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CONCEPTUAL REVIEW ARTICLE

The Role of Crosslinguistic Influence in Multilingual Processing: Lexicon Versus Syntax

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Multilingual research could offer a unique perspective on how the languages already acquired by a person affect the online processing of a new language. But it is currently difficult to assess this issue because theoretical accounts of multilingualism have focused on acquisition rather than processing and most empirical research to date has gathered untimed (offline) evidence. To help bridge this gap, we formulate hypotheses that can help derive processing predictions from existing accounts of multilingualism. But crucially, and based on previous findings in second language processing, we identify ways in which assumptions about crosslinguistic influence may need to be revised to allow the separate treatment of lexical and syntactic processing, and to consider the role of variables such as language dominance and proficiency. In our view, the question of what's special about multilingualism is worth studying, but more research is needed before we can begin answering it.

Keywords multilingualism; crosslinguistic influence; processing; lexicon; grammar

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Introduction

Psycholinguistic research has developed a keen interest in how humans represent and use multiple languages within one cognitive architecture. In particular, work within the emerging field of multilingualism is beginning to study in what ways the knowledge of previously learned languages may affect the acquisition and processing of a new language. But with the proliferation of new terminological distinctions[1] and specialized conferences and journals, an outstanding question is whether multilingualism as a field is inherently different from longer-standing fields like second language acquisition (SLA) and bilingual processing. From the point of view of processing, addressing this question involves asking whether the real-time representation and use of an additional language (Ln) differ from a second language (L2). This article identifies ways to tackle this question, while acknowledging that much more empirical work is needed to answer it.

Surely, many questions need to be addressed to fully compare the processing of a L2 and a Ln. For example, one might want to establish whether both systems interact similarly with cognitive domains such as working memory, executive function, and attention. Or whether the same neurophysiological circuits reported for L2 processing operate in Ln processing. Because covering all issues is unrealistic in one article, here we will focus on one topic that is central to both fields: To what extent is the real-time processing of a language affected by previously acquired languages?

In L2 processing, this question is often posed in terms of *language transfer* or *crosslinguistic influence* (CLI): How active in L2 processing are the words and grammatical procedures of a native language (L1)? And conversely (and much less understood), how does knowing a L2 impact L1 processing? Turning this line of questioning to multilingualism creates a potentially unique research area, because a Ln may be influenced not only by speakers' native language but also by any other languages acquired prior to the Ln (Figure 1). Thus, whereas there is only one possible source of CLI in bilingual processing, at least two potential sources (the L1 and L2) may influence Ln processing. Since these languages differ in a host of theoretically interesting properties (native vs. nonnative status, dominance, proficiency, etc.), multilingual research potentially allows for a richer and more nuanced understanding of the factors that condition CLI.

To explore the issue of CLI in L2 and Ln processing, this article is structured as follows. First, we summarize what is known about the role of CLI in the lexical and morphosyntactic processing of a second language (for an overview of phonological work see Cabrelli Amaro & Wrembel, 2016). This

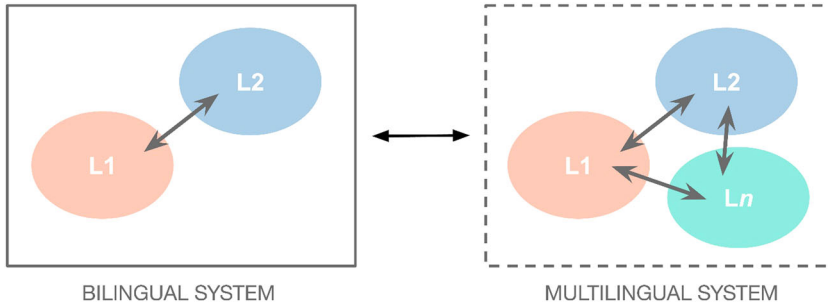

Figure 1 Theoretically possible relationships between languages in bilingual and multilingual systems. Whereas there is only one possible source of CLI in bilingual processing, there are at least two potential sources (the L1 and L2) in multilingual processing, which allows the study of how their differential properties might condition CLI. [Color figure can be viewed at wileyonlinelibrary.com]

summary is by no means exhaustive: We will only cover the research that we know best, which comprises reading or listening comprehension studies on adult late L2 learners, that is, people who acquired their L2 after middle childhood (around 8–10 years) and after adequate L1 language skills had been achieved. We will not cover production findings, but rather processing evidence in comprehension: measurements taken while people read or listen to language using techniques such as response time paradigms, speeded acceptability judgments, eye-tracking, and electroencephalography. These measures are different from untimed (offline) measures like pen-and-paper questionnaires, which record responses when participants have unlimited time to process stimuli (for review of Ln untimed studies, see De Bot & Jaensch, 2015; Puig-Mayenco, González Alonso, & Rothman, 2020). While untimed measures may tell us something about what learners know, they do not necessarily reflect online processing because they do not reveal how people use their knowledge as stimuli unfold in real-time.

After reviewing findings about L2 processing, this article turns to multilingualism. This field has experienced a recent explosion of theoretical proposals about the role of CLI, but the experimental evidence gathered so far has often been restricted to untimed judgments and written production data, leaving it unclear how languages are processed in real-time. We outline ways to bridge this gap, suggesting how future Ln processing studies could be informed by findings on L2 processing. By doing so, we articulate suggestions to allow

a more precise comparison between the two fields and thus an answer to the question of what's special, if anything, about multilingual processing.

Bilingual Research

Word Processing

The bilingual word recognition literature has long studied CLI, which is understood as the possibility that speakers activate words in one language when using the other language (Hamers & Lambert, 1972). Thus, CLI within this literature refers to the coactivation of words in different languages. L2 processing work has focused on the nature and dynamics of crosslinguistic coactivation: Do words across languages coactivate each other's meaning, form, or both? How quickly does coactivation take place and to what extent does it depend on factors such as language dominance and the immersion context of bilinguals?

To study coactivation, L2 research often adopts a priming paradigm widely used in L1: Participants are asked to recognize a target word presented after a prime word and their response latencies are used as an index of processing difficulty. Crucially, the prime and target words may be related in some dimension. For example, in semantic priming paradigms, a word like "*jam*" may be preceded by a semantically related or unrelated prime (e.g., "*bread*" vs. "*broom*"). Numerous experiments have found that participants are faster to recognize the target word when it is preceded by the related prime, which suggests that the prime facilitates target recognition. This *semantic priming effec*t is taken as evidence that the prime and target words are stored closely together in the lexicon or share semantic representations (for review, Neely, 1991).

If semantic priming can reveal real-time within-language word coactivation, it can also be used to assess between-language coactivation. And indeed, much L2 research has found that priming effects occur not only when the prime and target are in the same language, but also when they are in different languages. For example, an English–German bilingual may show semantic priming for "*jam*" not only when it is preceded by "*bread*," but also by "*Brot*," the German word for "*bread*." This indicates that words of different languages also share semantic representations (for review, Altarriba & Basnight-Brown, 2009).

Bilingual semantic priming effects are pervasive: They are found in both language directions (i.e., from L1 to L2 and vice versa; Altarriba & Basnight-Brown, 2007; Basnight-Brown, & Altarriba, 2007), between L1–L2s with different scripts (Chen & Ng, 1989; Gollan, Forster, & Frost, 1997; Smith, Walters, & Prior, 2019), in bilinguals of different proficiencies (Basnight-Brown & Altarriba, 2007) and in toddlers as young as 2.5 years (Singh, 2014).

Importantly, priming effects are modulated by language dominance, such that they are stronger when the prime belongs to bilinguals' L1, which is usually the dominant language (Chen & Ng, 1989; Keatley, Spinks, & De Gelder, 1994; Schwanenflugel & Rey, 1986).

Whereas the occurrence of semantic coactivation may be unsurprising, coactivation also occurs when L1–L2 words are related in form, either phonological or orthographic. Many studies have shown that when bilinguals process words in one language, they experience interference (i.e., processing difficulty) from form-related words in the other language. This occurs, for example, with homographs, which are words related in form but not meaning (e.g., "*room*" means "space" in English but "cream" in Dutch) and with cognates, which share both form and meaning (e.g., "*hotel*" in English and Dutch). Reaction-time studies have found that homographs take longer to recognize than non-homographs (Dijkstra, Jaarsveld, & Brinke, 1998; Dijkstra, Timmermans, & Schriefers, 2000), while cognates are easier to recognize than noncognates (Dijkstra et al., 1998; Dijkstra, Grainger, & van Heuven, 1999; Sunderman & Kroll, 2006; Sunderman & Schwartz, 2008). Interestingly, phonological coactivation is also affected by language dominance such that L1–L2 interference is stronger than L2–L1 interference, at least when bilinguals are L1-dominant (Blumenfeld & Marian, 2007; Gollan et al., 1997; Nakayama, Sears, & Lupker, 2010; Weber & Cutler, 2004).

Another surprising aspect of L1–L2 word form coactivation is that it occurs not only in *explicit paradigms* such as priming tasks—in which bilinguals are required to make explicit lexical decisions to words in both languages—but also in *implicit paradigms*, which do not require metalinguistic decisions or in which the "other" language is not even part of the testing situation (Marian & Spivey, 2003; Spivey & Marian, 1999; Thierry & Wu, 2004, 2007). For example, Marian and Spivey (2003) tested a group of Russian speakers who were highly proficient in English and had been living in the United States for an average of seven years. Participants heard English instructions asking them to manipulate visually presented objects, for example, "*Move the plug under the cross*." Their eye movements showed that after hearing the word "plug," they were distracted by the picture of a plum, whose label is phonologically related to "plug." But surprisingly, participants were also distracted by the picture of a dress, which is not phonologically related to "*plug*" in English, but it is in Russian ("plat"). Therefore, even though the experiment only involved English and even though participants were living in an English-speaking environment, their eye movements showed interference from their L1 Russian, suggesting coactivation of their English and Russian lexicons.

Sentence Processing

Perhaps partly due to the abundant evidence of CLI at the word level, much of the L2 processing literature has assumed that CLI should also occur at the sentence level. When applied to syntactic processing, evidence of L1 influence would consist of demonstrations that comprehenders parse L2 sentences using L1 processing mechanisms, or that they have more difficulty applying L2 grammatical constraints when they are absent or expressed differently in their L1.

As space limitations prevent a comprehensive summary of L2 research, here we illustrate it using as an example the computation of morphosyntactic agreement. We describe ERP (event-related-potential) studies on agreement to show the methodological problems that arise when trying to find evidence of L1 influence. Our goal is not to criticize agreement research, which is comparable to research on other phenomena such as filler-gap dependencies, attachment ambiguities, verb subcategorization or garden-paths (for reviews see Dussias, Dietrich, & Villegas, 2015; Frenck-Mestre, 2005; Roberts, 2013; van Hell & Tokowicz, 2010). Rather, agreement research is useful because it is prolific and it serves to highlight methodological limitations that apply to research on other phenomena. Due to these limitations, we believe that there is scarce evidence of L1 influence in L2 syntactic processing, in stark contrast with word processing.

A key methodological point about CLI in syntactic research is that to conclusively establish L1 influence it is not enough to show that a particular L2 behavior is *consistent* with speakers' L1. Crucially, one needs to show that the behavior is *selective* or *specific* to speakers' L1, for example, by performing controlled comparisons with other speakers whose L1s differ in the behavior of the target phenomenon (Felix, 1976; Jarvis, 2000; Pienemann, Di Biase, Kawaguchi, & Håkansson, 2005). Otherwise, one might attribute to L1 influence behaviors that are instead due to general-purpose processing mechanisms, which may be used universally by L2 speakers.

In the domain of agreement processing, much ERP research has focused on whether L2 speakers have difficulty computing agreement for grammatical features that are absent in their L1. If so, these speakers should be less able to detect L2 agreement violations and thus show reduced sensitivity in their brain responses compared to speakers whose L1 has the relevant features (Chen, Shu, Liu, Zhao, & Li, 2007; Ojima, Nakata, & Kakigi, 2005; Rossi, Gugler, Friederici, & Hahne, 2006; White, Genesee, & Steinhauer, 2012). A commonly tested brain response is the P600 component. In native speakers, a P600 effect emerges as a positive deflection of the evoked response when encountering an

ungrammatical word as in (2) compared to its grammatical counterpart in (1). This effect typically starts around 600 milliseconds post-word onset and has a posterior scalp distribution (Molinaro, Barber, & Carreiras, 2011).

(1) **The boys** in the kindergarten sing a song.
(2) **The boy** in the kindergarten *sing a song.

Seminal L2 findings indeed suggested that speakers whose L1 lacked agreement had reduced P600 responses compared to speakers whose L1 instantiated agreement. For instance, Italian and German native speakers, who were intermediate-level learners of L2 German and Italian, respectively, were able to quickly detect subject–verb number violations like (2), thus showing P600 effects at the verb (Rossi et al., 2006). By contrast, a study that tested Japanese speakers did not find evidence of P600 effects for similar violations in L2 English (Ojima et al., 2005). Since German and Italian instantiate subject–verb agreement but Japanese does not, this contrast indicated that the lack of L1 agreement impairs its L2 processing.

But is L1 influence the only plausible explanation of these findings? The use of different L2 languages (German/Italian vs. English) introduces potential confounds, because different linguistic materials may vary in their complexity or in the markedness of the target construction. Further, while Italian and German have similar writing/orthographic systems, Japanese and English do not. Due to less efficient reading in English, the P600 of Japanese speakers may have been delayed, rather than absent. This possibility was supported by a later study, which compared the processing of tense agreement by Chinese and Korean learners of the same L2 language, English (White et al., 2012; see also Chen et al., 2007). Chinese lacks tense agreement, whereas Korean has it, although expressed differently than English. However, after only 9 months of exposure to English, both Korean and Chinese speakers showed P600 effects, inconsistent with L1 influence. The only between-group difference was a slightly delayed effect in the Chinese group (an effect again consistent with orthographic influence because Chinese is a logographic language while both Korean and English are alphabetic).

But even when the same L2 language is examined, one might worry that comparisons between different speaker groups introduce other problems, because the groups may vary in individual variables known to modulate processing, such as L2 proficiency, age of acquisition, and working memory capacity (Kotz, 2009). Thus, an alternative method to assess L1 influence is to use a single speaker group and compare their performance between two types of L2 construction: one that exists in their L1 and one that does

not. While it is important to ensure that the constructions under study are indeed comparable (Jarvis, 2010), this design has the advantage of increasing statistical power by avoiding the variability inherent to between-participant comparisons (Brysbaert & Stevens, 2018; Westfall, Kenny, & Judd, 2014).

A within-participant design was recently used in a large-scale ERP study with 78 English learners of Spanish of different proficiency levels (Alemán Bañón, Fiorentino, & Gabriele, 2018). The study focused on the processing of number and gender agreement violations in Spanish adjectives (only number agreement is instantiated in English). The results showed that in comparison with grammatical adjectives, low-proficiency Spanish speakers only showed P600 effects for number violations, whereas high-proficiency speakers showed P600 effects for both number and gender violations. However, P600 responses to number and gender violations did not show statistically significant differences in either group, thus failing to support L1 influence.

As more agreement studies accrue, it becomes clear that L1 influence, if present, is highly selective and depends on many other variables (Foucart & Frenck-Mestre, 2011; Gillon-Dowens, Guo, Guo, Barber, & Carreiras, 2011; Gillon-Dowens, Vergara, Barber, & Carreiras, 2010; Kotz, Holcomb, & Osterhout, 2008; Sabourin & Stowe, 2008; Tokowicz & MacWhinney, 2005). For example, some studies have found that sensitivity to agreement violations depends not solely on whether a feature exists in the L1 and L2 grammar, but rather on whether it is expressed similarly or used in the same syntactic configurations (Foucart & Frenck-Mestre, 2012; Gillon-Dowens et al., 2011; Tokowicz & MacWhinney, 2005). Another study suggested that L1 influence might affect not necessarily the presence of ERP components but rather their type or topographical distribution (Sabourin & Stowe, 2008). These findings raise questions about the generality of L1 influence in syntactic processing, at least compared to other factors such as L2 age of acquisition, proficiency, and immersion. In fact, a recent meta-analysis of 41 ERP studies on syntactic processing, which used L1–L2 similarity together with these factors to predict the presence/absence of ERP responses did not find L1–L2 similarity to be a significant predictor of any of the four ERP components under study, including the P600 (Caffarra, Molinaro, Davidson, & Carreiras, 2015).

Whereas the processing of agreement is only one research area, it is convenient to illustrate methodological issues in CLI work more generally. Importantly, other domains have also shown inconclusive evidence. For example, studies comparing the processing of displaced elements known as "gaps" (e.g., "*Who$_i$ are you talking to e$_i$*") between native speakers of languages with and without overt wh-movement have found remarkably similar reading patterns,

even if comprehenders' untimed judgments differ (Juffs, 2016; Juffs & Harrington, 1995, 1996; Marinis, Roberts, Felser, & Clahsen, 2005; Pliatsikas & Marinis, 2013; Williams, Möbius, & Kim, 2001). Similarly, findings on attachment ambiguities, which initially supported L1 influence, now suggest that L2 attachment preferences are more strongly driven by lexico-semantic variables (Felser, Roberts, Marinis, & Gross, 2003; Papadopoulou & Clahsen, 2003) as well as L2 proficiency and immersion experience (Dussias, 2001; see Dussias et al., 2015). Finally, accruing evidence on the resolution of anaphoric dependencies shows similar L2 reading profiles in speakers of different L1 backgrounds, despite evidence of L1 influence in untimed judgments (Felser & Cunnings, 2012; Roberts, Gullberg, & Indefrey, 2008).

Perhaps partly due to the unclear empirical status of L1 influence, much of the current L2 literature focuses on other aspects of processing, such as bilinguals' assignment of structural relationships (Dussias, 2003; Felser et al., 2003), their ability to generate predictions (Grüter, Rohde, & Schafer, 2014), to retrieve information from memory (Cunnings, Fotiadou, & Tsimpli, 2017), and to revise ambiguous input (Cunnings et al., 2017; Jacob & Felser, 2016) as well as the sources of L1–L2 processing differences (Clahsen & Felser, 2006) and the potential effects of cognitive limitations (Dekydtspotter, Schwartz, & Sprouse, 2006; Hopp, 2010).

Summary

Our overview indicates that L1 influence is clearer in L2 word processing than in syntactic processing. Of course, this does not negate a potential role of L1 influence in syntactic processing: It is possible that reliable evidence will emerge once methodologically improved comparisons are conducted. What is interesting, however, is that this variability is not observed in L2 word processing. For words, learners seem to show reliable evidence of coactivation at the form and meaning level, despite differences in L2 dominance. This suggests that CLI may differentially affect lexical and syntactic processing. A serious consideration of this fact, together with the development of experiments that avoid the methodological pitfalls of some of the past L2 work, should help develop processing research on multilingualism, the area described next.

Multilingual Research

CLI plays a central role in all existing accounts of the multilingual lexicon and grammar. However, most of the empirical work in comprehension has focused on morphosyntactic phenomena. Therefore, we first briefly summarize

work on the lexicon and then focus the rest of this section on models of Ln morphosyntax.

The most well-known proposal about the multilingual lexicon is the Parasitic Model (PM) (Ecke, 2015; Hall & Ecke, 2003). This model focuses on acquisition, rather than processing: It proposes that Ln words are initially stored "parasitically," such that their entries are associated with similar, already known words in learners' L1, L2, or Ln lexicon. These known words function as "hosts," and learners assess the similarity between a host and a parasite subconsciously and on multiple levels, although initially they rely more on orthographic and phonological similarity (form level) and only later—as their proficiency increases—on grammatical and conceptual similarity (frame and concept levels, respectively). During initial learning stages, the PM predicts pervasive CLI in processing, as hearing or reading an Ln word should activate its host(s) in other languages. When a new word is successfully learned, its form, frame, and conceptual connections are severed, such that the parasite detaches from the host and its lexical access proceeds autonomously.

Empirical support for the PM comes mainly from L2 priming studies, which have shown that less proficient L2 speakers are more affected by L1–L2 form similarity than speakers of higher proficiency (Sunderman & Kroll, 2006; Talamas, Kroll, & Dufour, 1999). To our knowledge, the few Ln studies supporting the PM have targeted production, not comprehension (de Groot & Hoeks, 1995; González Alonso, 2012). For example, a recent study examined L1 Polish–L2 English beginning and advanced speakers of Ln Russian (9 and 3, respectively). Participants were instructed to name pictures in Russian after hearing phonologically related or unrelated words in either their L1 or L2 (González Alonso, 2012). The results showed that Ln words were named faster when preceded by phonologically related primes, and that priming effects were larger for beginning than advanced learners, a result that was taken to support the PM. While these findings are promising, it will be critical to replicate them with larger participant samples, and to assess whether they occur in comprehension. Future research should also address whether the strength of priming effects differs depending on whether the prime is a L1 or L2 word, since words belonging to a native language might have stronger connections and thus be easier to separate from nonnative L2 or Ln words (de Bot, 2004).

Meanwhile, sentence-level models of multilingualism have also centered on acquisition, placing their focus on the types of knowledge available to initial-state learners, rather than on the mechanisms used to apply this knowledge in real-time comprehension. Thus, these models make claims about offline knowledge representation, rather than processing. They all seem to

assume that CLI occurs but they differ in their predictions of which language(s) should transfer. The following paragraphs outline these accounts and the empirical evidence that supports them.

Morphosyntactic models of multilingualism can be broadly separated into two groups, which we refer to as *status-based models* and *similarity-based models*. Status-based models claim that CLI to a Ln originates from either the native or nonnative language due to their intrinsic status and properties. However, they differ in whether they propose that CLI occurs only from the L1 (*L1 transfer* account: Hermas, 2010; Jin, 2009; Lozano, 2002; Na Ranong & Leung, 2009) or only from the L2 (*L2 transfer account*: Bardel & Falk, 2007; Bardel & Sánchez, 2017; Falk & Bardel, 2011).

The L1 transfer account argues that speakers' L1 affects Ln acquisition due to the intrinsic properties of a native language, which is acquired effortlessly from birth and, in the majority of the cases, to successful completion. Therefore, learners should acquire a L1 through their more robust and consolidated L1 knowledge. By contrast, the L2 transfer account argues that speakers' L2 affects Ln acquisition due to the shared nonnative status of these languages, as well as similarities in their sociolinguistic and learning contexts: For example, they both take place after childhood and require an explicit learning process, usually in classroom settings. Due to these similar circumstances, learners might perceive their L2 knowledge as more relevant for Ln acquisition.

While status-based accounts base their claims on the native or nonnative status of a language, similarity-based models posit that CLI is driven by the linguistic similarity between the Ln and prior languages. But these models differ in how similarity is evaluated. *Language-based similarity accounts* claim that correspondences are appraised at a global/whole language level. Specifically, based on a combination of lexical, phonological/phonotactic, morphological, and syntactic cues, learners subconsciously assess whether the whole L1 or L2 systems are more similar to the Ln (Rothman, 2010, 2011, 2015; Rothman & Cabrelli Amaro, 2010). These accounts predict, for example, that L1 Spanish–L2 English learners of Ln Brazilian Portuguese (BP) should only transfer Spanish to the acquisition of BP, because these languages should be perceived as similar due to their shared properties (many of them related to Spanish and BP being Romance languages).

Finally, *property-specific accounts* also assume that similarity provides the basis for transfer but they believe that CLI occurs on a property-by-property basis, because learners should transfer prior knowledge only when helpful to their learning (Berkes & Flynn, 2012; Flynn, Foley, & Vinnitskaya, 2004; Slabakova, 2017; Westergaard, Mitrofanova, Mykhaylyk, & Rodina, 2017).

For instance, L1 Norwegian–L2 Russian speakers learning Ln English adverb placement should transfer their Russian knowledge, as both English and Russian place adverbs before main finite verbs (e.g., *Emma often eats sweets*), whereas Norwegian places adverbs after finite verbs. However, when acquiring subject-auxiliary inversion in Ln English, the same speakers should transfer their Norwegian knowledge, as English and Norwegian show subject–verb inversion (e.g., *What will the little girl read?*) but Russian does not.

Empirical work testing morphosyntactic accounts has used two types of paradigms: one that compares a group of Ln speakers with a group of L2 speakers, and one that compares two Ln groups with the same L1-L2 languages but in a reverse configuration. In the first paradigm, the idea is to test a property common to the Ln/L2 language of the groups, and to observe which group has an advantage implementing it. For example, consider a group of L1 English–L2 Brazilian Portuguese learners and a group of L1 English–L2 Spanish–Ln BP learners, who are tested on BP adjective–noun gender agreement, which is realized in Spanish but not in English. In this setting, an advantage of the Ln group over the L2 group would suggest that knowledge of L2 Spanish facilitates the use of Portuguese gender agreement. This result would be consistent with either a L2 transfer account (whereby the learner transfers the L2 to the Ln) or a similarity-based account, whereby the learner transfers Spanish because it is the language most similar to the Ln (at a property or global language level). To distinguish between L2 and similarity-based accounts, studies using this paradigm often test additional Ln groups with L2s that are dissimilar from the Ln, or they test additional properties that are dissimilar between the speakers' L2 and the nonnative language under study. However, this results in a high number of speaker groups, different linguistic materials, and multiple statistical comparisons, which can complicate the interpretation of the findings.

The second frequent paradigm involves two Ln groups with reversed L1–L2 languages. Take the example of two groups of Ln BP learners that know either L1 Spanish–L2 English or L1 English–L2 Spanish. In this case, the paradigm involves testing a Ln property attested in only one of these prior languages and determining the group that shows an advantage implementing this property in the Ln. Consider again BP adjective–noun gender agreement, attested in Spanish but not in English. In the two hypothetical groups above, an advantage of the L1 Spanish over the L1 English group would suggest that Spanish knowledge facilitates the use of Portuguese gender agreement when Spanish functions as a native language, consistent with the L1 transfer account. By contrast, the opposite outcome would support the L2 transfer account, as it would suggest that learners can resort to their Spanish knowledge only when it

is acquired as a L2. Finally, similar performance in both groups would suggest that learners transfer Spanish regardless of its L1 or L2 status, consistent with similarity-based accounts. Note that the lack of differences between groups is also consistent with the absence of transfer, that is, the possibility that both groups learn BP similarly regardless of their prior languages (a general "learner effect"; for discussion see Stutter, 2019). Whereas existing work rarely acknowledges this possibility, it is worth taking it seriously given the unclear role of CLI in L2 syntactic processing (we return to this issue below).

Untimed Ln experiments so far have shown mixed results (for review see Puig-Mayenco et al., 2020). Some findings have supported the L1 transfer account. For instance, learners whose L1 licenses null arguments are more likely to apply the null subject constraint in a Ln than learners whose L1 lacks null subjects (Lozano, 2002). Meanwhile, other findings have supported the L2 transfer account. For example, Falk and Bardel (2011) tested object pronoun placement in German using an untimed grammaticality judgment correction task. German object pronouns appear linearly after finite verbs in main clauses but before verbs in subordinate clauses. Falk and Bardel (2011) examined Ln German learners who knew either L1 French–L2 English or L1 English–L2 French. Crucially, each language shows only one of the word orders available in German: English object pronouns appear after finite verbs (e.g., "*I saw him*"), similar to German main clauses. French clitic pronouns appear before finite objects (e.g., "*Je l'ai vu*," 'I him saw'), similarly to German subordinate clauses. Findings showed that, as predicted by L2 transfer accounts, L1 French–L2 English speakers made more correct grammaticality judgments in German main clauses (consistent with a benefit from their L2 English), whereas L1 English–L2 French speakers made more correct judgments in German subordinate clauses (consistent with a benefit from their L2 French).

Meanwhile, other studies have supported similarity-based accounts (Flynn et al., 2004; Rothman, 2010, 2011; Rothman & Cabrelli Amaro, 2010; Westergaard et al., 2017). With regard to language-based accounts, Rothman (2010) tested word order constraints with two groups of beginning Ln BP learners who were either L1 Spanish–L2 English or L1 English–L2 Spanish speakers. The comparison of interest concerned declarative versus interrogative clauses. In declarative sentences, BP and English require subject–verb word order, while Spanish additionally licenses verb-subject order, although it is noncanonical. However, in interrogative clauses, English and Spanish require subject–verb inversion, while BP still maintains the declarative subject–verb order.

The results of an untimed grammaticality judgment correction task showed similar judgment accuracy in the two Ln groups in both declarative and interrogative constructions. Although these results were taken as evidence for the wholesale transfer of Spanish across groups, note that the lack of differences is also consistent with the absence of transfer, consistent with the idea that both groups were learning subject–verb placement in BP in a similar way, unaffected by their prior languages (a "learner effect"; Stutter Garcia, 2019). Similar caveats apply to other studies that have argued for language-based similarity (Rothman, 2011; Rothman & Cabrelli Amaro, 2010).

Finally, some of the evidence in support of property-specific accounts comes from Westergaard et al. (2017), who used an untimed grammaticality judgment task to test subject–verb inversion and adverb placement in English. Learners consisted of both bilingual and multilingual speakers. The bilingual groups were L1 Norwegian or L1 Russian learners of L2 English; the multilingual group were L1 Norwegian–L2 Russian–Ln English learners. Subject–verb inversion in English and Russian results in a similar surface word order, in contrast with Norwegian. For adverb placement in main clauses, English and Norwegian show a similar word order, in contrast with Russian. Thus, if participants transfer prior knowledge on a property-by-property basis, Ln English speakers should be more accurate in judging adverb placement than L1 Russian–L2 English learners, because the multilinguals should benefit from their knowledge of Norwegian. Further, multilingual speakers should be more accurate in judging subject–verb inversion than L1 Norwegian–L2 English learners, because the former group should benefit from their Russian knowledge. The results partially supported these predictions: Ln English learners correctly judged adverb placement more often than L1 Russian–L2 English learners, but no between-group differences were found with subject–verb inversion.

To summarize, we can state that work specifically targeting the multilingual lexicon has mostly taken place in production, where it has provided some timed evidence consistent with CLI and supportive of the Parasitic Model. However, studies are scarce and it is unclear whether their findings extend to Ln comprehension. By contrast, morphosyntactic studies have targeted comprehension but not with processing methods, because they probed for responses without time restrictions. Therefore, it is unclear to what extent participants' responses reflect the application of automatic parsing mechanisms, as opposed to later processes more dependent on task heuristics and/or the use of metalinguistic knowledge. A second concern is that some studies have failed to distinguish between across-the-board transfer and no transfer at all, as

both would paradoxically predict the same pattern (i.e., no differences between speaker groups, which statistically emerges as a null effect). Finally, many Ln studies have not matched their groups in L2 properties such as proficiency, age of acquisition or knowledge of the target L2 construction, even though these have been shown to modulate performance in L2 processing studies. Therefore, more work is necessary to provide clearer empirical evidence about the source of CLI in syntactic and word processing. In what follows, we suggest how processing methods could be deployed to obtain more nuanced comparisons between speaker groups.

Bridging the Gap

This final section outlines ideas to develop more studies on lexical and syntactic Ln processing. We believe that it is worth grounding experiments within current theoretical accounts of Ln acquisition, to maintain a close relationship between theory and experimentation. For syntactic processing, adapting current accounts would involve assuming that knowledge of previous languages can affect the real-time mechanisms that comprehenders use to parse Ln sentences. This might occur not only in beginning learners but also in intermediate or advanced learners who have already achieved accurate knowledge of a construction, because learners might still need to process this construction using the heuristics of their previous L1 or L2 systems. Alternatively, CLI might affect beginning and advanced learners differently, as their language dominance changes (Rah, 2010).

How could previous syntactic studies be extended to processing? Consider the study described previously on French–English learners of Ln German (Falk & Bardel, 2011). This study supported the L2 influence account by showing that L1 French–L2 English speakers made more correct grammaticality judgments in German main clauses, consistent with a benefit from their L2 English, which has a verb-pronoun surface order. By contrast, L1 English–L2 French speakers made more correct judgments in German subordinate clauses, consistent with a benefit from their L2 French, which has a pronoun-verb surface order. A processing version of this study could involve a reading paradigm and use reading times to make inferences about parsing mechanisms: Does L2 influence also affect sentence reading, such that participants show more processing difficulty with Ln word orders that are inconsistent with their L2 grammar? If so, this would show that L2 parsing heuristics are applied online in a Ln, rather than reflecting the application of later, task-related decision heuristics used to solve judgment tasks.

Recently, we have started using processing methods to study Ln sentence comprehension (Lago, Garcia, & Felser, 2019). We examined the processing of German possessive pronouns like "*ihren*" in (3), which show a complex pattern of gender agreement: the stem of the pronoun (bolded) encodes possessor agreement, whereas the suffix (underlined) encodes possessee agreement (e.g., *-en* for a masculine possessee):

(3) **Frau Müller**$_{\text{.possessor}}$ liebt **ihr**<u>en</u> <u>Sohn</u>$_{\text{.possessee}}$.
Ms. Müller loves her$_{\text{.masc}}$*son*.

We tested intermediate-to-advanced learners of Ln German divided in two groups, who were matched in their German age of acquisition and proficiency: L1 English–L2 Spanish and L1 Spanish–L2 English. In these languages, the behavior of possessive pronouns differs. Like German, English encodes possessor agreement ("*his*" vs. "*her*"), whereas Spanish only encodes possessee agreement (e.g., "*nuestr<u>o</u> hijo*" vs. "*nuestr<u>a</u> hija*," "our.$_{\text{MASC}}$ son" vs. "our.$_{\text{FEM}}$ daughter"; note that the third person form "*su*" lacks a gender marker). Our research question was whether the two groups would differentially process possessor agreement violations, which are infelicitous in German and English but not in Spanish.

We used a judgment task like Falk and Bardel (2011) but we presented sentences in a speeded format such that participants only had limited time to provide their answers. This type of *speeded* acceptability task has been shown to mirror processing effects by requiring participants to rely on their working memory to construct a representation of the sentence and by restricting the amount of time that they have to reflect on their responses (Drenhaus, Frisch, & Saddy, 2005; Parker & Phillips, 2016; Wagers, Lau, & Phillips, 2009). Our study measured participants' judgment accuracy and response times to infelicitous sentences with possessor violations like "*Frau Muller liebt *seinen Sohn*." Later, to evaluate participants' implicit grammatical sensitivity, we conducted a self-paced reading task in which participants' word-by-word reading times were recorded as they read the same sentences for comprehension, in the absence of judgments.

Our results showed evidence of both L1 and L2 influence: L1 English speakers seemed more sensitive to German possessor violations, as shown by their increased reading times and judgment latencies (Figure 2). By contrast, L2 influence only affected participants' judgment accuracy: L1 Spanish speakers of higher L2 English proficiency were more accurate detecting German possessor violations than less proficient speakers. Thus, L1 influence was seen

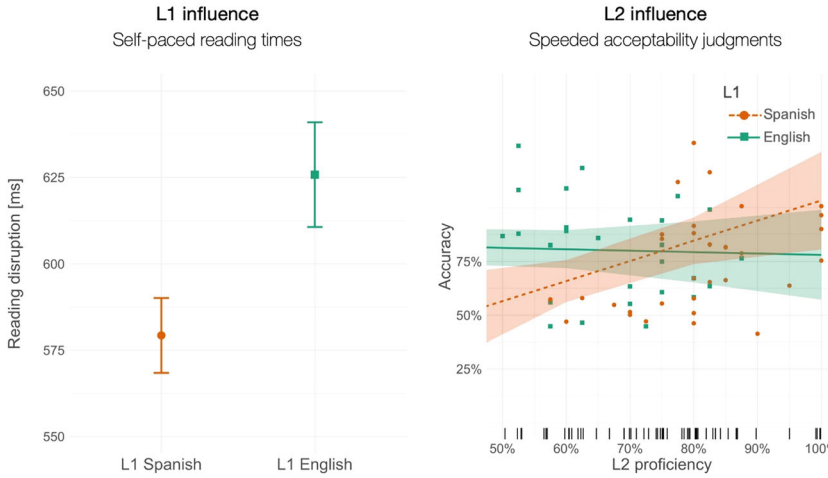

Figure 2 An example of L1 and L2 influence in Ln morphosyntactic processing (Lago et al., 2019). *L1 influence*: compared to English natives, L1 Spanish speakers, whose native grammar lacks possessor gender agreement, showed smaller reading disruptions after infelicitous German possessives, consistent with inhibitory L1 influence. *L2 influence*: L1 Spanish speakers with higher L2 English proficiency were more accurate in judging German possessor violations than less proficient L2 speakers. By contrast, L1 English speakers' judgments were not affected by their Spanish proficiency, suggesting that L2 knowledge may help, but not hurt, multilinguals' ability to process an additional language. [Color figure can be viewed at wileyonlinelibrary.com]

across experiments in implicit timing measures, but L2 influence was restricted to the judgment task, which required participants to make metalinguistic decisions. This type of dissociations may help establish not only which prior languages condition CLI but also potentially why. One appealing hypothesis is that L1-driven mechanisms may be more available in real-time comprehension because, due to their earlier acquisition, they might be more automatized than L2 mechanisms, which may need to be consciously invoked to affect processing.

By contrast to morphosyntactic work, in which the lack of previous Ln processing studies is the first obstacle to overcome, there are already some Ln word processing studies. However, these studies were not developed to test the assumptions of the Ln theories described above. Thus, a first step for future work would be to reinterpret these findings by trying to relate them to multilingualism accounts. As we describe below, even cursory attempts at doing so reveal that notions like proficiency and dominance may be critical to findings

about CLI in multilingual word processing. This creates the need to further elaborate existing theories to include these notions.

Several studies already suggest that all previous languages of a multilingual can affect Ln word recognition (de Groot & Hoeks, 1995; Lemhöfer, Dijkstra, & Michel, 2004; Szubko-Sitarek, 2011). So far, CLI seems to be modulated by language dominance, with stronger interference from more dominant languages. For example, Francis and Gallard (2005) tested the recognition of words in the three languages of multilingual speakers and showed that semantic overlap speeds up Ln word recognition and that prime words in the stronger L1 lead to larger speedups than prime words in the weaker L2. The authors also found that semantic overlap facilitated recognition in both the L1 and L2, an effect that was driven by language dominance. For instance, a L1 word was easier to recognize when it was semantically related to a word in the stronger nonnative language rather than in the weaker nonnative language. This suggests that CLI is not linked to a specific language combination but can affect all languages in the multilingual lexicon. This is prima facie evidence that CLI is not restricted to a single source in word recognition, which disconfirms language-status accounts.

Moreover, Lemhöfer et al. (2004) have shown that the influence of two languages can add up. The authors used a word recognition task to test for cognate effects in a group of L1 Dutch–L2 English speakers who were advanced learners of Ln German. The experiment included cognates that were only shared by the L1 and Ln ("double cognates") and cognates shared by all three languages ("triple cognates"). The results showed that double cognates were recognized faster than noncognates and that triple cognates were recognized faster than double cognates, suggesting cumulative L1 and L2 effects. A similar result was reported by Szubko-Sitarek (2011), who tested L1 Polish–L2 English intermediate speakers of Ln German. The results showed faster recognition times for triple than double cognates, and for double cognates compared to noncognates. However, when speakers were tested in their L1 Polish, triple cognates elicited faster responses than double cognates, but no differences were found between double cognates and noncognates. As interpreted by the author, this null effect might be ascribed to a low Ln proficiency, such that a minimum proficiency level may be required for a language to interfere during multilingual word processing (see also van Hell & Dijkstra, 2002).

While language dominance seems to affect Ln processing, it remains unclear whether other variables like language similarity also do. So far, informal comparisons across studies suggest that L1 and L2 affect Ln word recognition, both when the languages are typologically close at the word level (e.g.,

Dutch and German; Lemhöfer et al., 2004) and when they are more distant (e.g., Polish and German; Szubko-Sitarek, 2011). But as argued above, to formally quantify the role of language similarity it would be necessary to perform a direct statistical comparison between two language groups within a single study. This would allow determining whether comparable interference effects are obtained in a controlled manipulation of language similarity.

Altogether, recent findings suggest that CLI affects Ln word recognition, similarly to L2 word recognition: Multiple languages seem to be active and interfere with each other during lexical processing. Further, interference appears to be modulated by language dominance, with more interference from stronger than weaker languages. If future experiments replicate these patterns and extend them to syntactic processing, and if it can be shown that CLI extends to typologically different systems, then this would disconfirm Ln models that posit that CLI should come from a single language, whether it is the L1, the L2, or the language typologically closest to the Ln. This would suggest that Ln models need to be revised, or that different accounts of CLI are needed for word and sentence processing, a conclusion that would raise an interesting parallel between bilingual and multilingual processing.

Overall, much more work is needed to understand the real-time use of the multilingual lexicon and grammar and to address the question of how they compare to L2 processing research. And while new challenges will surely arise as the field develops, some useful guidelines can already be gleaned from previous work:

1. It is too simplistic to describe CLI monolithically, in terms of one whole language affecting the processing of another language (this relates to the oversimplified conceptualization of languages as discrete, clearlybounded entities; Berthele, this volume). If CLI were a monolithic phenomenon, it is unclear why it would differentially affect lexical and syntactic L2 processing, as suggested in this article.
2. To examine CLI in a more nuanced manner, processing studies should aim for more detail in their theoretical discussions and experimental predictions. For instance, rather that stating "*Language X should affect the processing of language Y*" in word recognition studies, researchers could articulate why they expect CLI to affect word coactivation in the multilingual lexicon: What are their assumptions about the architecture of the lexicon(s) and the nature of word retrieval mechanisms? Similarly, studies on Ln syntactic processing should hypothesize how CLI might influence the cognitive mechanisms that implement syntactic operations: are syntactic rules

or constraints represented separately or jointly for each language? Through which mechanism(s) may CLI affect the real-time use of constraints? (e.g., by modulating the activation or weight of constraints during processing, via inter-constraint interactions, etc.)

3. There is currently a clear gap between theories of multilingual acquisition, which discuss the type of untimed knowledge that multilinguals may have, and the evidence obtained in timed processing studies, which consist of measurements taken while people read or listen to language. If we want processing evidence to inform acquisition theories, we need to formulate linking hypotheses to connect the claims of acquisition theories with the real-time processing mechanisms used by learners. We should move from yes/no-statements (e.g., "*Does language X affect the processing of language Y?*") to how-statements (e.g., "*How might knowledge of language X affect the mechanisms used to parse language Y?*"). In short, we should engage in discussions about the relationship between grammatical knowledge and processing mechanisms (Lewis & Phillips, 2015; Phillips & Ehrenhofer, 2015).
4. To better compare L2 and Ln processing, improvements are needed in the description of participant groups. In many L2 studies, participants often have more than two languages, even if only two are targeted for experimentation and the Ln is not considered methodologically. This means that interpreting L2 in a strictly numerical sense risks creating an artificial division between L2 and Ln. This is a difficult issue to tackle (Berthele, this volume), but at a minimum, researchers should endure to provide more detail about the language background of their participants, regardless of whether the study pertains to L2 or Ln processing. Relatedly, and given the role of dominance in word processing studies, studies on Ln syntactic processing should consider this variable in their demographic reports and analyses.
5. Studies on Ln syntactic processing often assume that having learned a specific L2 (e.g., English) automatically confers participants knowledge of all L2 syntactic constructions, such that these can influence the processing of the Ln construction under study. However, as argued before, languages are not monolithic entities and it may be unwarranted to assume that knowing a language means having exhaustive knowledge of its properties and syntactic constructions. Thus, it is important to test multilinguals' knowledge of the construction under study in both the L2 and the Ln.

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Note

1 An additional language has been referred to as "L3," "Lx," "Ln," and "La," among others (de Bot & Jaensch, 2015). Here we adopt the term "Ln" because it has a semantically transparent notation and it avoids making assumptions about acquisition order. With regard to the terms "second language research," "bilingualism," and "L2," we use them interchangeably. Although psychologists typically use "bilinguals," while psycholinguists prefer to talk about "L2 learners," these terms often refer to the same population.

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Appendix: Accessible Summary (also publicly available at https://oasis-database.org)

The Role of Crosslinguistic Influence in Multilingual Processing: Lexicon Versus Syntax

What This Research Was About and Why It Is Important

While the world population is increasingly becoming multilingual, there is very little research on how multilinguals understand words and sentences during real-time processing. Instead, most accounts of multilingualism focus on acquisition (rather than processing) and collect untimed evidence. To help bridge this gap, this article reviews existing accounts of multilingualism and puts forth ideas to help derive processing predictions in future studies.

What the Researchers Did

- We reviewed studies that investigated how the two languages of bilingual speakers interact during the real-time processing of words and sentences.
- We then reviewed theoretical accounts and empirical studies on multilingual speakers, which investigated possible interactions between two or more languages at the word and sentence level.

What the Researchers Found

- Interactions between languages during processing are less pervasive than previously thought.
  - In bilingual studies, crosslinguistic interactions are more attested in word than sentence processing. It is unknown whether a similar contrast holds in multilingual processing.
  - To formulate theories of multilingual processing, researchers need to articulate explicit assumptions about how learners' grammatical knowledge informs the real-time mechanisms used to process language.

Things to Consider

- Multilingual processing is an exciting new field of research, but presently there are too few empirical studies to assess whether it differs from bilingual processing.
- There is currently a gap between theories of multilingual acquisition, which discuss the type of untimed knowledge that multilinguals may have, and the evidence obtained in studies measuring how people use their languages in real-time.
- If researchers want processing evidence to inform acquisition theories, they need to formulate explicit hypotheses about how linguistic (untimed) knowledge affects learners' real-time processing mechanisms.

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