutto il giorno.

Chi si allena tutto il giorno?

- a. L'uomo
- b. La donna

25. Il padre / lavora / in ufficio. / Invece / la madre / rimane / a casa.

Chi lavora in ufficio?

- a. Il padre
- b. La madre

26. La madre / lavora / in ufficio. / Invece / il padre / rimane / a casa.

Chi lavora in ufficio?

- a. Il padre
- b. La madre

27. Il padre / lavora / in ufficio. / Invece / la madre / rimane / a casa.

Chi rimane a casa?

- a. Il padre
- b. La madre

28. Lucia / mangia / cibo fatto in casa. / Invece / Marco / odia / cucinare.

Chi mangia cibo fatto in casa?

- a. Lucia
- b. Marco

29. Marco / mangia / cibo fatto in casa. / Invece / Lucia / odia / cucinare.

Chi mangia cibo fatto in casa?

- a. Lucia
- b. Marco

30. Marco / mangia / cibo fatto in casa. / Invece / Lucia / odia / cucinare.

Chi odia cucinare?

- a. Lucia
- b. Marco

31. Gianni / parla / quattro lingue. / Invece / Stefano / conosce / solo l'inglese.

Chi parla quattro lingue?

- a. Gianni
- b. Stefano

32. Stefano / parla / quattro lingue. / Invece / Gianni / conosce / solo l'inglese.

Chi parla quattro lingue?

- a. Gianni
- b. Stefano

33. Gianni / parla / quattro lingue. / Invece / Stefano / conosce / solo l'inglese.

Chi conosce solo l'inglese?

- a. Gianni
- b. Stefano

34. La bimba / piange / per tutto. / Invece / il bimbo / strilla / di continuo.

Chi piange per tutto?

- a. La bimba
- b. Il bimbo

35. Il bimbo / piange / per tutto. / Invece / la bimba / strilla / di continuo.

Chi piange per tutto?

- a. La bimba
- b. Il bimbo

36. Il bimbo / piange / per tutto. / Invece / la bimba / strilla / di continuo.

Chi strilla di continuo?

- a. La bimba
- b. Il bimbo

5. RC Attachment Ambiguity Resolution (English): Target (a) and Baseline (b) Items

1a. Peter / saw / the pet / of the little girl / that / was running / around the room.

1b. Peter / saw / the pet / of the little girl / that / was singing / around the room.

Who or what was running/ singing around the room?

- a. The pet
- b. The little girl

2a. John / met / the professor / of his friend / that / was living / in Germany.

2b. John / met / the professor / of his friend / who / was teaching / in Germany.

Who was living/ teaching in Germany?

- a. The professor
- b. The friend

3a. Amelia / wrote / to the cousin / of the singer / that / was running / around town.

3b. Amelia / wrote / to the cousin / of the singer / who / was performing / around town.

Who was running/ performing around town?

- a. The cousin
- b. The singer

4a. The maid / observed / the toy / of the little boy / that / was lying / on the bed.

4b. The maid / observed / the toy / of the little boy / that / was broken / on the bed.

Who or what was lying/ broken on the bed?

- a. The toy
- b. The little boy

5a. The journalist / interviewed / the father / of the little boy / that / was walking / in the park.

5b. The journalist / interviewed / the father / of the little boy / who / was playing / in the park.

Who was walking/ playing in the park?

- a. The father
- b. The little boy

6a. George / stroked / the cat / of the young lady / that / was drinking / at the fountain.

6b. George / stroked / the cat / of the young lady / that / was meowing / at the fountain.

Who or what was drinking/ meowing at the fountain?

- a. The cat
- b. The young lady

7a. Martha / greeted / the brother / of the priest / that / was reading / in the church.

7b. Martha / greeted / the brother / of the priest / who / was preaching / in the church.

Who was reading/ preaching in the church?

- a. The brother
- b. The priest

8a. The crazy man / hit / the dog / of the neighbour / that / was resting / in the garden.

8b. The crazy man / hit / the dog / of the neighbour / that / was barking / in the garden.

Who or what was resting/ barking in the garden?

- a. The dog
- b. The neighbour

9a. Mary / said hi / to the friend / of the teacher / that / was giving a hand / to Mark.

9b. Mary / said hi / to the friend / of the teacher / who / was giving a lesson / to Mark.

Who was giving a hand/ a lesson to Mark?

- a. The friend
- b. The teacher

10a. Andrea / noticed / the necklace / of the actress / that / was adored / by the Queen.

10b. Andrea / noticed / the necklace / of the actress / that / was worn / by the Queen.

Who or what was adored/ worn by the Queen?

- a. The necklace
- b. The actress

11a. Lewis / ran over / the puppy / of the greengrocer / that / was making noise / in the neighbourhood.

11b. Lewis / ran over / the puppy / of the greengrocer / that / was making deliveries / in the neighbourhood.

Who or what was making noise/ deliveries in the neighbourhood?

- a. The puppy
- b. The greengrocer

12a. The policeman / arrested / the son / of the dead victim / that / was leaning / on the sofa.

12b. The policeman / arrested / the son / of the dead victim / who / was crying / on the sofa.

Who was leaning/ crying on the sofa?

- a. The son
- b. The dead victim

6. RC Attachment Ambiguity Resolution (English): Filler Items

1. Peter / told me / that / the sister / of your friend / went / to Paris.

Who went to Paris?

- a. The sister
- b. The friend

2. John / said / that / the boyfriend / of his neighbour / was / his doctor.

Who was his doctor?

- a. The boyfriend
- b. The neighbour

3. Amelia / told us / that / the daughter / of her professor / studied / in Chicago.

Who studied in Chicago?

- a. The daughter
- b. The professor

4. The old lady / said / that / the niece / of your friend / broke / the window.

Who broke the window?

- a. The niece
- b. The friend

5. The journalist / argued / that / the son / of the minister / never graduated / from university.

Who never graduated from university?

- a. The son
- b. The minister

6. George / affirmed / that / the son / of your friend / fed / his cat.

Who fed his cat?

- a. The son
- b. The friend

7. Martha / said / that / the mother / of her friend / bought / the restaurant.

Who bought the restaurant?

- a. The mother
- b. The friend

8. The crazy man / said / that / the friend / of his girlfriend / killed / Billie.

Who killed Billie?

- a. The friend
- b. The girlfriend

9. Mary / told me / that / the son / of her neighbour / is / sick.

Who is sick?

- a. The son
- b. The neighbour

10. The policeman / said / that / the friend / of the suspect / had been / helpful.

Who had been helpful?

- a. The friend
- b. The suspect

11. Andrea / stated / that / the uncle / of her friend / was / unhappy.

Who was unhappy?

- a. The uncle
- b. The friend

12. Lewis / told you / that / the auntie / of his friend / was / mad.

Who was mad?

- a. The auntie
- b. The friend

13. Peter / said / that / the daughter / of your friend / came back / from Rome.

Who came back from Rome?

- a. Peter
- b. The daughter

14. John / told me / that / the partner / of his mother / was / his friend.

Who was his friend?

- a. John

b. The partner

15. Amelia / said / that / the sister / of her teacher / lived / in Florence.

Who lived in Florence?

- a. Amelia
- b. The sister

16. The old lady / told me / that / the kid / of her neighbour / was / always hungry.

Who was always hungry?

- a. The old lady
- b. The kid

17. The journalist / said / that / the son / of the artist / was / very rude.

Who was very rude?

- a. The journalist
- b. The son

18. George / argued / that / the mother / of his friend / was / extremely nice.

Who was extremely nice?

- a. George
- b. The mother

19. Martha / affirmed / that / the girlfriend / of her neighbour / broke into / the house.

Who broke into the house?

- a. Martha
- b. The girlfriend

20. The crazy man / told me / that / the uncle / of the man / set fire / to the house.

Who set fire to the house?

- a. The crazy man
- b. The uncle

21. Mary / said / that / the auntie / of his friend / was / crying.

Who was crying?

- a. Mary
- b. The auntie

22. The policeman / stated / that / the friend / of the victim / had / escaped.

Who had escaped?

- a. The policeman
- b. The friend

23. Andrea / said / that / the partner / of her mother / was / old.

Who was old?

- a. Andrea
- b. The partner

24. Lewis / told us / that / the son / of his neighbour / had / disappeared.

Who had disappeared?

- a. Lewis
- b. The son

7. RC Attachment Ambiguity Resolution (Italian): Target (a) and Baseline (b) Items

1a. Pietro / ha visto / il coniglio / della bambina / che / correva / in sala.

1b. Pietro / ha visto / il coniglio / della bambina / che / cantava / in sala.

Chi o cosa correva/ cantava in salone?

- a. Il coniglio
- b. La bambina

2a. Giovanni / ha incontrato / il professore / del suo amico / che / viveva / in Germania.

2b. Giovanni / ha incontrato / il professore / del suo amico / che / insegnava / in Germania.

Chi viveva/ insegnava in Germania?

- a. Il professore
- b. L'amico

3a. Amelia / ha scritto / al cugino / del cantante / che / camminava / per la città.

3b. Amelia / ha scritto / al cugino / del cantante / che / si esibiva / per la città.

Chi camminava/ si esibiva per la città?

- a. Il cugino
- b. Il cantante

4a. La domestica / ha osservato / il giocattolo / del ragazzino / che / era appoggiato / sul letto.

4b. La domestica / ha osservato / il giocattolo / del ragazzino / che / era rotto / sul letto.

Chi o cosa era appoggiato/ rotto sul letto?

- a. Il giocattolo
- b. Il ragazzino

5a. Il giornalista / ha intervistato / il padre / del bambino / che / camminava / al parco.

5b. Il giornalista / ha intervistato / il padre / del bambino / che / giocava / al parco.

Chi camminava/ giocava al parco?

- a. Il padre
- b. Il bambino

6a. Giorgio / ha accarezzato / il gatto / della giovane / che / beveva / alla fontana.

6b. Giorgio / ha accarezzato / il gatto / della giovane / che / miagolava / alla fontana.

Chi o cosa beveva/miagolava alla fontana?

- a. Il gatto
- b. La giovane

7a. Marta / ha accolto / il fratello / del prete / che / leggeva / in chiesa.

7b. Marta / ha accolto / il fratello / del prete / che / predicava / in chiesa.

Chi leggeva/ predicava in chiesa?

- a. Il fratello
- b. Il prete

8a. Il pazzo / ha colpito / il cane / del vicino / che / riposava / in giardino.

8b. Il pazzo / ha colpito / il cane / del vicino / che / abbaia / in giardino.

Chi o cosa riposava/ abbaia in giardino?

- a. Il cane
- b. Il vicino

9a. Maria / ha salutato / l'amico / dell'insegnante / che / dava una mano / a Marco.

9b. Maria / ha salutato / l'amico / dell'insegnante / che / dava una lezione / a Marco.

Chi dava una mano / una lezione a Marco?

- a. L'amico
- b. L'insegnante

10a. Andrea / ha notato / la collana / dell'attrice / che / era adorata / dalla regina.

10b. Andrea / ha notato / la collana / dell'attrice / che / era indossata / dalla regina.

Chi o cosa era adorata/ indossata dalla regina?

- a. La collana
- b. L'attrice

11a. Luigi / ha investito / il cucciolo / del fruttivendolo / che / faceva confusione / nel vicinato.

11b. Luigi / ha investito / il cucciolo / del fruttivendolo / che / faceva consegne / nel vicinato.

Chi o cosa faceva confusione/ consegne nel vicinato?

- a. Il cucciolo
- b. Il fruttivendolo

12a. Il poliziotto / ha arrestato / il figlio / della vittima esanime / che / stava sdraiata / sulla poltrona.

12b. Il poliziotto / ha arrestato / il figlio / della vittima esanime / che / stava piangendo / sulla poltrona.

Chi stava sdraiato/ piangendo sulla poltrona?

- a. Il figlio
- b. La vittima esanime

8. *RC Attachment Ambiguity Resolution (Italian): Filler Items*

1. Pietro / mi ha detto / che / la sorella / del tuo amico / è andata / a Parigi.

Chi è andata a Parigi?

- a. La sorella
- b. Il tuo amico

2. Giovanni / ha detto / che / il fidanzato / della sua vicina / era / il suo dottore.

Chi era il suo dottore?

- a. Il fidanzato
- b. La sua vicina

3. Amelia / ci ha detto / che / la figlia / del suo professore / ha studiato / a Chicago.

Chi ha studiato a Chicago?

- a. La figlia
- b. Il professore

4. L'anziana signora / ha detto / che / la nipote / del tuo amico / ha rotto / la finestra.

Chi ha rotto la finestra?

- a. La nipote
- b. L'amico

5. Il giornalista / ha sostenuto / che / il figlio / del ministro / non si era / laureato.

Chi non si era laureato?

- a. Il figlio
- b. Il ministro

6. Giorgio / ha affermato / che / il nipote / del tuo amico / ha sfamato / il suo gatto.

Chi ha sfamato il suo gatto?

- a. Il figlio
- b. L'amico

7. Marta / ha detto / che / la mamma / della sua amica / ha comprato / il ristorante.

Chi ha comprato il ristorante?

- a. La madre
- b. L'amica

8. Il pazzo / ha detto / che / l'amico / della sua ragazza / ha ucciso / Billie.

Chi ha ucciso Billie?

- a. L'amico
- b. La ragazza

9. Maria / mi ha detto / che / il figlio / della sua vicina / è / malato.

Chi è malato?

- a. Il figlio
- b. La vicina

10. Il poliziotto / disse / che / l'amico / dell'indiziato / era stato / d'aiuto.

Chi era stato d'aiuto?

- a. L'amico
- b. L'indiziato

11. Andrea / ha detto / che / lo zio / del suo amico / era / malato.

Chi era malato?

- a. Lo zio

b. L'amico

12. Luigi / ti ha detto / che / la zia / del suo amico / era / pazza.

Chi era pazza?

- a. La zia
- b. L'amico

13. Pietro / ha detto / che / la figlia / del tuo amico / è tornata / da Roma.

Chi è tornata da Roma?

- a. Pietro
- b. La figlia

14. Giovanni / mi ha detto / che / il compagno / di sua madre / era / suo amico.

Chi era suo amico?

- a. Giovanni
- b. Il compagno

15. Amelia / ha detto / che / la sorella / della sua insegnante / viveva / a Firenze.

Chi viveva a Firenze?

- a. Amelia
- b. La sorella

16. L'anziana signora / mi ha detto / che / il bambino / del suo vicino / era / sempre affamato.

Chi era sempre affamato?

- a. L'anziana signora
- b. Il bambino

17. Il giornalista / ha detto / che / il figlio / dell'artista / era / molto scortese.

Chi era molto scortese?

- a. Il giornalista
- b. Il figlio

18. Giorgio / ha sostenuto / che / la madre / del suo amico / era / estremamente scortese.

Chi era estremamente scortese?

- a. Giorgio
- b. La madre

19. Marta / ha affermato / che / la fidanzata / del suo vicino / ha fatto irruzione / in casa.

Chi ha fatto irruzione in casa?

- a. Marta
- b. La fidanzata

20. Il pazzo / mi ha detto / che / lo zio / dell'uomo / ha dato fuoco / alla casa.

Chi ha dato fuoco alla casa?

- a. Il pazzo
- b. Lo zio

21. Maria / ha detto / che / la zia / del suo amico / stava / piangendo.

Chi stava piangendo?

- a. Maria
- b. La zia

22. Il poliziotto / ha affermato / che / l'amico / della vittima / era / scappato.

Chi era scappato?

- a. Il poliziotto
- b. L'amico

23. Andrea / ha detto / che / il compagno / della madre / era / vecchio.

Chi era vecchio?

- a. Andrea
- b. Il compagno

24. Luigi / ci ha detto / che / il figlio / del suo vicino / era / scomparso.

Chi era scomparso?

- a. Luigi
- b. Il figlio

Appendix D: Inferential Statistics (Syntactic Attrition)

Self-paced Reading Task (Anaphora Resolution)

1. One-Tailed One-Sample Wilcoxon Signed-Rank Tests of Means

a. University Students' English Anaphora Resolution (Baseline NP1)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	12087	< .001

Note. $H_a \mu > 0.5$

b. University Students' English Anaphora Resolution (Baseline NP2)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	320	< .001

Note. $H_a \mu < 0.5$

c. University Students' English Anaphora Resolution (Target)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	22294	0.033

Note. $H_a \mu > 0.5$

d. Long-Term Residents' English Anaphora Resolution (Baseline NP1)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	12089	< .001

Note. $H_a \mu > 0.5$

e. Long-Term Residents' English Anaphora Resolution (Baseline NP2)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	77.5	< .001

Note. $H_a \mu < 0.5$

f. Long-Term Residents' English Anaphora Resolution (Target)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	13976	0.215

Note. $H_a \mu > 0.5$

g. English L1 Controls' English Anaphora Resolution (Baseline NP1)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	14616	< .001

Note. $H_a \mu > 0.5$

h. English L1 Controls' English Anaphora Resolution (Baseline NP2)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	435	< .001

Note. $H_a \mu < 0.5$

i. English L1 Controls' English Anaphora Resolution (Target)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	22400	0.007

Note. $H_a \mu > 0.5$

j. University Students' Italian Anaphora Resolution (Baseline NP1)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	10001	< .001

Note. $H_a \mu > 0.5$

k. University Students' Italian Anaphora Resolution (Baseline NP2)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	710	< .001

Note. $H_a \mu < 0.5$

l. University Students' Italian Anaphora Resolution (Target)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	12138	0.984

Note. $H_a \mu > 0.5$

m. Long-Term Residents' Italian Anaphora Resolution (Baseline NP1)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	12012	< .001

Note. $H_a \mu > 0.5$

n. Long-Term Residents' Italian Anaphora Resolution (Baseline NP2)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	310	< .001

Note. $H_a \mu < 0.5$

o. Long-Term Residents' Italian Anaphora Resolution (Target)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	14170	0.995

Note. $H_a \mu > 0.5$

p. Italian L1 Controls' Italian Anaphora Resolution (Baseline NP1)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	15842	< .001

Note. $H_a \mu > 0.5$

q. Italian L1 Controls' Italian Anaphora Resolution (Baseline NP2)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	89.5	< .001

Note. $H_a \mu < 0.5$

r. Italian L1 Controls' Italian Anaphora Resolution (Target)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	18972	< .001

Note. $H_a \mu < 0.5$

2. Mixed Binomial Logistic Regression Models for Preference

a. English Anaphora Resolution Preference

Model Info

Info	Value	Comment
Model Type	Logistic	Model for binary y
Call	glm	preference ~ 1 + group + condition + group:condition + (1 itemID) + (1 + condition subjectID)
Link function	Logit	Log of the odd of y=1 over y=0
Direction	$P(y=1)/P(y=0)$	$P(\text{preference} = \text{NP1}) / P(\text{preference} = \text{NP2})$
Distribution	Binomial	Dichotomous event distribution of y
LogLikel.	-532.422	Unconditional Log-Likelihood
-2*LogLikel.	1064.844	Unconditional absolute deviance
Deviance	821.425	Conditional relative deviance
R-squared	0.689	Marginal
R-squared	0.920	Conditional
AIC	1096.840	Less is better
BIC	1184.450	Less is better
Residual DF	1748.000	
Chi-squared/DF	0.460	Overdispersion indicator
Converged	yes	
Optimizer	bobyqa	

Fixed Effect Omnibus tests

	X²	df	p
group	0.103	2.00	0.950
condition	35.650	2.00	< .001
group * condition	1.370	4.00	0.849

Post Hoc Comparisons – condition

Comparison						
condition		condition	exp(B)	SE	z	p_{bonferroni}
baselineNP1	-	baselineNP2	1.20e+6	2.82e+6	5.94	< .001
baselineNP1	-	target	108	134	3.81	< .001
baselineNP2	-	target	9.07e-5	1.77e-4	-4.77	< .001

b. Italian Anaphora Resolution Preference

Model Info

Info	Value	Comment
Model Type	Logistic	Model for binary y

Model Info

Info	Value	Comment
Call	glm	preference ~ 1 + group + condition + condition:group + (1 itemID) + (1 subjectID)
Link function	Logit	Log of the odd of y=1 over y=0
Direction	$P(y=1)/P(y=0)$	$P(\text{preference} = \text{NP1}) / P(\text{preference} = \text{NP2})$
Distribution	Binomial	Dichotomous event distribution of y
LogLikel.	-590.288	Unconditional Log-Likelihood
-2*LogLikel.	1180.576	Unconditional absolute deviance
Deviance	1026.464	Conditional relative deviance
R-squared	0.734	Marginal
R-squared	0.809	Conditional
AIC	1202.580	Less is better
BIC	1262.729	Less is better
Residual DF	1741.000	
Chi-squared/DF	0.885	Overdispersion indicator
Converged	yes	
Optimizer	bobyqa	

Fixed Effect Omnibus tests

	X²	df	p
group	0.838	2.00	0.658
condition	113.166	2.00	< .001
condition * group	16.859	4.00	0.002

Post Hoc Comparisons - condition * group

Comparison					exp(B)	SE	z	p _{bonferroni}
condition	group		condition	group				
baselineNP1	L1controls	-	baselineNP1	residents	1.20532	1.73613	0.1296	1.000
baselineNP1	L1controls	-	baselineNP2	L1controls	96918.62500	150266.80516	7.4054	< .001
baselineNP1	L1controls	-	baselineNP2	residents	18700.98053	24155.70834	7.6151	< .001
baselineNP1	L1controls	-	target	L1controls	505.75518	571.50175	5.5098	< .001
baselineNP1	L1controls	-	target	residents	495.39677	568.54068	5.4070	< .001
baselineNP1	residents	-	baselineNP2	residents	15515.40245	19798.65538	7.5620	< .001
baselineNP1	residents	-	target	residents	411.00948	464.01430	5.3311	< .001
baselineNP1	students	-	baselineNP1	L1controls	0.08448	0.09262	-2.2541	0.871
baselineNP1	students	-	baselineNP1	residents	0.10183	0.11151	-2.0862	1.000
baselineNP1	students	-	baselineNP2	L1controls	8187.86118	10160.00954	7.2614	< .001
baselineNP1	students	-	baselineNP2	residents	1579.89275	1390.97352	8.3654	< .001

Post Hoc Comparisons - condition * group

Comparison					exp(B)	SE	z	p _{bonferroni}
condition	group		condition	group				
baselineNP1	students	-	baselineNP2	students	529.14279	403.94857	8.2149	< .001
baselineNP1	students	-	target	L1controls	42.72711	27.93424	5.7432	< .001
baselineNP1	students	-	target	residents	41.85202	27.42642	5.6982	< .001
baselineNP1	students	-	target	students	40.73369	25.51060	5.9192	< .001
baselineNP2	L1controls	-	baselineNP1	residents	1.24e-5	1.94e-5	-7.2502	< .001
baselineNP2	L1controls	-	baselineNP2	residents	0.19296	0.22220	-1.4287	1.000
baselineNP2	L1controls	-	target	L1controls	0.00522	0.00586	-4.6805	< .001
baselineNP2	L1controls	-	target	residents	0.00511	0.00583	-4.6239	< .001
baselineNP2	residents	-	target	residents	0.02649	0.01881	-5.1133	< .001
baselineNP2	students	-	baselineNP1	L1controls	1.60e-4	1.96e-4	-7.1104	< .001
baselineNP2	students	-	baselineNP1	residents	1.92e-4	2.36e-4	-6.9748	< .001
baselineNP2	students	-	baselineNP2	L1controls	15.47382	16.79737	2.5233	0.419
baselineNP2	students	-	baselineNP2	residents	2.98576	1.94215	1.6816	1.000
baselineNP2	students	-	target	L1controls	0.08075	0.05026	-4.0429	0.002
baselineNP2	students	-	target	residents	0.07909	0.04935	-4.0666	0.002
baselineNP2	students	-	target	students	0.07698	0.04563	-4.3259	< .001
target	L1controls	-	baselineNP1	residents	0.00238	0.00273	-5.2773	< .001
target	L1controls	-	baselineNP2	residents	36.97635	27.17365	4.9127	< .001
target	L1controls	-	target	residents	0.97952	0.27257	-0.0744	1.000
target	students	-	baselineNP1	L1controls	0.00207	0.00238	-5.3770	< .001
target	students	-	baselineNP1	residents	0.00250	0.00287	-5.2255	< .001

Post Hoc Comparisons - condition * group

Comparison					exp(B)	SE	z	p _{bonferroni}
condition	group	condition	group					
target	students	- baselineNP2	L1controls		201.00956	229.62644	4.6424	< .001
target	students	- baselineNP2	residents		38.78590	28.62981	4.9557	< .001
target	students	- target	L1controls		1.04894	0.29752	0.1684	1.000
target	students	- target	residents		1.02745	0.29436	0.0945	1.000

3. Linear Mixed Effects Models for RT

c. English Anaphora Resolution RT (Critical Region 5 and Post-Critical Regions 6-7)

Model Info

Info	
Estimate	Linear mixed model fit by REML
Call	resRT ~ 1 + group + region + condition + age + rspan_a + group:region + group:condition + region:condition + group:region:condition+(1 itemID)+(1 subjectID)
AIC	57331.0643
BIC	57344.2667
LogLikel.	-28539.6501
R-squared Marginal	0.0749

Model Info

Info	
R-squared Conditional	0.2816
Converged	yes
Optimizer	bobyqa

Fixed Effect Omnibus tests

	F	Num df	Den df	p
group	0.129	2	83.1	0.879
region	38.837	2	3838.5	< .001
condition	10.639	2	22.2	< .001
age	2.541	1	76.7	0.115
rspan_a	0.618	1	83.8	0.434
group * region	4.944	4	3836.5	< .001
group * condition	2.891	4	3848.2	0.021
region * condition	12.169	4	3831.8	< .001
group * region * condition	2.669	8	3831.4	0.006

Note. Satterthwaite method for degrees of freedom

Post Hoc Comparisons - group * region * condition

Comparison						Difference	SE	t	df	p _{bonferroni}	
group	region	condition	group	region	condition						
L1controls	5	baselineNP1	-	L1controls	5	baselineNP2	33.53	43.8	0.7656	446	1.000
L1controls	5	baselineNP1	-	L1controls	5	target	7.40	38.5	0.1922	470	1.000
L1controls	5	baselineNP1	-	L1controls	6	baselineNP1	114.14	46.5	2.4563	3833	1.000
L1controls	5	baselineNP1	-	L1controls	6	baselineNP2	107.01	48.9	2.1864	648	1.000
L1controls	5	baselineNP1	-	L1controls	6	target	125.42	40.4	3.1042	558	0.704
L1controls	5	baselineNP1	-	L1controls	7	baselineNP1	15.22	43.4	0.3507	3841	1.000
L1controls	5	baselineNP1	-	L1controls	7	baselineNP2	31.46	44.5	0.7073	473	1.000
L1controls	5	baselineNP1	-	L1controls	7	target	-72.26	39.2	-1.8431	503	1.000
L1controls	5	baselineNP1	-	residents	5	baselineNP1	-7.01	76.2	-0.0920	148	1.000
L1controls	5	baselineNP1	-	residents	5	baselineNP2	-8.23	77.6	-0.1060	154	1.000
L1controls	5	baselineNP1	-	residents	5	target	-29.36	74.5	-0.3942	132	1.000
L1controls	5	baselineNP1	-	residents	6	baselineNP1	138.67	76.6	1.8101	151	1.000
L1controls	5	baselineNP1	-	residents	6	baselineNP2	155.35	78.5	1.9792	160	1.000
L1controls	5	baselineNP1	-	residents	6	target	136.57	75.0	1.8217	136	1.000
L1controls	5	baselineNP1	-	residents	7	baselineNP1	53.35	76.9	0.6933	153	1.000
L1controls	5	baselineNP1	-	residents	7	baselineNP2	83.45	78.2	1.0667	159	1.000
L1controls	5	baselineNP1	-	residents	7	target	-235.79	74.8	-3.1543	134	0.697
L1controls	5	baselineNP1	-	students	5	baselineNP2	-2.54	68.7	-0.0370	234	1.000
L1controls	5	baselineNP1	-	students	5	target	-80.52	63.9	-1.2595	184	1.000
L1controls	5	baselineNP1	-	students	6	baselineNP1	52.07	71.5	0.7282	296	1.000

Post Hoc Comparisons - group * region * condition

Comparison						Difference	SE	t	df	p _{bonferroni}
group	region	condition	group	region	condition					
L1controls	5	baselineNP1	- students	6	baselineNP2	47.36	72.6	0.6520	290	1.000
L1controls	5	baselineNP1	- students	6	target	57.45	65.7	0.8739	204	1.000
L1controls	5	baselineNP1	- students	7	baselineNP1	101.70	67.6	1.5051	238	1.000
L1controls	5	baselineNP1	- students	7	baselineNP2	25.46	68.7	0.3705	235	1.000
L1controls	5	baselineNP1	- students	7	target	-50.01	63.9	-0.7829	183	1.000
L1controls	5	baselineNP2	- L1controls	5	target	-26.13	38.0	-0.6879	449	1.000
L1controls	5	baselineNP2	- L1controls	6	baselineNP2	73.49	46.7	1.5742	3841	1.000
L1controls	5	baselineNP2	- L1controls	6	target	91.89	39.9	2.3036	533	1.000
L1controls	5	baselineNP2	- L1controls	7	baselineNP2	-2.07	42.0	-0.0492	3822	1.000
L1controls	5	baselineNP2	- L1controls	7	target	-105.79	38.6	-2.7379	477	1.000
L1controls	5	baselineNP2	- residents	5	baselineNP2	-41.76	76.3	-0.5476	148	1.000
L1controls	5	baselineNP2	- residents	5	target	-62.88	74.2	-0.8477	130	1.000
L1controls	5	baselineNP2	- residents	6	baselineNP2	121.82	77.1	1.5792	155	1.000
L1controls	5	baselineNP2	- residents	6	target	103.04	74.7	1.3796	134	1.000
L1controls	5	baselineNP2	- residents	7	baselineNP2	49.92	76.9	0.6494	153	1.000
L1controls	5	baselineNP2	- residents	7	target	-269.32	74.5	-3.6163	132	0.149
L1controls	5	baselineNP2	- students	5	target	-114.05	63.6	-1.7944	180	1.000
L1controls	5	baselineNP2	- students	6	baselineNP2	13.83	71.1	0.1944	290	1.000
L1controls	5	baselineNP2	- students	6	target	23.92	65.4	0.3659	199	1.000
L1controls	5	baselineNP2	- students	7	baselineNP2	-8.07	67.1	-0.1202	233	1.000
L1controls	5	baselineNP2	- students	7	target	-83.54	63.5	-1.3155	179	1.000

Post Hoc Comparisons - group * region * condition

Comparison						Difference	SE	t	df	p _{bonferroni}
group	region	condition	group	region	condition					
L1controls	5	target	- L1controls	6	target	118.02	32.1	3.6808	3830	0.083
L1controls	5	target	- L1controls	7	target	-79.66	30.5	-2.6126	3830	1.000
L1controls	5	target	- residents	5	target	-36.75	70.5	-0.5213	108	1.000
L1controls	5	target	- residents	6	target	129.17	71.0	1.8185	112	1.000
L1controls	5	target	- residents	7	target	-243.19	70.8	-3.4345	110	0.294
L1controls	5	target	- students	6	target	50.06	61.2	0.8183	160	1.000
L1controls	5	target	- students	7	target	-57.40	59.2	-0.9704	142	1.000
L1controls	6	baselineNP1	- L1controls	5	baselineNP2	-80.61	47.8	-1.6873	605	1.000
L1controls	6	baselineNP1	- L1controls	5	target	-106.75	43.0	-2.4817	690	1.000
L1controls	6	baselineNP1	- L1controls	6	baselineNP2	-7.13	52.4	-0.1361	811	1.000
L1controls	6	baselineNP1	- L1controls	6	target	11.27	44.6	0.2525	781	1.000
L1controls	6	baselineNP1	- L1controls	7	baselineNP1	-98.92	47.3	-2.0917	3836	1.000
L1controls	6	baselineNP1	- L1controls	7	baselineNP2	-82.68	48.4	-1.7089	632	1.000
L1controls	6	baselineNP1	- L1controls	7	target	-186.40	43.6	-4.2740	724	0.008
L1controls	6	baselineNP1	- residents	5	baselineNP2	-122.38	80.0	-1.5291	173	1.000
L1controls	6	baselineNP1	- residents	5	target	-143.50	77.0	-1.8644	151	1.000
L1controls	6	baselineNP1	- residents	6	baselineNP1	24.53	79.0	0.3103	170	1.000
L1controls	6	baselineNP1	- residents	6	baselineNP2	41.21	80.9	0.5096	180	1.000
L1controls	6	baselineNP1	- residents	6	target	22.42	77.5	0.2895	154	1.000
L1controls	6	baselineNP1	- residents	7	baselineNP1	-60.79	79.4	-0.7659	173	1.000
L1controls	6	baselineNP1	- residents	7	baselineNP2	-30.69	80.6	-0.3807	178	1.000

Post Hoc Comparisons - group * region * condition

Comparison						Difference	SE	t	df	p _{bonferroni}
group	region	condition	group	region	condition					
L1controls	6	baselineNP1	- residents	7	target	-349.94	77.2	-4.5300	153	0.004
L1controls	6	baselineNP1	- students	5	baselineNP2	-116.69	71.4	-1.6341	272	1.000
L1controls	6	baselineNP1	- students	5	target	-194.67	66.9	-2.9120	219	1.000
L1controls	6	baselineNP1	- students	6	baselineNP2	-66.79	75.2	-0.8880	331	1.000
L1controls	6	baselineNP1	- students	6	target	-56.69	68.6	-0.8266	239	1.000
L1controls	6	baselineNP1	- students	7	baselineNP1	-12.44	70.3	-0.1769	277	1.000
L1controls	6	baselineNP1	- students	7	baselineNP2	-88.68	71.4	-1.2414	272	1.000
L1controls	6	baselineNP1	- students	7	target	-164.15	66.8	-2.4576	218	1.000
L1controls	6	baselineNP2	- L1controls	5	target	-99.62	43.7	-2.2820	713	1.000
L1controls	6	baselineNP2	- L1controls	6	target	18.40	45.3	0.4061	805	1.000
L1controls	6	baselineNP2	- L1controls	7	baselineNP2	-75.55	47.3	-1.5959	3845	1.000
L1controls	6	baselineNP2	- L1controls	7	target	-179.28	44.2	-4.0560	743	0.019
L1controls	6	baselineNP2	- residents	5	target	-136.37	77.3	-1.7651	153	1.000
L1controls	6	baselineNP2	- residents	6	baselineNP2	48.34	80.1	0.6034	180	1.000
L1controls	6	baselineNP2	- residents	6	target	29.55	77.7	0.3801	157	1.000
L1controls	6	baselineNP2	- residents	7	baselineNP2	-23.56	79.9	-0.2951	178	1.000
L1controls	6	baselineNP2	- residents	7	target	-342.81	77.5	-4.4210	155	0.006
L1controls	6	baselineNP2	- students	5	target	-187.54	67.2	-2.7918	223	1.000
L1controls	6	baselineNP2	- students	6	target	-49.56	68.9	-0.7194	244	1.000
L1controls	6	baselineNP2	- students	7	baselineNP2	-81.55	70.6	-1.1558	282	1.000
L1controls	6	baselineNP2	- students	7	target	-157.02	67.1	-2.3396	222	1.000

Post Hoc Comparisons - group * region * condition

Comparison						Difference	SE	t	df	p _{bonferroni}
group	region	condition	group	region	condition					
L1controls	6	target	- L1controls	7	target	-197.68	32.8	-6.0356	3831	< .001
L1controls	6	target	- residents	6	target	11.15	72.1	0.1547	118	1.000
L1controls	6	target	- residents	7	target	-361.21	71.9	-5.0253	117	< .001
L1controls	6	target	- students	7	target	-175.42	60.5	-2.9019	154	1.000
L1controls	7	baselineNP1	- L1controls	5	baselineNP2	18.30	44.8	0.4089	483	1.000
L1controls	7	baselineNP1	- L1controls	5	target	-7.83	39.5	-0.1983	516	1.000
L1controls	7	baselineNP1	- L1controls	6	baselineNP2	91.79	49.7	1.8483	681	1.000
L1controls	7	baselineNP1	- L1controls	6	target	110.19	41.3	2.6681	603	1.000
L1controls	7	baselineNP1	- L1controls	7	baselineNP2	16.24	45.4	0.3578	508	1.000
L1controls	7	baselineNP1	- L1controls	7	target	-87.49	40.0	-2.1858	541	1.000
L1controls	7	baselineNP1	- residents	5	baselineNP2	-23.46	78.1	-0.3004	157	1.000
L1controls	7	baselineNP1	- residents	5	target	-44.58	74.9	-0.5949	136	1.000
L1controls	7	baselineNP1	- residents	6	baselineNP2	140.13	78.9	1.7751	164	1.000
L1controls	7	baselineNP1	- residents	6	target	121.34	75.4	1.6086	139	1.000
L1controls	7	baselineNP1	- residents	7	baselineNP1	38.13	77.4	0.4926	157	1.000
L1controls	7	baselineNP1	- residents	7	baselineNP2	68.23	78.7	0.8671	162	1.000
L1controls	7	baselineNP1	- residents	7	target	-251.02	75.2	-3.3370	138	0.382
L1controls	7	baselineNP1	- students	5	baselineNP2	-17.77	69.2	-0.2566	242	1.000
L1controls	7	baselineNP1	- students	5	target	-95.75	64.5	-1.4839	191	1.000
L1controls	7	baselineNP1	- students	6	baselineNP2	32.13	73.2	0.4392	298	1.000
L1controls	7	baselineNP1	- students	6	target	42.23	66.3	0.6367	210	1.000

Post Hoc Comparisons - group * region * condition

Comparison						Difference	SE	t	df	p _{bonferroni}
group	region	condition	group	region	condition					
L1controls	7	baselineNP1	- students	7	baselineNP2	10.24	69.3	0.1478	242	1.000
L1controls	7	baselineNP1	- students	7	target	-65.23	64.5	-1.0119	190	1.000
L1controls	7	baselineNP2	- L1controls	5	target	-24.07	38.7	-0.6213	482	1.000
L1controls	7	baselineNP2	- L1controls	6	target	93.95	40.6	2.3159	567	1.000
L1controls	7	baselineNP2	- L1controls	7	target	-103.73	39.3	-2.6386	508	1.000
L1controls	7	baselineNP2	- residents	5	target	-60.82	74.6	-0.8153	133	1.000
L1controls	7	baselineNP2	- residents	6	target	105.10	75.1	1.3996	137	1.000
L1controls	7	baselineNP2	- residents	7	baselineNP2	51.99	77.3	0.6727	156	1.000
L1controls	7	baselineNP2	- residents	7	target	-267.26	74.9	-3.5690	135	0.174
L1controls	7	baselineNP2	- students	5	target	-111.99	64.0	-1.7503	185	1.000
L1controls	7	baselineNP2	- students	6	target	25.99	65.8	0.3950	204	1.000
L1controls	7	baselineNP2	- students	7	target	-81.47	63.9	-1.2746	184	1.000
L1controls	7	target	- residents	7	target	-163.53	71.2	-2.2980	112	1.000
residents	5	baselineNP1	- L1controls	5	baselineNP2	40.54	77.0	0.5264	149	1.000
residents	5	baselineNP1	- L1controls	5	target	14.40	74.0	0.1945	129	1.000
residents	5	baselineNP1	- L1controls	6	baselineNP1	121.15	78.6	1.5409	167	1.000
residents	5	baselineNP1	- L1controls	6	baselineNP2	114.02	80.0	1.4258	173	1.000
residents	5	baselineNP1	- L1controls	6	target	132.42	75.1	1.7644	136	1.000
residents	5	baselineNP1	- L1controls	7	baselineNP1	22.23	76.6	0.2901	151	1.000
residents	5	baselineNP1	- L1controls	7	baselineNP2	38.47	77.4	0.4971	152	1.000
residents	5	baselineNP1	- L1controls	7	target	-65.26	74.4	-0.8774	132	1.000

Post Hoc Comparisons - group * region * condition

Comparison						Difference	SE	t	df	p _{bonferroni}	
group	region	condition	group	region	condition						
residents	5	baselineNP1	-	residents	5	baselineNP2	-1.23	42.9	-0.0286	413	1.000
residents	5	baselineNP1	-	residents	5	target	-22.35	37.0	-0.6039	408	1.000
residents	5	baselineNP1	-	residents	6	baselineNP1	145.68	41.0	3.5505	3827	0.137
residents	5	baselineNP1	-	residents	6	baselineNP2	162.36	44.2	3.6723	461	0.094
residents	5	baselineNP1	-	residents	6	target	143.57	37.8	3.8017	440	0.058
residents	5	baselineNP1	-	residents	7	baselineNP1	60.36	41.6	1.4522	3827	1.000
residents	5	baselineNP1	-	residents	7	baselineNP2	90.46	43.9	2.0606	449	1.000
residents	5	baselineNP1	-	residents	7	target	-228.79	37.5	-6.1048	426	< .001
residents	5	baselineNP1	-	students	5	baselineNP2	4.46	86.8	0.0514	144	1.000
residents	5	baselineNP1	-	students	5	target	-73.52	83.1	-0.8849	122	1.000
residents	5	baselineNP1	-	students	6	baselineNP1	59.08	89.0	0.6638	161	1.000
residents	5	baselineNP1	-	students	6	baselineNP2	54.36	89.9	0.6047	165	1.000
residents	5	baselineNP1	-	students	6	target	64.46	84.5	0.7632	130	1.000
residents	5	baselineNP1	-	students	7	baselineNP1	108.71	85.9	1.2656	140	1.000
residents	5	baselineNP1	-	students	7	baselineNP2	32.47	86.8	0.3740	144	1.000
residents	5	baselineNP1	-	students	7	target	-43.00	83.0	-0.5179	122	1.000
residents	5	baselineNP2	-	L1controls	5	target	15.63	74.4	0.2100	132	1.000
residents	5	baselineNP2	-	L1controls	6	baselineNP2	115.25	79.3	1.4541	172	1.000
residents	5	baselineNP2	-	L1controls	6	target	133.65	75.4	1.7720	139	1.000
residents	5	baselineNP2	-	L1controls	7	baselineNP2	39.70	76.7	0.5178	151	1.000
residents	5	baselineNP2	-	L1controls	7	target	-64.03	74.7	-0.8567	134	1.000

Post Hoc Comparisons - group * region * condition

Comparison											
group	region	condition		group	region	condition	Difference	SE	t	df	p _{bonferroni}
residents	5	baselineNP2	-	residents	5	target	-21.12	37.5	-0.5630	429	1.000
residents	5	baselineNP2	-	residents	6	baselineNP2	163.58	42.7	3.8348	3826	0.045
residents	5	baselineNP2	-	residents	6	target	144.80	38.2	3.7870	460	0.061
residents	5	baselineNP2	-	residents	7	baselineNP2	91.68	42.4	2.1628	3830	1.000
residents	5	baselineNP2	-	residents	7	target	-227.56	38.0	-5.9886	448	< .001
residents	5	baselineNP2	-	students	5	target	-72.29	83.4	-0.8665	124	1.000
residents	5	baselineNP2	-	students	6	baselineNP2	55.59	89.3	0.6226	163	1.000
residents	5	baselineNP2	-	students	6	target	65.68	84.8	0.7746	132	1.000
residents	5	baselineNP2	-	students	7	baselineNP2	33.69	86.2	0.3910	142	1.000
residents	5	baselineNP2	-	students	7	target	-41.78	83.4	-0.5011	124	1.000
residents	5	target	-	L1controls	6	target	154.77	71.6	2.1624	115	1.000
residents	5	target	-	L1controls	7	target	-42.91	70.9	-0.6055	111	1.000
residents	5	target	-	residents	6	target	165.92	30.2	5.5030	3829	< .001
residents	5	target	-	residents	7	target	-206.44	29.8	-6.9205	3824	< .001
residents	5	target	-	students	6	target	86.81	81.4	1.0666	113	1.000
residents	5	target	-	students	7	target	-20.65	79.9	-0.2585	106	1.000
residents	6	baselineNP1	-	L1controls	5	baselineNP2	-105.15	77.4	-1.3579	152	1.000
residents	6	baselineNP1	-	L1controls	5	target	-131.28	74.5	-1.7626	132	1.000
residents	6	baselineNP1	-	L1controls	6	baselineNP2	-31.66	80.4	-0.3938	176	1.000
residents	6	baselineNP1	-	L1controls	6	target	-13.26	75.5	-0.1756	139	1.000
residents	6	baselineNP1	-	L1controls	7	baselineNP1	-123.45	77.1	-1.6018	155	1.000

Post Hoc Comparisons - group * region * condition

Comparison						Difference	SE	t	df	p _{bonferroni}
group	region	condition	group	region	condition					
residents	6	baselineNP1	- L1controls	7	baselineNP2	-107.21	77.8	-1.3776	155	1.000
residents	6	baselineNP1	- L1controls	7	target	-210.94	74.8	-2.8193	135	1.000
residents	6	baselineNP1	- residents	5	baselineNP2	-146.91	43.5	-3.3793	434	0.278
residents	6	baselineNP1	- residents	5	target	-168.03	37.7	-4.4560	436	0.004
residents	6	baselineNP1	- residents	6	baselineNP2	16.68	44.7	0.3731	480	1.000
residents	6	baselineNP1	- residents	6	target	-2.11	38.3	-0.0549	464	1.000
residents	6	baselineNP1	- residents	7	baselineNP1	-85.32	42.1	-2.0268	3822	1.000
residents	6	baselineNP1	- residents	7	baselineNP2	-55.22	44.4	-1.2428	469	1.000
residents	6	baselineNP1	- residents	7	target	-374.47	38.1	-9.8182	453	< .001
residents	6	baselineNP1	- students	5	baselineNP2	-141.22	87.2	-1.6198	146	1.000
residents	6	baselineNP1	- students	5	target	-219.20	83.5	-2.6250	125	1.000
residents	6	baselineNP1	- students	6	baselineNP2	-91.32	90.3	-1.0113	168	1.000
residents	6	baselineNP1	- students	6	target	-81.22	84.9	-0.9570	132	1.000
residents	6	baselineNP1	- students	7	baselineNP1	-36.97	86.3	-0.4284	143	1.000
residents	6	baselineNP1	- students	7	baselineNP2	-113.21	87.2	-1.2980	146	1.000
residents	6	baselineNP1	- students	7	target	-188.68	83.5	-2.2610	124	1.000
residents	6	baselineNP2	- L1controls	5	target	-147.96	75.3	-1.9647	138	1.000
residents	6	baselineNP2	- L1controls	6	target	-29.94	76.3	-0.3923	145	1.000
residents	6	baselineNP2	- L1controls	7	baselineNP2	-123.89	77.5	-1.5977	158	1.000
residents	6	baselineNP2	- L1controls	7	target	-227.61	75.6	-3.0091	140	1.000
residents	6	baselineNP2	- residents	5	target	-184.71	39.0	-4.7337	494	0.001

Post Hoc Comparisons - group * region * condition

Comparison						Difference	SE	t	df	p _{bonferroni}
group	region	condition	group	region	condition					
residents	6	baselineNP2	- residents	6	target	-18.79	39.6	-0.4742	521	1.000
residents	6	baselineNP2	- residents	7	baselineNP2	-71.90	43.7	-1.6470	3828	1.000
residents	6	baselineNP2	- residents	7	target	-391.15	39.5	-9.9126	512	< .001
residents	6	baselineNP2	- students	5	target	-235.88	84.3	-2.7994	129	1.000
residents	6	baselineNP2	- students	6	target	-97.90	85.6	-1.1435	137	1.000
residents	6	baselineNP2	- students	7	baselineNP2	-129.89	87.0	-1.4933	147	1.000
residents	6	baselineNP2	- students	7	target	-205.36	84.2	-2.4388	129	1.000
residents	6	target	- L1controls	7	target	-208.83	71.4	-2.9253	114	1.000
residents	6	target	- residents	7	target	-372.36	30.7	-12.1341	3831	< .001
residents	6	target	- students	7	target	-186.58	80.4	-2.3206	108	1.000
residents	7	baselineNP1	- L1controls	5	baselineNP2	-19.82	77.8	-0.2549	155	1.000
residents	7	baselineNP1	- L1controls	5	target	-45.96	74.8	-0.6142	135	1.000
residents	7	baselineNP1	- L1controls	6	baselineNP2	53.66	80.7	0.6649	179	1.000
residents	7	baselineNP1	- L1controls	6	target	72.07	75.8	0.9502	142	1.000
residents	7	baselineNP1	- L1controls	7	baselineNP2	-21.89	78.2	-0.2800	158	1.000
residents	7	baselineNP1	- L1controls	7	target	-125.61	75.2	-1.6712	137	1.000
residents	7	baselineNP1	- residents	5	baselineNP2	-61.58	44.0	-1.4007	453	1.000
residents	7	baselineNP1	- residents	5	target	-82.71	38.3	-2.1609	461	1.000
residents	7	baselineNP1	- residents	6	baselineNP2	102.00	45.1	2.2593	498	1.000
residents	7	baselineNP1	- residents	6	target	83.22	38.9	2.1398	488	1.000
residents	7	baselineNP1	- residents	7	baselineNP2	30.10	44.9	0.6707	486	1.000

Post Hoc Comparisons - group * region * condition

Comparison						Difference	SE	t	df	p _{bonferroni}
group	region	condition	group	region	condition					
residents	7	baselineNP1	- residents	7	target	-289.15	38.7	-7.4724	478	< .001
residents	7	baselineNP1	- students	5	baselineNP2	-55.89	87.5	-0.6389	148	1.000
residents	7	baselineNP1	- students	5	target	-133.87	83.8	-1.5971	126	1.000
residents	7	baselineNP1	- students	6	baselineNP2	-5.99	90.6	-0.0662	170	1.000
residents	7	baselineNP1	- students	6	target	4.10	85.2	0.0481	134	1.000
residents	7	baselineNP1	- students	7	baselineNP2	-27.89	87.5	-0.3186	148	1.000
residents	7	baselineNP1	- students	7	target	-103.36	83.8	-1.2338	126	1.000
residents	7	baselineNP2	- L1controls	5	target	-76.05	75.0	-1.0136	136	1.000
residents	7	baselineNP2	- L1controls	6	target	41.97	76.0	0.5518	143	1.000
residents	7	baselineNP2	- L1controls	7	target	-155.71	75.4	-2.0659	139	1.000
residents	7	baselineNP2	- residents	5	target	-112.81	38.7	-2.9139	479	1.000
residents	7	baselineNP2	- residents	6	target	53.12	39.3	1.3508	506	1.000
residents	7	baselineNP2	- residents	7	target	-319.24	39.1	-8.1643	495	< .001
residents	7	baselineNP2	- students	5	target	-163.97	84.0	-1.9519	128	1.000
residents	7	baselineNP2	- students	6	target	-26.00	85.4	-0.3045	135	1.000
residents	7	baselineNP2	- students	7	target	-133.46	84.0	-1.5896	127	1.000
students	5	baselineNP1	- L1controls	5	baselineNP1	27.23	66.6	0.4088	225	1.000
students	5	baselineNP1	- L1controls	5	baselineNP2	60.76	67.5	0.9000	219	1.000
students	5	baselineNP1	- L1controls	5	target	34.63	64.1	0.5402	185	1.000
students	5	baselineNP1	- L1controls	6	baselineNP1	141.37	69.4	2.0369	264	1.000
students	5	baselineNP1	- L1controls	6	baselineNP2	134.25	70.9	1.8929	265	1.000

Post Hoc Comparisons - group * region * condition

Comparison						Difference	SE	t	df	p _{bonferroni}	
group	region	condition	group	region	condition						
students	5	baselineNP1	-	L1controls	6	target	152.65	65.3	2.3376	198	1.000
students	5	baselineNP1	-	L1controls	7	baselineNP1	42.46	67.2	0.6320	233	1.000
students	5	baselineNP1	-	L1controls	7	baselineNP2	58.69	67.9	0.8644	224	1.000
students	5	baselineNP1	-	L1controls	7	target	-45.03	64.5	-0.6984	189	1.000
students	5	baselineNP1	-	residents	5	baselineNP1	20.22	85.1	0.2375	136	1.000
students	5	baselineNP1	-	residents	5	baselineNP2	19.00	86.5	0.2197	141	1.000
students	5	baselineNP1	-	residents	5	target	-2.13	83.6	-0.0254	125	1.000
students	5	baselineNP1	-	residents	6	baselineNP1	165.90	85.6	1.9390	138	1.000
students	5	baselineNP1	-	residents	6	baselineNP2	182.58	87.3	2.0922	146	1.000
students	5	baselineNP1	-	residents	6	target	163.80	84.1	1.9476	128	1.000
students	5	baselineNP1	-	residents	7	baselineNP1	80.58	85.9	0.9384	140	1.000
students	5	baselineNP1	-	residents	7	baselineNP2	110.68	87.0	1.2718	145	1.000
students	5	baselineNP1	-	residents	7	target	-208.56	83.9	-2.4859	127	1.000
students	5	baselineNP1	-	students	5	baselineNP2	24.69	48.6	0.5084	639	1.000
students	5	baselineNP1	-	students	5	target	-53.29	41.9	-1.2729	631	1.000
students	5	baselineNP1	-	students	6	baselineNP1	79.30	52.0	1.5237	3832	1.000
students	5	baselineNP1	-	students	6	baselineNP2	74.59	53.7	1.3891	886	1.000
students	5	baselineNP1	-	students	6	target	84.68	43.9	1.9278	742	1.000
students	5	baselineNP1	-	students	7	baselineNP1	128.93	46.8	2.7566	3830	1.000
students	5	baselineNP1	-	students	7	baselineNP2	52.69	48.8	1.0805	649	1.000
students	5	baselineNP1	-	students	7	target	-22.78	41.8	-0.5444	628	1.000

Post Hoc Comparisons - group * region * condition

Comparison						Difference	SE	t	df	p _{bonferroni}	
group	region	condition	group	region	condition						
students	5	baselineNP2	-	L1controls	5	baselineNP2	36.07	67.1	0.5376	232	1.000
students	5	baselineNP2	-	L1controls	5	target	9.94	65.0	0.1530	195	1.000
students	5	baselineNP2	-	L1controls	6	baselineNP2	109.56	70.5	1.5531	282	1.000
students	5	baselineNP2	-	L1controls	6	target	127.96	66.2	1.9342	209	1.000
students	5	baselineNP2	-	L1controls	7	baselineNP2	34.01	67.5	0.5039	237	1.000
students	5	baselineNP2	-	L1controls	7	target	-69.72	65.3	-1.0670	199	1.000
students	5	baselineNP2	-	residents	5	baselineNP2	-5.69	86.1	-0.0661	142	1.000
students	5	baselineNP2	-	residents	5	target	-26.81	84.3	-0.3181	129	1.000
students	5	baselineNP2	-	residents	6	baselineNP2	157.90	86.9	1.8161	147	1.000
students	5	baselineNP2	-	residents	6	target	139.11	84.8	1.6412	132	1.000
students	5	baselineNP2	-	residents	7	baselineNP2	85.99	86.7	0.9919	146	1.000
students	5	baselineNP2	-	residents	7	target	-233.25	84.6	-2.7584	131	1.000
students	5	baselineNP2	-	students	5	target	-77.98	43.3	-1.8000	707	1.000
students	5	baselineNP2	-	students	6	baselineNP2	49.90	53.2	0.9377	3842	1.000
students	5	baselineNP2	-	students	6	target	59.99	45.4	1.3221	824	1.000
students	5	baselineNP2	-	students	7	baselineNP2	28.00	48.1	0.5816	3832	1.000
students	5	baselineNP2	-	students	7	target	-47.47	43.4	-1.0941	709	1.000
students	5	target	-	L1controls	5	target	87.92	59.2	1.4845	143	1.000
students	5	target	-	L1controls	6	target	205.94	60.5	3.4030	155	0.298
students	5	target	-	L1controls	7	target	8.26	59.6	0.1386	147	1.000
students	5	target	-	residents	5	target	51.17	80.0	0.6400	106	1.000

Post Hoc Comparisons - group * region * condition

Comparison						Difference	SE	t	df	p _{bonferroni}
group	region	condition	group	region	condition					
students	5	target	- residents	6	target	217.09	80.5	2.6983	109	1.000
students	5	target	- residents	7	target	-155.27	80.2	-1.9350	108	1.000
students	5	target	- students	6	target	137.98	36.5	3.7846	3840	0.055
students	5	target	- students	7	target	30.52	33.9	0.8997	3849	1.000
students	6	baselineNP1	- L1controls	5	baselineNP2	-18.54	72.3	-0.2563	286	1.000
students	6	baselineNP1	- L1controls	5	target	-44.67	69.2	-0.6458	248	1.000
students	6	baselineNP1	- L1controls	6	baselineNP1	62.07	74.1	0.8374	338	1.000
students	6	baselineNP1	- L1controls	6	baselineNP2	54.95	75.5	0.7274	336	1.000
students	6	baselineNP1	- L1controls	6	target	73.35	70.3	1.0436	264	1.000
students	6	baselineNP1	- L1controls	7	baselineNP1	-36.84	72.0	-0.5115	304	1.000
students	6	baselineNP1	- L1controls	7	baselineNP2	-20.61	72.7	-0.2834	291	1.000
students	6	baselineNP1	- L1controls	7	target	-124.33	69.5	-1.7885	253	1.000
students	6	baselineNP1	- residents	5	baselineNP2	-60.30	90.3	-0.6681	167	1.000
students	6	baselineNP1	- residents	5	target	-81.42	87.5	-0.9301	150	1.000
students	6	baselineNP1	- residents	6	baselineNP1	86.61	89.4	0.9688	164	1.000
students	6	baselineNP1	- residents	6	baselineNP2	103.28	91.0	1.1346	173	1.000
students	6	baselineNP1	- residents	6	target	84.50	88.0	0.9602	153	1.000
students	6	baselineNP1	- residents	7	baselineNP1	1.28	89.7	0.0143	166	1.000
students	6	baselineNP1	- residents	7	baselineNP2	31.38	90.8	0.3456	171	1.000
students	6	baselineNP1	- residents	7	target	-287.86	87.8	-3.2783	151	0.455
students	6	baselineNP1	- students	5	baselineNP2	-54.61	54.7	-0.9978	951	1.000

Post Hoc Comparisons - group * region * condition

Comparison						Difference	SE	t	df	p _{bonferroni}	
group	region	condition	group	region	condition						
students	6	baselineNP1	-	students	5	target	-132.59	48.9	-2.7106	1051	1.000
students	6	baselineNP1	-	students	6	baselineNP2	-4.71	59.0	-0.0798	1188	1.000
students	6	baselineNP1	-	students	6	target	5.38	50.6	0.1064	1158	1.000
students	6	baselineNP1	-	students	7	baselineNP1	49.63	53.1	0.9354	3825	1.000
students	6	baselineNP1	-	students	7	baselineNP2	-26.61	54.9	-0.4846	962	1.000
students	6	baselineNP1	-	students	7	target	-102.08	49.0	-2.0831	1055	1.000
students	6	baselineNP2	-	L1controls	5	target	-39.96	69.1	-0.5780	248	1.000
students	6	baselineNP2	-	L1controls	6	baselineNP2	59.66	74.4	0.8022	344	1.000
students	6	baselineNP2	-	L1controls	6	target	78.06	70.2	1.1113	264	1.000
students	6	baselineNP2	-	L1controls	7	baselineNP2	-15.89	71.5	-0.2223	296	1.000
students	6	baselineNP2	-	L1controls	7	target	-119.62	69.5	-1.7217	253	1.000
students	6	baselineNP2	-	residents	5	target	-76.71	87.5	-0.8766	150	1.000
students	6	baselineNP2	-	residents	6	baselineNP2	108.00	90.1	1.1991	169	1.000
students	6	baselineNP2	-	residents	6	target	89.21	88.0	1.0141	153	1.000
students	6	baselineNP2	-	residents	7	baselineNP2	36.09	89.8	0.4018	167	1.000
students	6	baselineNP2	-	residents	7	target	-283.15	87.8	-3.2259	151	0.540
students	6	baselineNP2	-	students	5	target	-127.88	48.9	-2.6167	1033	1.000
students	6	baselineNP2	-	students	6	target	10.10	50.5	0.1998	1141	1.000
students	6	baselineNP2	-	students	7	baselineNP2	-21.90	53.4	-0.4102	3841	1.000
students	6	baselineNP2	-	students	7	target	-97.36	49.0	-1.9888	1037	1.000
students	6	target	-	L1controls	6	target	67.97	62.4	1.0887	174	1.000

Post Hoc Comparisons - group * region * condition

Comparison						Difference	SE	t	df	p _{bonferroni}
group	region	condition	group	region	condition					
students	6	target	- L1controls	7	target	-129.71	61.6	-2.1069	164	1.000
students	6	target	- residents	6	target	79.12	81.9	0.9663	116	1.000
students	6	target	- residents	7	target	-293.25	81.7	-3.5908	115	0.171
students	6	target	- students	7	target	-107.46	36.5	-2.9463	3846	1.000
students	7	baselineNP1	- L1controls	5	baselineNP2	-68.17	68.5	-0.9959	231	1.000
students	7	baselineNP1	- L1controls	5	target	-94.30	65.1	-1.4487	196	1.000
students	7	baselineNP1	- L1controls	6	baselineNP2	5.31	71.8	0.0740	278	1.000
students	7	baselineNP1	- L1controls	6	target	23.72	66.3	0.3578	210	1.000
students	7	baselineNP1	- L1controls	7	baselineNP1	-86.48	68.1	-1.2693	246	1.000
students	7	baselineNP1	- L1controls	7	baselineNP2	-70.24	68.8	-1.0203	236	1.000
students	7	baselineNP1	- L1controls	7	target	-173.96	65.5	-2.6574	200	1.000
students	7	baselineNP1	- residents	5	baselineNP2	-109.93	87.2	-1.2607	146	1.000
students	7	baselineNP1	- residents	5	target	-131.06	84.4	-1.5531	129	1.000
students	7	baselineNP1	- residents	6	baselineNP2	53.65	88.0	0.6097	151	1.000
students	7	baselineNP1	- residents	6	target	34.87	84.9	0.4109	132	1.000
students	7	baselineNP1	- residents	7	baselineNP1	-48.35	86.6	-0.5582	145	1.000
students	7	baselineNP1	- residents	7	baselineNP2	-18.25	87.8	-0.2080	150	1.000
students	7	baselineNP1	- residents	7	target	-337.49	84.7	-3.9867	131	0.039
students	7	baselineNP1	- students	5	baselineNP2	-104.24	49.7	-2.0970	694	1.000
students	7	baselineNP1	- students	5	target	-182.22	43.3	-4.2094	709	0.010
students	7	baselineNP1	- students	6	baselineNP2	-54.34	54.7	-0.9930	943	1.000

Post Hoc Comparisons - group * region * condition

Comparison											
group	region	condition		group	region	condition	Difference	SE	t	df	p _{bonferroni}
students	7	baselineNP1	-	students	6	target	-44.25	45.3	-0.9771	822	1.000
students	7	baselineNP1	-	students	7	baselineNP2	-76.24	49.9	-1.5286	702	1.000
students	7	baselineNP1	-	students	7	target	-151.71	43.4	-3.4950	715	0.177
students	7	baselineNP2	-	L1controls	5	target	-18.07	65.0	-0.2779	195	1.000
students	7	baselineNP2	-	L1controls	6	target	99.96	66.2	1.5102	210	1.000
students	7	baselineNP2	-	L1controls	7	baselineNP2	6.00	67.5	0.0889	238	1.000
students	7	baselineNP2	-	L1controls	7	target	-97.72	65.4	-1.4948	200	1.000
students	7	baselineNP2	-	residents	5	target	-54.82	84.3	-0.6500	129	1.000
students	7	baselineNP2	-	residents	6	target	111.11	84.8	1.3101	132	1.000
students	7	baselineNP2	-	residents	7	baselineNP2	57.99	86.7	0.6685	146	1.000
students	7	baselineNP2	-	residents	7	target	-261.26	84.6	-3.0879	131	0.864
students	7	baselineNP2	-	students	5	target	-105.98	43.6	-2.4332	722	1.000
students	7	baselineNP2	-	students	6	target	31.99	45.6	0.7020	837	1.000
students	7	baselineNP2	-	students	7	target	-75.47	43.5	-1.7351	717	1.000
students	7	target	-	L1controls	7	target	-22.25	59.6	-0.3736	146	1.000
students	7	target	-	residents	7	target	-185.79	80.2	-2.3170	107	1.000

d. Italian Anaphora Resolution RT (Critical Region 5 and Post-Critical Regions 6-7)

Model Info

Info	
Estimate	Linear mixed model fit by REML
Call	resRT ~ 1 + group + condition + age + rspan_a + region + group:condition + group:region + condition:region + group:condition:region+(1 itemID)+(1 subjectID)
AIC	69521.0301
BIC	69527.3208
LogLikel.	-34628.1086
R-squared Marginal	0.0822
R-squared Conditional	0.2170
Converged	yes
Optimizer	bobyqa

Fixed Effect Omnibus tests

	F	Num df	Den df	p
group	2.817	2	76.3	0.066
condition	35.346	2	21.4	< .001
age	0.902	1	75.2	0.345
rspan_a	0.871	1	72.8	0.354

Fixed Effect Omnibus tests

	F	Num df	Den df	p
region	27.935	2	4672.7	< .001
group * condition	3.163	4	4682.1	0.013
group * region	8.043	4	4672.2	< .001
condition * region	18.328	4	4669.2	< .001
group * condition * region	1.155	8	4668.6	0.323

Note. Satterthwaite method for degrees of freedom

Post Hoc Comparisons - condition * region

Comparison				Difference	SE	t	df	p _{bonferroni}	
condition	region	condition	region						
baselineNP1	5	-	baselineNP1	6	78.845	24.9	3.1610	4677	0.057
baselineNP1	5	-	baselineNP1	7	96.337	23.7	4.0701	4671	0.002
baselineNP1	5	-	baselineNP2	5	-18.330	24.3	-0.7548	116	1.000
baselineNP1	5	-	baselineNP2	6	74.206	25.5	2.9057	141	0.153
baselineNP1	5	-	baselineNP2	7	97.186	24.8	3.9255	125	0.005
baselineNP1	5	-	target	5	-60.656	21.3	-2.8456	122	0.187
baselineNP1	5	-	target	6	57.357	21.9	2.6150	136	0.357
baselineNP1	5	-	target	7	-116.945	21.5	-5.4349	126	< .001
baselineNP1	6	-	baselineNP1	7	17.492	25.1	0.6963	4673	1.000
baselineNP1	6	-	baselineNP2	6	-4.638	26.9	-0.1727	172	1.000

Post Hoc Comparisons - condition * region

Comparison					SE	t	df	p _{bonferroni}
condition	region	condition	region	Difference				
baselineNP1	6	- baselineNP2	7	18.341	26.2	0.7010	155	1.000
baselineNP1	6	- target	6	-21.488	23.5	-0.9153	177	1.000
baselineNP1	6	- target	7	-195.790	23.1	-8.4629	168	< .001
baselineNP1	7	- baselineNP2	7	0.849	24.9	0.0340	129	1.000
baselineNP1	7	- target	7	-213.282	21.8	-9.8035	133	< .001
baselineNP2	5	- baselineNP1	6	97.175	25.7	3.7787	145	0.008
baselineNP2	5	- baselineNP1	7	114.667	24.5	4.6842	120	< .001
baselineNP2	5	- baselineNP2	6	92.537	24.2	3.8240	4665	0.005
baselineNP2	5	- baselineNP2	7	115.516	23.4	4.9411	4663	< .001
baselineNP2	5	- target	5	-42.325	21.0	-2.0176	114	1.000
baselineNP2	5	- target	6	75.687	21.6	3.5016	129	0.023
baselineNP2	5	- target	7	-98.615	21.2	-4.6543	119	< .001
baselineNP2	6	- baselineNP1	7	22.131	25.7	0.8608	145	1.000
baselineNP2	6	- baselineNP2	7	22.980	24.7	0.9322	4665	1.000
baselineNP2	6	- target	6	-16.850	23.0	-0.7323	165	1.000
baselineNP2	6	- target	7	-191.152	22.6	-8.4427	155	< .001
baselineNP2	7	- target	7	-214.131	21.7	-9.8522	132	< .001
target	5	- baselineNP1	6	139.500	22.9	6.0826	162	< .001
target	5	- baselineNP1	7	156.993	21.6	7.2825	128	< .001
target	5	- baselineNP2	6	134.862	22.4	6.0078	149	< .001
target	5	- baselineNP2	7	157.842	21.5	7.3299	127	< .001

Post Hoc Comparisons - condition * region

Comparison					SE	t	df	p _{bonferroni}
condition	region	condition	region	Difference				
target	5	- target	6	118.012	17.4	6.7772	4675	< .001
target	5	- target	7	-56.290	16.9	-3.3338	4671	0.031
target	6	- baselineNP1	7	38.981	22.2	1.7591	142	1.000
target	6	- baselineNP2	7	39.829	22.1	1.7988	142	1.000
target	6	- target	7	-174.302	17.7	-9.8620	4676	< .001

Post Hoc Comparisons - group * region

Comparison					SE	t	df	p _{bonferroni}
group	region	group	region	Difference				
L1controls	5	- L1controls	6	43.935	22.3	1.96830	4685.6	1.000
L1controls	5	- L1controls	7	84.773	21.0	4.04411	4681.9	0.002
L1controls	5	- residents	5	-147.745	52.9	-2.79223	91.5	0.229
L1controls	5	- residents	6	22.120	53.3	0.41496	94.2	1.000
L1controls	5	- residents	7	-76.752	53.1	-1.44497	92.9	1.000
L1controls	5	- students	6	32.281	47.3	0.68297	110.0	1.000
L1controls	5	- students	7	-43.514	46.7	-0.93158	105.2	1.000
L1controls	6	- L1controls	7	40.838	22.5	1.81401	4685.1	1.000

Post Hoc Comparisons - group * region

Comparison				Difference	SE	t	df	p _{bonferroni}
group	region	group	region					
L1controls	6	- residents	6	-21.815	54.0	-0.40409	98.9	1.000
L1controls	6	- residents	7	-120.688	53.8	-2.24325	97.5	0.977
L1controls	6	- students	7	-87.449	47.6	-1.83604	113.2	1.000
L1controls	7	- residents	7	-161.525	53.2	-3.03639	93.4	0.112
residents	5	- L1controls	6	191.680	53.6	3.57622	96.1	0.020
residents	5	- L1controls	7	232.518	53.0	4.38780	92.0	0.001
residents	5	- residents	6	169.865	21.3	7.95647	4663.3	< .001
residents	5	- residents	7	70.992	20.9	3.39676	4660.0	0.025
residents	5	- students	6	180.026	61.0	2.95005	91.8	0.145
residents	5	- students	7	104.231	60.6	1.72018	89.3	1.000
residents	6	- L1controls	7	62.653	53.4	1.17363	94.7	1.000
residents	6	- residents	7	-98.872	21.6	-4.57462	4662.4	< .001
residents	6	- students	7	-65.634	61.0	-1.07671	91.5	1.000
students	5	- L1controls	5	43.313	46.5	0.93141	103.3	1.000
students	5	- L1controls	6	87.248	47.4	1.83967	111.2	1.000
students	5	- L1controls	7	128.086	46.6	2.74828	104.0	0.254
students	5	- residents	5	-104.432	60.4	-1.72796	88.4	1.000
students	5	- residents	6	65.432	60.8	1.07615	90.5	1.000
students	5	- residents	7	-33.440	60.6	-0.55146	89.6	1.000
students	5	- students	6	75.594	23.7	3.18894	4670.4	0.052
students	5	- students	7	-0.201	22.7	-0.00887	4662.2	1.000

Post Hoc Comparisons - group * region

Comparison				Difference	SE	t	df	p _{bonferroni}	
group	region	group	region						
students	6	-	L1controls	6	11.654	48.2	0.24192	118.1	1.000
students	6	-	L1controls	7	52.492	47.4	1.10820	110.7	1.000
students	6	-	residents	6	-10.161	61.4	-0.16553	93.9	1.000
students	6	-	residents	7	-109.034	61.2	-1.78088	93.0	1.000
students	6	-	students	7	-75.795	24.1	-3.14235	4671.9	0.061
students	7	-	L1controls	7	128.287	46.8	2.74044	105.9	0.259
students	7	-	residents	7	-33.238	60.8	-0.54674	90.5	1.000

Post Hoc Comparisons - group * condition

Comparison					Difference	SE	t	df	p _{bonferroni}
group	condition	group	condition						
L1controls	baselineNP1	-	L1controls	baselineNP2	-10.66	25.0	-0.4260	129.7	1.000
L1controls	baselineNP1	-	L1controls	target	-51.83	22.1	-2.3403	140.1	0.745
L1controls	baselineNP1	-	residents	baselineNP1	-83.79	54.4	-1.5406	101.9	1.000
L1controls	baselineNP1	-	residents	baselineNP2	-93.75	54.9	-1.7081	102.2	1.000
L1controls	baselineNP1	-	residents	target	-216.03	53.4	-4.0438	93.1	0.004
L1controls	baselineNP1	-	students	baselineNP2	-45.79	48.8	-0.9379	117.4	1.000
L1controls	baselineNP1	-	students	target	-155.66	47.2	-3.2957	105.4	0.048

Post Hoc Comparisons - group * condition

Comparison					Difference	SE	t	df	p _{bonferroni}
group	condition		group	condition					
L1controls	baselineNP2	-	L1controls	target	-41.17	21.6	-1.9018	128.0	1.000
L1controls	baselineNP2	-	residents	baselineNP2	-83.09	54.2	-1.5332	100.5	1.000
L1controls	baselineNP2	-	residents	target	-205.37	53.2	-3.8597	91.7	0.008
L1controls	baselineNP2	-	students	target	-144.99	46.9	-3.0883	103.1	0.093
L1controls	target	-	residents	target	-164.20	51.5	-3.1889	82.0	0.073
residents	baselineNP1	-	L1controls	baselineNP2	73.13	54.7	1.3379	100.7	1.000
residents	baselineNP1	-	L1controls	target	31.96	53.2	0.6003	92.0	1.000
residents	baselineNP1	-	residents	baselineNP2	-9.96	24.4	-0.4075	119.2	1.000
residents	baselineNP1	-	residents	target	-132.24	21.1	-6.2642	118.0	< .001
residents	baselineNP1	-	students	baselineNP2	38.00	62.0	0.6126	96.2	1.000
residents	baselineNP1	-	students	target	-71.86	60.8	-1.1822	89.4	1.000
residents	baselineNP2	-	L1controls	target	41.92	53.3	0.7872	92.1	1.000
residents	baselineNP2	-	residents	target	-122.28	21.1	-5.7872	118.3	< .001
residents	baselineNP2	-	students	target	-61.90	60.8	-1.0181	89.4	1.000
students	baselineNP1	-	L1controls	baselineNP1	44.30	48.5	0.9141	121.2	1.000
students	baselineNP1	-	L1controls	baselineNP2	33.63	48.7	0.6902	116.7	1.000
students	baselineNP1	-	L1controls	target	-7.53	47.2	-0.1597	105.3	1.000
students	baselineNP1	-	residents	baselineNP1	-39.50	61.7	-0.6397	96.2	1.000
students	baselineNP1	-	residents	baselineNP2	-49.46	62.2	-0.7954	97.1	1.000
students	baselineNP1	-	residents	target	-171.73	60.9	-2.8209	90.0	0.212
students	baselineNP1	-	students	baselineNP2	-1.50	26.7	-0.0561	168.1	1.000

Post Hoc Comparisons - group * condition

Comparison					Difference	SE	t	df	p _{bonferroni}
group	condition	group	condition						
students	baselineNP1	-	students	target	-111.36	23.5	-4.7374	179.7	< .001
students	baselineNP2	-	L1controls	baselineNP2	35.13	48.0	0.7317	117.1	1.000
students	baselineNP2	-	L1controls	target	-6.04	47.0	-0.1285	103.7	1.000
students	baselineNP2	-	residents	baselineNP2	-47.96	61.6	-0.7783	95.5	1.000
students	baselineNP2	-	residents	target	-170.24	60.7	-2.8027	89.2	0.224
students	baselineNP2	-	students	target	-109.86	23.2	-4.7449	169.2	< .001
students	target	-	L1controls	target	103.82	45.0	2.3058	90.5	0.843
students	target	-	residents	target	-60.38	59.3	-1.0190	81.5	1.000

4. One-Tailed One-Sample Wilcoxon Signed-Rank Tests of Means (RC Attachment Ambiguity Resolution)

a. University Students' English RC Attachment Resolution (Baseline High)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	11172	< .001

Note. $H_a \mu > 0.5$

b. University Students' English RC Attachment Resolution (Baseline Low)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	1985	< .001

Note. $H_a \mu < 0.5$

c. University Students' English RC Attachment Resolution (Target)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	28178	< .001

Note. $H_a \mu > 0.5$

d. Long-Term Residents' English RC Attachment Resolution (Baseline High)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	8840	< .001

Note. $H_a \mu > 0.5$

e. Long-Term Residents' English RC Attachment Resolution (Baseline Low)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	1139	< .001

Note. $H_a \mu < 0.5$

f. Long-Term Residents' English RC Attachment Resolution (Target)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	19608	0.002

Note. $H_a \mu > 0.5$

g. English L1 Controls' English RC Attachment Resolution (Baseline High)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	10349	< .001

Note. $H_a \mu > 0.5$

h. English L1 Controls' English RC Attachment Resolution (Baseline Low)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	2280	< .001

Note. $H_a \mu < 0.5$

i. English L1 Controls' English RC Attachment Resolution (Target)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	25992	0.987

Note. $H_a \mu < 0.5$

j. University Students' Italian RC Attachment Resolution (Baseline High)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	7973	< .001

Note. $H_a \mu > 0.5$

k. University Students' Italian RC Attachment Resolution (Baseline Low)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	1416	< .001

Note. $H_a \mu < 0.5$

l. University Students' Italian RC Attachment Resolution (Target)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	18031	0.998

Note. $H_a \mu < 0.5$

m. Long-Term Residents' Italian RC Attachment Resolution (Baseline High)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	9860	< .001

Note. $H_a \mu > 0.5$

n. Long-Term Residents' Italian RC Attachment Resolution (Baseline Low)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	1360	< .001

Note. $H_a \mu < 0.5$

o. Long-Term Residents' Italian RC Attachment Resolution (Target)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	21084	1.000

Note. $H_a \mu < 0.5$

p. Italian L1 Controls' Italian RC Attachment Resolution (Baseline High)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	13937	< .001

Note. $H_a \mu > 0.5$

q. Italian L1 Controls' Italian RC Attachment Resolution (Baseline Low)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	3178	< .001

Note. $H_a \mu < 0.5$

r. Italian L1 Controls' Italian RC Attachment Resolution (Target)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	36424	< .001

Note. $H_a \mu > 0.5$

5. One-Tailed One-Sample Wilcoxon Signed-Rank Tests of Means (RC Attachment Ambiguity Resolution) Run Separately for Human/Non-Human Referents (Target Only)

a. University Students' English RC Resolution (Target, Human)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	5110	0.277

Note. $H_a \mu > 0.5$

b. University Students' English RC Resolution (Target, Non-Human)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	9180	< .001

Note. $H_a \mu > 0.5$

c. Long-Term Residents' English RC Resolution (Target, Human)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	3444	0.818

Note. $H_a \mu > 0.5$

d. Long-Term Residents' English RC Resolution (Target, Non-Human)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	6528	< .001

Note. $H_a \mu > 0.5$

e. English L1 Controls' English RC Resolution (Target, Human)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	5475	0.403

Note. $H_a \mu < 0.5$

f. English L1 Controls' English RC Resolution (Target, Non-Human)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	7595	1.000

Note. $H_a \mu < 0.5$

g. University Students' Italian RC Resolution (Target, Human)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	6216	0.042

Note. $H_a \mu > 0.5$

h. University Students' Italian RC Resolution (Target, Non-Human)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	6451	1.000

Note. $H_a \mu < 0.5$

i. Long-Term Residents' Italian RC Resolution (Target, Human)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	3192	0.463

Note. $H_a \mu < 0.5$

j. Long-Term Residents' Italian RC Resolution (Target, Non-Human)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	7728	1.000

Note. $H_a \mu < 0.5$

k. Italian L1 Controls' Italian RC Resolution (Target, Human)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	6216	0.042

Note. $H_a \mu > 0.5$

l. Italian L1 Controls' Italian RC Resolution (Target, Non-Human)

One Sample T-Test

		Statistic	p
preference	Wilcoxon W	12358	< .001

Note. $H_a \mu > 0.5$

6. Mixed Binomial Logistic Regression Models for Preference

a. English RC Attachment Ambiguity Resolution Preference

Model Info

Info	Value	Comment
Model Type	Logistic	Model for binary y
Call	glm	preference ~ 1 + group + human + condition + human:condition + group:condition + human:group + human:condition:group + (1 itemID) + (1 subjectID)
Link function	Logit	Log of the odd of y=1 over y=0
Direction	P(y=1)/P(y=0)	P(preference = 1) / P(preference = 0)
Distribution	Binomial	Dichotomous event distribution of y
LogLikel.	-738.653	Unconditional Log-Likelihood
-2*LogLikel.	1477.306	Unconditional absolute deviance
Deviance	1234.602	Conditional relative deviance
R-squared	0.510	Marginal
R-squared	0.694	Conditional
AIC	1517.310	Less is better
BIC	1626.354	Less is better
Residual DF	1704.000	
Chi-squared/DF	0.761	Overdispersion indicator

Model Info

Info	Value	Comment
Converged	yes	
Optimizer	bobyqa	

Fixed Effect Omnibus tests

	χ^2	df	p
group	4.89	2.00	0.087
human	1.44	1.00	0.230
condition	84.22	2.00	< .001
human * condition	8.08	2.00	0.018
group * condition	21.15	4.00	< .001
human * group	4.08	2.00	0.130
human * condition * group	6.82	4.00	0.146

Post Hoc Comparisons - human * condition

Comparison					exp(B)	SE	z	p _{bonferroni}
human	condition		human	condition				
no	ambiguous	-	yes	ambiguous	3.6207	1.8914	2.46	0.207
no	baseline.high	-	no	ambiguous	21.3287	15.8456	4.12	< .001
no	baseline.high	-	no	baseline.low	1595.4409	1538.7168	7.65	< .001
no	baseline.high	-	yes	ambiguous	77.2247	57.4817	5.84	< .001
no	baseline.high	-	yes	baseline.high	5.3216	4.9790	1.79	1.000
no	baseline.high	-	yes	baseline.low	424.6405	340.1918	7.55	< .001
no	baseline.low	-	no	ambiguous	0.0134	0.0107	-5.38	< .001
no	baseline.low	-	yes	ambiguous	0.0484	0.0386	-3.80	0.002
no	baseline.low	-	yes	baseline.low	0.2662	0.2240	-1.57	1.000
yes	baseline.high	-	no	ambiguous	4.0080	3.1117	1.79	1.000
yes	baseline.high	-	no	baseline.low	299.8071	296.4013	5.77	< .001
yes	baseline.high	-	yes	ambiguous	14.5117	11.2726	3.44	0.009
yes	baseline.high	-	yes	baseline.low	79.7963	66.2825	5.27	< .001
yes	baseline.low	-	no	ambiguous	0.0502	0.0300	-5.01	< .001
yes	baseline.low	-	yes	ambiguous	0.1819	0.1076	-2.88	0.060

Post Hoc Comparisons - group * condition

Comparison					exp(B)	SE	z	P _{bonferroni}
group	condition		group	condition				
L1controls	ambiguous	-	residents	ambiguous	0.8254	0.2995	-0.5290	1.000
L1controls	baseline.high	-	L1controls	ambiguous	5.0901	2.6891	3.0803	0.074
L1controls	baseline.high	-	L1controls	baseline.low	55.1648	35.8780	6.1661	< .001
L1controls	baseline.high	-	residents	ambiguous	4.2013	2.5666	2.3496	0.677
L1controls	baseline.high	-	residents	baseline.high	0.1229	0.0851	-3.0284	0.088
L1controls	baseline.high	-	residents	baseline.low	94.1218	68.8731	6.2106	< .001
L1controls	baseline.high	-	students	ambiguous	2.7561	1.6802	1.6630	1.000
L1controls	baseline.high	-	students	baseline.low	94.6933	72.6492	5.9315	< .001
L1controls	baseline.low	-	L1controls	ambiguous	0.0923	0.0503	-4.3721	< .001
L1controls	baseline.low	-	residents	ambiguous	0.0762	0.0477	-4.1140	0.001
L1controls	baseline.low	-	residents	baseline.low	1.7062	0.8690	1.0490	1.000
L1controls	baseline.low	-	students	ambiguous	0.0500	0.0312	-4.7916	< .001
residents	baseline.high	-	L1controls	ambiguous	41.4277	33.1542	4.6532	< .001
residents	baseline.high	-	L1controls	baseline.low	448.9812	397.6560	6.8952	< .001
residents	baseline.high	-	residents	ambiguous	34.1936	25.4793	4.7401	< .001
residents	baseline.high	-	residents	baseline.low	766.0494	657.4602	7.7381	< .001
residents	baseline.high	-	students	ambiguous	22.4317	18.0535	3.8648	0.004
residents	baseline.high	-	students	baseline.low	770.7009	718.8648	7.1266	< .001
residents	baseline.low	-	L1controls	ambiguous	0.0541	0.0347	-4.5480	< .001
residents	baseline.low	-	residents	ambiguous	0.0446	0.0258	-5.3876	< .001

Post Hoc Comparisons - group * condition

Comparison					exp(B)	SE	z	P _{bonferroni}
group	condition		group	condition				
residents	baseline.low	-	students	ambiguous	0.0293	0.0190	-5.4289	< .001
students	ambiguous	-	L1controls	ambiguous	1.8468	0.6669	1.6989	1.000
students	ambiguous	-	residents	ambiguous	1.5243	0.5715	1.1245	1.000
students	baseline.high	-	L1controls	ambiguous	57.7806	46.9025	4.9975	< .001
students	baseline.high	-	L1controls	baseline.high	11.3516	8.0071	3.4441	0.021
students	baseline.high	-	L1controls	baseline.low	626.2082	561.1818	7.1859	< .001
students	baseline.high	-	residents	ambiguous	47.6909	38.9843	4.7279	< .001
students	baseline.high	-	residents	baseline.high	1.3947	1.2206	0.3802	1.000
students	baseline.high	-	residents	baseline.low	1068.4331	977.2157	7.6249	< .001
students	baseline.high	-	students	ambiguous	31.2862	23.6125	4.5622	< .001
students	baseline.high	-	students	baseline.low	1074.9207	964.5752	7.7785	< .001
students	baseline.low	-	L1controls	ambiguous	0.0538	0.0367	-4.2867	< .001
students	baseline.low	-	L1controls	baseline.low	0.5826	0.3261	-0.9652	1.000
students	baseline.low	-	residents	ambiguous	0.0444	0.0306	-4.5113	< .001
students	baseline.low	-	residents	baseline.low	0.9940	0.5816	-0.0103	1.000
students	baseline.low	-	students	ambiguous	0.0291	0.0181	-5.6925	< .001

b. Italian RC Attachment Ambiguity Resolution Preference

Model Info

Info	Value	Comment
Model Type	Logistic	Model for binary y
Call	glm	preference ~ 1 + group + condition + human + group:condition + group:human + condition:human + human:condition:group + (1 itemID) + (1 subjectID)
Link function	Logit	Log of the odd of y=1 over y=0
Direction	P(y=1)/P(y=0)	P(preference = high) / P(preference = low)
Distribution	Binomial	Dichotomous event distribution of y
LogLikel.	-705.029	Unconditional Log-Likelihood
-2*LogLikel.	1410.058	Unconditional absolute deviance
Deviance	1232.946	Conditional relative deviance
R-squared	0.833	Marginal
R-squared	0.872	Conditional
AIC	1450.060	Less is better
BIC	1558.373	Less is better
Residual DF	1642.000	
Chi-squared/DF	0.773	Overdispersion indicator
Converged	yes	
Optimizer	bobyqa	

Fixed Effect Omnibus tests

	X²	df	p
group	6.0868	2.00	0.048
condition	68.7238	2.00	< .001
human	0.0480	1.00	0.827
group * condition	7.8932	4.00	0.096
group * human	0.2896	2.00	0.865
condition * human	10.9190	2.00	0.004
human * condition * group	3.7107	4.00	0.447

Post Hoc Comparisons - condition * human

Comparison									
condition	human		condition	human	exp(B)	SE	z	p	p_{bonferroni}
ambiguous	no	-	ambiguous	yes	6.0957	1.9706	5.591	< .001	< .001
ambiguous	no	-	baseline.high	yes	0.9429	0.4411	-0.126	0.900	1.000
ambiguous	no	-	baseline.low	yes	27.2750	10.1799	8.858	< .001	< .001
baseline.high	no	-	ambiguous	no	1365.2698	55047.5819	0.179	0.858	1.000
baseline.high	no	-	ambiguous	yes	8322.2571	335548.7696	0.224	0.823	1.000
baseline.high	no	-	baseline.high	yes	1287.2908	51903.9698	0.178	0.859	1.000
baseline.high	no	-	baseline.low	no	42554.4296	1.72e+6	0.264	0.792	1.000

Post Hoc Comparisons - condition * human

Comparison					exp(B)	SE	z	p	p _{bonferroni}
condition	human		condition	human					
baseline.high	no	-	baseline.low	yes	37237.6997	1.50e+6	0.261	0.794	1.000
baseline.high	yes	-	ambiguous	yes	6.4649	2.9992	4.023	< .001	< .001
baseline.high	yes	-	baseline.low	yes	28.9272	14.4561	6.733	< .001	< .001
baseline.low	no	-	ambiguous	no	0.0321	0.0151	-7.320	< .001	< .001
baseline.low	no	-	ambiguous	yes	0.1956	0.0898	-3.554	< .001	0.006
baseline.low	no	-	baseline.high	yes	0.0303	0.0174	-6.079	< .001	< .001
baseline.low	no	-	baseline.low	yes	0.8751	0.4296	-0.272	0.786	1.000
baseline.low	yes	-	ambiguous	yes	0.2235	0.0805	-4.161	< .001	< .001

7. Linear Mixed Effects Models for RT

a. English RC Attachment Ambiguity Resolution RT (Critical Region 5 and Post-Critical Regions 6-7)

Model Info

Info	
Estimate	Linear mixed model fit by REML
Call	resRT ~ 1 + group + condition + region + age + rspan_a + human + group:condition + group:region + condition:region + group:human + condition:human + region:human + region:group:condition + group:condition:human + group:region:human + condition:region:human + region:group:condition:human + (1 itemID) + (1 subjectID)

Model Info

Info	
AIC	40573.0832
BIC	40539.3597
LogLikel.	-20107.1771
R-squared Marginal	0.0503
R-squared Conditional	0.4054
Converged	yes
Optimizer	bobyqa

Fixed Effect Omnibus tests

	F	Num df	Den df	p
group	0.2074	2	80.5	0.813
condition	1.6354	2	18.7	0.222
region	19.5716	1	2649.5	< .001
age	2.2372	1	76.3	0.139
rspan_a	0.1650	1	79.9	0.686
human	0.0769	1	18.4	0.785
group * condition	1.9408	4	2652.3	0.101

Fixed Effect Omnibus tests

	F	Num df	Den df	p
group * region	2.9275	2	2648.9	0.054
condition * region	4.0669	2	2646.0	0.017
group * human	2.4458	2	2648.3	0.087
condition * human	1.0800	2	18.5	0.360
region * human	1.7977	1	2648.2	0.180
group * condition * region	0.5573	4	2645.4	0.694
group * condition * human	0.2731	4	2649.2	0.895
group * region * human	0.1257	2	2647.7	0.882
condition * region * human	1.2935	2	2646.6	0.274
group * condition * region * human	0.8752	4	2645.7	0.478

Note. Satterthwaite method for degrees of freedom

Post Hoc Comparisons - condition * region

Comparison									
condition	region		condition	region	Difference	SE	t	df	p_{bonferroni}
baseline.high	6	-	baseline.high	7	-85.14	29.1	-2.925	2646.6	0.052
baseline.high	6	-	baseline.low	6	-42.46	33.5	-1.268	50.7	1.000
baseline.high	6	-	baseline.low	7	-50.89	32.9	-1.549	47.0	1.000

Post Hoc Comparisons - condition * region

Comparison					Difference	SE	t	df	p _{bonferroni}
condition	region		condition	region					
baseline.high	6	-	target	7	-63.96	28.5	-2.241	51.2	0.441
baseline.high	7	-	baseline.low	7	34.25	32.2	1.063	43.3	1.000
baseline.low	6	-	baseline.high	7	-42.68	32.9	-1.296	47.1	1.000
baseline.low	6	-	baseline.low	7	-8.43	27.7	-0.304	2644.9	1.000
baseline.low	6	-	target	7	-21.50	27.9	-0.772	46.5	1.000
target	6	-	baseline.high	6	-39.18	28.7	-1.364	52.6	1.000
target	6	-	baseline.high	7	-124.32	28.1	-4.427	47.8	< .001
target	6	-	baseline.low	6	-81.65	28.1	-2.907	48.2	0.082
target	6	-	baseline.low	7	-90.07	27.3	-3.295	43.2	0.030
target	6	-	target	7	-103.14	18.8	-5.490	2648.6	< .001
target	7	-	baseline.high	7	-21.18	27.9	-0.760	46.2	1.000
target	7	-	baseline.low	7	13.07	27.1	0.483	41.5	1.000

b. Italian RC Attachment Ambiguity Resolution RT (Critical Region 5 and Post-Critical Regions 6-7)

Model Info

Info	
Estimate	Linear mixed model fit by REML

Model Info

Info	
Call	resRT ~ 1 + group + condition + region + age + rspan_a + human + region:group + region:condition + group:condition + group:human + condition:human + region:human + region:group:condition + region:group:human + region:condition:human + group:condition:human + region:group:condition:human+(1 itemID)+(1 subjectID)
AIC	48898.9136
BIC	48877.7357
LogLikel.	-24272.4385
R-squared Marginal	0.0658
R-squared Conditional	0.3197
Converged	yes
Optimizer	bobyqa

Fixed Effect Omnibus tests

	F	Num df	Den df	p
group	6.2045	2	77.0	0.003
condition	0.1076	2	18.0	0.899
region	10.1375	1	3227.8	0.001
age	1.0196	1	78.3	0.316
rspan_a	0.0336	1	72.6	0.855

Fixed Effect Omnibus tests

	F	Num df	Den df	p
human	0.4239	1	17.9	0.523
group * region	2.1712	2	3228.1	0.114
condition * region	0.8235	2	3227.4	0.439
group * condition	1.8313	4	3240.9	0.120
group * human	0.0729	2	3227.8	0.930
condition * human	0.1596	2	18.0	0.854
region * human	0.1991	1	3228.2	0.655
group * condition * region	0.8390	4	3227.7	0.500
group * region * human	0.5451	2	3228.5	0.580
condition * region * human	1.9227	2	3227.4	0.146
group * condition * human	0.7615	4	3229.4	0.550
group * condition * region * human	1.4847	4	3227.8	0.204

Note. Satterthwaite method for degrees of freedom

Post Hoc Comparisons - group

Comparison							
group		group	Difference	SE	t	df	p_{bonferroni}
L1controls	-	residents	-165.5	69.3	-2.388	76.9	0.058
students	-	L1controls	183.4	59.3	3.091	77.3	0.008
students	-	residents	17.9	79.6	0.225	76.7	1.000

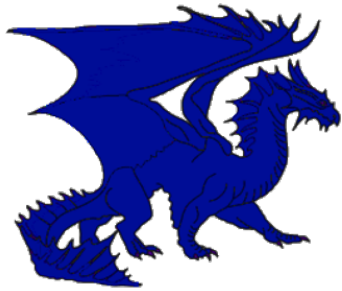
Post Hoc Comparisons - region

Comparison							
region		region	Difference	SE	t	df	p_{bonferroni}
6	-	7	41.0	12.9	3.18	3228	0.001

Appendix E: Materials (Prosodic Attrition)

Colour/Item Combinations in the Picture-Naming Task

1a. *Blue Dragon – Drago Blu*



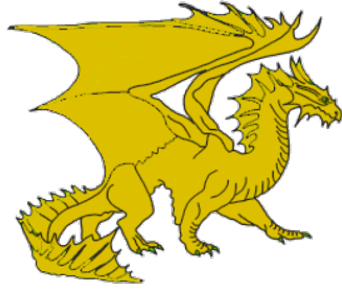
1b. *Green Dragon – Drago Verde*



1c. *Red Dragon – Drago Rosso*



1d. Yellow Dragon – *Drago Giallo*



2a. Blue Flower – *Fiore Blu*



2b. Green Flower – *Fiore Verde*



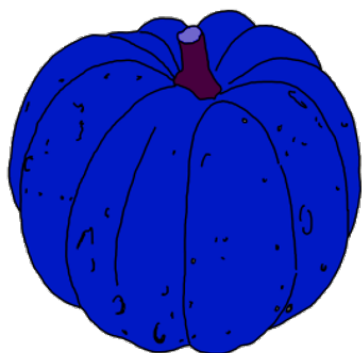
2c. Red Flower – Fiore Rosso



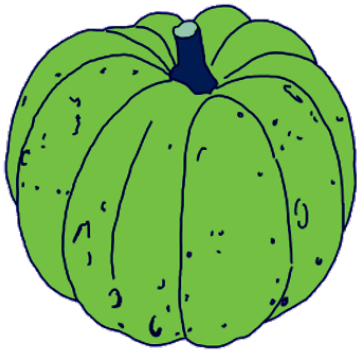
2d. Yellow Flower – Fiore Giallo



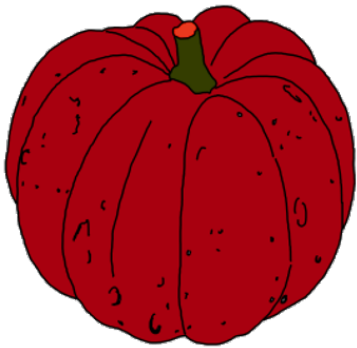
3a. Blue Pumpkin – Zucca Blu



3b. Green Pumpkin – Zucca Verde



3c. Red Pumpkin – Zucca Rossa



3d. Yellow Pumpkin – Zucca Gialla



4a. *Blue Tiger – Tigre Blu*



4b. *Green Tiger – Tigre Verde*



4c. *Red Tiger – Tigre Rossa*



4d. *Yellow Tiger – Tigre Gialla*



Appendix F: Reconciliation of Judgments (Prosodic Attrition)

(Dis)agreement Rates in English

1. Confirmatory Analyses

The overall disagreement rate between judges in English was 17.2% (agreement rate: 82.8%). Disagreements however differed across conditions: specifically, while in both CC and GC conditions the disagreement rates were 11.5% (agreement rates: 88.5%), in the CG condition the disagreement rate was 33.9% (agreement rate: 66.1%). That is, the majority of the disagreements were concentrated where the adjustment of prominence would be expected. In 90% of cases, the disagreements were due to first expert judging prominence as having been adjusted while the second judge rated prominence in the opposite direction. This highlights the fact that the boundary between judging prominence as being adjusted or not, and the exact phonetic cues that are used to formulate either judgment, are poorly understood. The fact that, by contrast, judges agreed 88.5% on CC and GC trials (where deaccenting would *not* be expected), and that most of the disagreements on CC and GC trials involved instances of cross-pair prominence adjustment (discussed later), is evidence in favour of the assumption that the adjustment of prominence is of a categorical nature (whose phonetics cues are, as stated above, not entirely clear as of yet).

Trials which had been flagged by either judge due to uncertainty were reconciled as follows: adjusted?/adjusted = adjusted; not adjusted?/not adjusted = not adjusted; adjusted?/not adjusted = not adjusted; not

adjusted?/adjusted = adjusted. In the event of both judges being unsure in the same direction, the judgments were reconciled as follows: adjusted?/adjusted? = adjusted; not adjusted?/not adjusted? = not adjusted. Where judges were unsure in different directions, separate judgments were retained for each expert.

For comparison purposes, mean percentages of trials where relative prominence was judged as adjusted (PA)/not adjusted (PNA) are reported below, using, respectively, (a) judgments from the first expert (the same ones reported in § 4.4) and (b) reconciled judgments (where possible, as explained above) joined with unreconciled judgments from the second expert.

- a. Mean percentage of trials where relative prominence was judged as adjusted/not adjusted in the English picture-naming task using two separate sets of judgments for comparison

	University students		Long-term residents		L1 English controls	
	PA	PNA	PA	PNA	PA	PNA
Judge 1						
CC	19.2%	80.8%	15.4%	84.6%	19.6%	80.4%
CG	87.3%	12.7%	89.6%	10.4%	92.2%	7.8%
GC	17.9%	80.1%	14%	86%	17.3%	82.7%
Reconciled + Judge 2						
CC	13.8%	86.2%	12.3%	87.7%	15.5%	84.5%
CG	70.1%	19.9%	74.7%	25.3%	76.6%	23.4%
GC	12.7%	87.3%	11.2%	88.8%	11.4%	88.6%

Note. PA = prominence (judged as) adjusted; PNA = prominence (judged as) not adjusted. CC = contrastive/contrastive; CG = contrastive/given; GC = given/contrastive.

As can be seen above, lower percentages of prominence judged as adjusted were reported (to a similar degree) on CC and GC items than on CG items for all groups in both sets of judgments, with judgments being more conservative in the second set (however still in the same direction as the first set). Two

logistic mixed models, one using each of the above sets of judgments, were thus fitted to investigate the likelihood of relative prominence being judged as adjusted (1) or not (0) across groups and conditions. Full model details and outputs can be consulted in Appendix G; what needs to be noted is that both models similarly showed only a significant main effect of condition. Across groups, prominence was significantly more likely to be judged as having been adjusted for repetition in CG trials than in GC trials, and significantly less likely to be judged as having been adjusted in CC trials than in CG trials. The likelihood of prominence being judged as having been adjusted for repetition did not differ significantly between CC trials and GC trials. Thus, overall, the two models yielded similar conclusions.

2. Exploratory Analyses

The full randomisation of item pair presentation gave rise to the presence of uncontrolled contexts with a potential to trigger cross-pair prominence adjustment – i.e., the second instance of two identical nouns in adjacent item pairs, such as ‘flower’ in the sequence [RED DRAGON, GREEN FLOWER] + [BLUE PUMPKIN, YELLOW flower]. Therefore, it seemed reasonable to compare (dis)agreement rates between judges also in such contexts. Given that different speakers were presented with a different number of cases where cross-pair adjustment may be triggered, separate (dis)agreement percentages were calculated for each individual speaker in each condition. Percentages were then summed within each speaker group, and divided by the total number of speakers within that group. The final percentages are reported below – in the case of agreement, percentages are divided into whether prominence was judged as adjusted or not.

- b. Percentages of agreement and disagreement for CC, CG, and GC items with potential for cross-pair prominence adjustment on the English picture-naming task

	University students				Long-term residents				L1 English controls			
	Agree%			Disagree%	Agree%			Disagree%	Agree%			Disagree%
	N	PA	PNA		N	PA	PNA		N	PA	PNA	
CC	54	15%	36%	49%	95	25%	48%	27%	88	30%	37%	33%
CG	25	34%	13%	53%	53	57%	10%	33%	45	61%	9%	30%
GC	23	32%	22%	46%	46	17%	62%	21%	53	26%	34%	40%

Note. (Dis)agree% = (dis)agreement percentage. N = total number of items per group in each condition. PA = prominence (judged as) adjusted; PNA = prominence (judged as) not adjusted. CC = contrastive/contrastive; CG = contrastive/given; GC = given/contrastive. Percentages in each condition were calculated separately for each participant, then summed and divided by the total number of participants within each group (specifically, 8 university students, 13 long-term residents and 12 L1 English controls).

As can be seen above, higher percentages of disagreement between experts were reported when judging students' responses than those of the other two groups. On CG trials (where the adjustment of prominence is expected by definition) the percentage of relative prominence judged as adjusted was, for all groups, always higher than that of prominence judged as not adjusted. By contrast, there are noticeable differences in the other two conditions across groups. Most importantly, of specific interest to the aim of this attrition study is the fact that the percentages of prominence judged as adjusted were much lower when judging long-term residents' responses than those of L1 English controls on both CC and GC items (17% and 25% for GC and CC items in the case of residents; 26% and 30% in the case of L1 English controls). These results are largely in line with the conclusions reported in § 4.4 on the basis of only the first set of judgments.

Appendix G: Inferential Statistics (Prosodic Attrition)

Expert Judgments (Picture-Naming Task)

1. Mixed Binomial Logistic Regression Models for Relative Prominence

a. English (Judge 1)

Model Info

Info	Value	Comment
Model Type	Logistic	Model for binary y
Call	glm	relative.prominence ~ 1 + group + condition + group:condition + (1 itemID) + (1 subjectID)
Link function	Logit	Log of the odd of y=1 over y=0
Direction	$P(y=1)/P(y=0)$	$P(\text{relative.prominence} = 1) / P(\text{relative.prominence} = 0)$
Distribution	Binomial	Dichotomous event distribution of y
LogLikel.	-1741.734	Unconditional Log-Likelihood
-2*LogLikel.	3483.468	Unconditional absolute deviance
Deviance	3326.972	Conditional relative deviance
R-squared	0.459	Marginal
R-squared	0.525	Conditional
AIC	3505.470	Less is better
BIC	3575.284	Less is better

Model Info

Info	Value	Comment
Residual DF	4206.000	
Chi-squared/DF	0.940	Overdispersion indicator
Converged	yes	
Optimizer	bobyqa	

Fixed Effect Omnibus tests

	χ^2	df	p
group	1.87	2.00	0.392
condition	1000.83	2.00	< .001
group * condition	4.41	4.00	0.353

Post Hoc Comparisons - condition

Comparison					
condition	condition	exp(B)	SE	z	p _{bonferroni}
CC	- CG	0.0181	0.00240	-30.33	< .001
CC	- GC	1.1338	0.11862	1.20	0.690

Post Hoc Comparisons - condition

Comparison						
condition	condition	exp(B)	SE	z	P _{bonferroni}	
CG	- GC	62.5179	9.18013	28.16	< .001	

c. English (Reconciled + Judge 2)

Model Info

Info	Value	Comment
Model Type	Logistic	Model for binary y
Call	glm	relative.prominence ~ 1 + group + condition + group:condition + (1 itemID) + (1 subjectID)
Link function	Logit	Log of the odd of y=1 over y=0
Direction	P(y=1)/P(y=0)	P(relative.prominence = 1) / P(relative.prominence = 0)
Distribution	Binomial	Dichotomous event distribution of y
LogLikel.	-1610.225	Unconditional Log-Likelihood
-2*LogLikel.	3220.450	Unconditional absolute deviance
Deviance	2991.636	Conditional relative deviance
R-squared	0.337	Marginal
R-squared	0.567	Conditional
AIC	3242.450	Less is better
BIC	3312.213	Less is better

Model Info

Info	Value	Comment
Residual DF	4186.000	
Chi-squared/DF	1.017	Overdispersion indicator
Converged	yes	
Optimizer	bobyqa	

Fixed Effect Omnibus tests

	X ²	df	p
group	0.444	2.00	0.801
condition	927.988	2.00	< .001
group * condition	5.275	4.00	0.260

Post Hoc Comparisons - condition

Comparison						
condition	condition	exp(B)	SE	z	p _{bonferroni}	
CC	- CG	0.0277	0.00348	-28.57	< .001	
CC	- GC	1.2350	0.15033	1.73	0.249	
CG	- GC	44.5884	6.55492	25.83	< .001	

d. Italian

Model Info

Info	Value	Comment
Model Type	Logistic	Model for binary y
Call	glm	relative.prominence ~ 1 + group + condition + group:condition + (1 + condition itemID) + (1 + condition subjectID)
Link function	Logit	Log of the odd of y=1 over y=0
Direction	P(y=1)/P(y=0)	P(relative.prominence = 1) / P(relative.prominence = 0)
Distribution	Binomial	Dichotomous event distribution of y
LogLikel.	-393.896	Unconditional Log-Likelihood
-2*LogLikel.	787.792	Unconditional absolute deviance
Deviance	633.508	Conditional relative deviance
R-squared	0.771	Marginal
R-squared	0.910	Conditional
AIC	829.790	Less is better
BIC	963.491	Less is better
Residual DF	4280.000	
Chi-squared/DF	0.337	Overdispersion indicator
Converged	yes	
Optimizer	bobyqa	

Fixed Effect Omnibus tests

	X²	df	p
group	3.42	2.00	0.181
condition	7.37	2.00	0.025
group * condition	20.47	4.00	< .001

Post Hoc Comparisons - group * condition

Comparison				exp(B)	SE	z	p_{bonferroni}
group	condition		group condition				
L1controls	CC	-	L1controls CG	1.67143	2.08209	0.412	1.000
L1controls	CC	-	L1controls GC	3.32e+7	1.75e0+9	0.329	1.000
L1controls	CC	-	residents CG	0.06088	0.06751	-2.524	0.418
L1controls	CC	-	residents GC	27.21739	108.16477	0.831	1.000
L1controls	CC	-	students CG	0.00456	0.00506	-4.863	< .001
L1controls	CC	-	students GC	17.67770	71.00862	0.715	1.000
L1controls	CG	-	L1controls GC	1.99e+7	1.05e0+9	0.319	1.000
L1controls	CG	-	residents GC	16.28393	63.04720	0.721	1.000
L1controls	CG	-	students GC	10.57641	41.30856	0.604	1.000
residents	CC	-	L1controls CC	0.50195	0.48556	-0.713	1.000
residents	CC	-	L1controls CG	0.83898	1.28780	-0.114	1.000
residents	CC	-	L1controls GC	1.67e+7	8.78e0+8	0.315	1.000

Post Hoc Comparisons - group * condition

Comparison					exp(B)	SE	z	p _{bonferroni}
group	condition		group	condition				
residents	CC	-	residents	CG	0.03056	0.03287	-3.242	0.043
residents	CC	-	residents	GC	13.66182	54.55293	0.655	1.000
residents	CC	-	students	CG	0.00229	0.00278	-5.005	< .001
residents	CC	-	students	GC	8.87335	36.30174	0.534	1.000
residents	CG	-	L1controls	CG	27.45539	29.33315	3.101	0.070
residents	CG	-	L1controls	GC	5.45e+8	2.87e+10	0.382	1.000
residents	CG	-	residents	GC	447.08173	1666.60038	1.637	1.000
residents	CG	-	students	GC	290.37957	1112.36597	1.480	1.000
residents	GC	-	L1controls	GC	1.22e+6	6.43e0+7	0.266	1.000
students	CC	-	L1controls	CC	4.37280	3.73393	1.728	1.000
students	CC	-	L1controls	CG	7.30881	9.79756	1.484	1.000
students	CC	-	L1controls	GC	1.45e+8	7.65e0+9	0.357	1.000
students	CC	-	residents	CC	8.71159	8.09463	2.330	0.714
students	CC	-	residents	CG	0.26621	0.26143	-1.348	1.000
students	CC	-	residents	GC	119.01614	465.94873	1.221	1.000
students	CC	-	students	CG	0.01995	0.01451	-5.382	< .001
students	CC	-	students	GC	77.30098	299.85595	1.121	1.000
students	CG	-	L1controls	CG	366.38525	411.70989	5.254	< .001
students	CG	-	L1controls	GC	7.28e+9	3.84e+11	0.431	1.000
students	CG	-	residents	CG	13.34475	9.85821	3.508	0.016
students	CG	-	residents	GC	5966.19295	22594.49577	2.296	0.781

Post Hoc Comparisons - group * condition

Comparison					exp(B)	SE	z	p _{bonferroni}
group	condition	group	condition					
students	CG	-	students	GC	3875.04217	14487.84800	2.210	0.976
students	GC	-	L1controls	GC	1.88e+6	9.90e0+7	0.274	1.000
students	GC	-	residents	GC	1.53965	2.99930	0.222	1.000

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