Does L1 syntax affect L2 processing?
A study with highly proficient early bilinguals∗

Mikel Santesteban & Albert Costa

Universitat de Barcelona (UB) & UB Parc Científic

Abstract

In a picture naming experiment we explored whether the syntactic properties (word-order) of L1 affect L2 speech production in highly-proficient early bilinguals. We asked Basque-Spanish and Catalan-Spanish bilinguals to name pictures with singular or plural Determiner Phrase (DP) structures in their L2 (Spanish). The word order of these languages’ DPs is different: Basque DPs have Noun+Determiner structure, while Spanish and Catalan DPs have Determiner+Noun structures. In the experiment, information regarding the noun or the number of the target picture was provided before its presentation. The naming latencies of pictures primed with number advanced information and noun advanced information were registered. The bilinguals’ naming performance was contrasted to that of Spanish Native speakers. Differences were observed between Basque-Spanish bilinguals and Spanish native speakers, but not between Catalan-Spanish bilinguals and Spanish native speakers. These results are interpreted as indicating that L1 syntax does affect L2 processing.

0. Introduction

Any second language (L2) learner realizes that it is difficult to correctly speak in L2. Research on the way L2 is processed in language production has shown that the properties of the first language (L1) modulate second language learners’ L2 processing. For example, traces of L1 phonological properties are reflected in L2 learners’ foreign language accent (Flege, Munro & MacKay, 1995). Furthermore, other factors such as the age at which the L2 is acquired also affects the way L2 is processed. Research on L2 acquisition suggests that there is a progressive loss of the acquisition capacity (Birdsong, 1999) and that there are different time-windows for the optimal acquisition of different linguistic aspects. For example, while vocabulary can be learned at any age, the acquisition of other L2 aspects such syntax has proved to be particularly difficult (Neville & Bavelier, 2000). In the case of phonology, even early bilinguals have shown difficulties in the processing of some L2
phonological contrasts not existing in their L1, both in perception and production (Sebastián-Gallés & Kroll, 2003). Thus, it seems that both age of acquisition and linguistic similarity between L1 and L2 play a role on the way L2 is processed. Till now, L2 processing research has mainly centred around the perception domain, while little research has been done in language production. Moreover, existing research from a production point of view on the way L2 is processed has mainly focused on the phonological or lexical levels (Sebastián-Gallés & Kroll, 2003). However, at the syntactic level, precise characterization of L2 processing is still lacking and is unfortunately still poorly understood.

This work aims at studying the way L1 syntax affects bilinguals’ L2 processing. With this objective in mind, highly proficient early bilinguals of languages with syntactically similar (Basque-Spanish) and dissimilar (Catalan-Spanish) word order were tested while producing Spanish L2 structures for which they show native-like performance: Determiner Phrase (DP) structures (e.g. los coches, [the cars]). Their performance was compared to that of Spanish native speakers. Thus, our main goal here was to investigate whether early bilinguals’ L2 syntactic processing is affected by their L1’s syntactic properties, even when they produce L2 DP structures for which their performance is native-like.

1. Previous studies on the L2 syntactic processing

We already know that L1 syntactic properties affect late bilinguals’ production of L2 syntactic structures. However, this influence is not so clear in the case of early bilinguals’ production, as they usually attain a high and apparently native-like syntactic processing performance in their L2. Still, do early bilinguals use the same processing mechanisms as native speakers do in their production of L2 syntactic structures?

A line of research developed by Weber-Fox and Neville (1996) addressed the question of how maturational constraints affect the development of the sub-systems involved in the processing of L2 syntax perception. Four groups of Chinese-English bilinguals who acquired L2 (English) at different ages (1-3, 4-6, 7-10, 11-13 and after 16 years of age) plus a control group of English native speakers were tested. Participants were asked to read and make grammaticality judgments over utterances including either semantic anomalies or various types of syntactic violations (phrase structure, specificity constraints and subadjacency constraints). Both behavioral (error percentage) and neurological (event-related brain
DOES L1 SYNTAX AFFECT L2 PROCESSING?

potentials (ERP)) data were recorded. Late bilinguals showed native-like performance in the processing of semantic anomalies in both the judgment task (L2 acquired before the age of 14), and the ERP measures (L2 acquired before 10). However, for syntactic type ungrammaticalities, only bilinguals that had acquired L2 before the age of 7 showed grammaticality judgments similar to those of native speakers, and their accuracy decreased in correlation with age of L2 acquisition. Moreover, the ERP neurological data revealed that even those bilinguals that had acquired L2 before the age of 7 processed syntactic ungrammaticalities differently from native speakers. This was the case even though grammaticality judgment data showed that they were at native-like performance levels. Hence, this work showed that, similarly to the case of phonology, the age of L2 acquisition is a fundamental factor for the acquisition of L2 syntactic competence. In other words, being an early bilingual does not guarantee native-like syntactic processing competence in comprehension. However, maturational constraints seem to affect differently the different L2 components, as even late bilinguals show native-like performance while processing utterances containing semantic anomalies.

In the production modality, the first approaches to the study of how L2 syntactic structures are represented have been done using syntactic priming tasks. In monolingual production research, these tasks revealed the speakers’ tendency to reuse previously processed syntactic structures (e.g., speakers tend to produce more passive sentences after previous exposure to a passive sentence; see Pickering & Branigan, 1999). These priming effects constitute supporting evidence for the existence of syntactic representations formally stored separately from lexical ones (Bock and Levelt, 1994; Vigliocco & Hartsuiker, 2002). In the case of bilinguals, recent research using cross-linguistic syntactic priming tasks has revealed the existence of significant cross-linguistic syntactic priming effects. These results suggest that some syntactic representations might be shared across languages. For example, Hartsuiker et al. (2004) found that Spanish-English late bilinguals tended to use more English passives to describe pictures when they had just heard a Spanish passive sentence as compared to an intransitive or active control. Meijer & Fox Tree (2003) found that, in Spanish-English early bilinguals, Spanish prepositional dative constructions primed English dative constructions over double object dative constructions. However, in a work on German-English bilinguals, Loebell & Bock (2003) reported syntactic priming effects between alternative forms of German and English datives (prepositional and double-object datives), but not between
English and German active and passive forms. This was attributed to the word order differences between English and German passive sentences. In sum, these studies put forth the possibility of shared syntactic representations for structures common to both languages for both early and late bilinguals.

In order to study L2 syntactic processing, Nicol & Greth (2003) tested English-Spanish late bilinguals’ subject-verb agreement performance. The nature of agreement encoding in production has been largely studied by manipulating and examining the occurrence of attraction errors (i.e. incorrect agreement with a word that is not the one governing agreement) in cases such as the subject-verb number agreement in sentence completion tasks (Bock & Miller 1991). Several factors have been shown to affect agreement encoding. For example, accuracy in agreement encoding is more likely when the to-be-agreed-with subject’s conceptual number (whether it refers to one vs. many entities) and its corresponding syntactic information (singular vs. plural) are congruent (e.g. both singular: the man is tall) than when they are incongruent (e.g. conceptually plural but syntactically singular nouns: *money are green). Interestingly, cross-linguistic differences have been reported on the way these so-called distributivity effects affect agreement encoding. For example, the subjects’ semantic distributivity notions seem to have a greater impact in Spanish than in English subject-verb agreement processing (Vigliocco, et al., 1996). Thus, Nicol & Greth (2003) used these cross-linguistic differences to make a first approximation to the poorly understood L2 production. They studied the distributivity effects in the subject-verb number agreement performance of English-Spanish bilinguals in both their L1 and L2. Similar patterns were found in both cases, suggesting that bilinguals implement L2 agreement in the same way they do in their L1. In other words, these results suggests that L1 syntax affects the way L2 is processed.

In the perception modality, Weber-Fox & Neville (1994) showed the importance of early L2 acquisition for achieving native-like syntactic competence. However, their neurological data reveals subtle differences between native and non-native speakers’ syntactic comprehension processing, even for early bilinguals showing native-like syntactic performance. In the case of L2 production, cross-linguistic syntactic priming effects indicate that L1 syntax interacts with the way L2 syntax is represented, both in early and late bilinguals. With regard to whether L1 affects L2 production, Nicol & Greth (2003) revealed that English-Spanish late bilinguals used their L1 syntax processing strategies in order to
process L2 agreement. However, more research would be necessary to get a better understanding of how bilinguals process L2.

In this work we will investigate whether L1 syntax affects L2 processing. All the evidence presented above suggests that L1 syntax influences L2 processing. However, there is a situation in which the answer to this question is not so clear. This is the case of highly-proficient early bilinguals, as they attain native-like L2 performance in many linguistic aspects. For example, they do not make mistakes while producing small DP structures like the car or the bridges. So, our main contribution here will be to test whether L1 syntax interferes with L2 processing when early bilinguals produce syntactic structures for which they show native-like performance. To do that, we will test whether the syntactic rules determining L1 DPs word ordering affect the production of L2 structures. Next we will explain how sentence production models explain the way word order is processed.

2. The incremental nature of syntactic structures production

Most language production models assume that there are different levels involved in the production of sentences. Three main levels have been identified: the conceptual, the sentence, and the articulatory levels. Importantly, it is at the sentence level where lexical retrieval, sentence structure building, and phonological processing occurs (Bock & Levelt, 1994; Vigliocco & Hartsuiker, 2002). This level is divided in three different sublevels: functional, positional and phonological. There are different points of view regarding the place and the way the different pieces of information necessary to build sentences are processed. For example, Bock and Levelt (1994) propose the existence of a functional assignment level (assignment of syntactic functions -e.g. subject, direct object, etc.- for the main constituents of the sentence) followed by a positional assignment level (the ordering of the constituents). Furthermore, they assume that both the functional and the positional levels are engaged in syntactic processing, whereas Vigliocco & Hartsuiker (2002) propose that only the functional level is engaged in syntactic processing. However, for our purposes here, we only need to focus our attention on one specific assumption of these production models: incremental processing.

It is broadly accepted that the process of sentence generation is incremental in nature (e.g. Bock & Levelt, 1994; Vigliocco & Hartsuiker, 2002). According to the incrementality
assumption, the construction of an utterance is done piecemeal, in a way that different pieces of a sentence could be at different levels of processing at the same time. So, for example, once the first lexical entry is completely retrieved from the lexicon, it could start being processed at the phonological level, even if not all the lexical entries of the to-be-uttered sentence have been accessed. That is, both the lexical and the phonological levels can be working simultaneously. So, the articulation of a sentence can start before the morphophonological processing is completed.

Evidence favoring the incrementality assumption comes from studies measuring the different time course of the processing of both semantic and phonological information in syntactic processing. Such experiments have used both the picture-word interference paradigm (Schriefers, Meyer and Levelt, 1990; Meyer, 1996; Schriefers, 1999; Costa and Caramazza, 2002), and the Advanced Information Paradigm (AIP) (Schriefers, de Ruiter and Steigerwald, 1999; Yu, 2001). In addition, they demonstrate that word order is an important factor determining the way information is processed in sentence production. Consequently, we will exploit these important data to study the influence of L1 syntactic structures’ in the processing of L2 by addressing a more specific question: Does L1 word order have any influence on the production of L2 structures? An appropriate tool that has shown to be sensible enough to the different processing mechanisms used to construct different word order structures in different languages is the one introduced by Schriefers and collaborators (1999): the AIP.

3. The Advanced Information Paradigm

Schriefers and collaborators’ used the AIP in order to study how lexical retrieval and phonological encoding processes are coordinated in the incremental production process of German DPs (der rote tisch [the red table]) and NPs (roter tisch [red table]) containing color adjectives. In this paradigm participants received a piece of information relevant to the production of the utterance they were asked to produce before the target itself was presented. For example, Schriefers et al. (1999) presented participants with advanced information concerning either the adjective or the noun they were requested to subsequently produce. Adjective information was primed by presenting a series of Xs printed in the same color as the target picture. Noun information was primed by presenting the proper object drawn in black. The reaction time (RT) differences between the production of targets primed by
adjective and noun information were taken as an indicator of the different contribution these parts of speech made to the production of both German DP and NP structures.

German determiners agree in gender (feminine, masculine or neuter) with nouns. Thus, the authors claim that in order to produce German DPs, speakers have to have accessed the nouns’ syntactic gender information in order to be able to initiate the determiners’ lexical retrieval (see also Caramazza et al., 2002). Results showed that adjective advanced information led to shorter RTs than noun advanced information when NPs without determiner were to be uttered (roter tisch). However, shorter RTs were found with noun than with adjective advanced information when DPs had to be uttered (der rote tisch). These results fit well with the authors’ assumption, and allow them to discuss several aspects of the way the linguistic properties and structures of the to-be-produced utterances affects speakers’ production strategies. In a similar study, Yu (2001) tested how English (the red car) and Spanish (el coche rojo [lit. the car red]) DSs differing in their component word order were processed by native speakers. Using the AIP with noun and adjective priming conditions, Yu found faster RTs for pictures with noun than with adjective advanced information in the case of Spanish DSs, in which the noun precedes the adjective (el coche rojo). The reverse pattern was found when participants had to produce English DPs where the adjective precedes the noun (the red car). Hence, these studies have demonstrated that the AIP is sensitive enough to reveal different processing strategies for structures differing in both the agreement constraints between their constituents (e.g. gender) or in their constituents’ word order. Consequently, we have found the appropriate tool to study how L1 syntactic properties affect L2 syntax production in highly-proficient bilinguals: the Advanced Information Paradigm.

4. Producing Determiner Phrases in L2: Does L1 syntax interfere with L2 processing?

Highly proficient early bilinguals seem to be able to properly acquire many syntactic rules of their L2, as suggested by their error-free performance. However, it remains to be seen whether they process L2 structures in the same way as native speakers do. For example, does L1 syntax interfere with L2 processing when L1 and L2 syntactic rules differ?

Two main hypotheses could account for these issues. On the one hand, it could be hypothesized that bilinguals’ L1 and L2 syntactic systems work in an autonomous way. That is, there would be no interaction between the syntactic processes of L1 and L2. According to
this hypothesis, bilingual speakers’ L2 production processes would resemble those of native speakers. On the other hand, the bilinguals’ L1 and L2 syntactic systems could interact with each other. Thus, L1 syntax would interfere with L2 syntactic processing. Consequently, the interaction hypothesis predicts that bilinguals’ L2 processing would be different from that of native-speakers.

In order to put to test these hypotheses, we will study the way Basque-Spanish and Catalan-Spanish highly proficient early bilinguals process DP structures in their L2 (Spanish). They will be asked to produce singular or plural DP structures containing a definite determiner and a noun (e.g. *el puente* or *los puentes*, [the bridge/s]). The AIP will be used, and number or noun advanced information will be provided in order to test how they process these structures. Their behavior will be compared to that of Spanish native speakers. Importantly, both Catalan and Spanish are head-initial languages, while Basque is a head-final one. The head-parameter determines the order of precedence of the phrase’s head with respect to its complement. Hence, in the concrete case of the DP structures with definite determiners that we will use to test bilinguals’ L2 processing, there is a crucial word order difference between Spanish and Catalan DPs on the one hand, and Basque DPs on the other: the DPs of the first two languages have a [Determiner,Noun] order, while Basque DPs’ have a [Noun,Determiner] order. Hierarchical relations remain constant across the three languages. Additionally, the definite determiners of both Spanish and Catalan DPs are free morphemes that agree in gender and number with their noun complement. In this case, both the noun and the determinant are marked for gender and number features. Thus, both the Spanish and Catalan definite determinant systems have four different forms. In Spanish, singular and plural feminine forms are *la* and *las*, respectively; whereas the masculine forms are *el* and *los* (e.g. *la manzana* / *las manzanas* [the apple/s]; *el puente* / *los puentes* [the bridge/s]). In Catalan, the feminine singular and plural forms are *la* and *les*, whereas the masculine ones are *el* and *els*, respectively (e.g. *la poma* / *les pomes* [the apple/s]; *el pont* / *els ponts* [the bridge/s]).

However, Basque is an agglutinative language that does not mark gender. Hence, in a Basque DP the determiner is a bound-morpheme attached to the noun. Number is marked by the head of the entire phrase, the determiner. Then, the bound determiner system is composed by two forms: *-a* and *-ak* for singular and plural, respectively (e.g. *zubi-a* [the bridge]; *zubi-ak* [the bridge]).

---

1 In Catalan, feminine and masculine singular determiners take the epenthetic form ‘’, like in *l’aigua* [the water] or *l’home* [the man], respectively.
bridges). Taken together, the word order and determiner system differences between Spanish/Catalan and Basque would predict the use of different processing strategies by speakers of these languages. Consequently, this scenario looks appropriate to test whether the L1 syntax affects L2 processing.

To do that, the experimental section will be structured in the following way: In Experiment 1 we will test whether both the Spanish and Basque native speakers process differently the DP structures in their respective native languages. So, this experiment will allow us to test whether the AIP is sensitive to the different processing strategies used by speakers producing different word-order syntactic structures. Advancing the results of Experiment 1, significant differences in DP processing were found between Spanish and Basque native speakers. Hence, in Experiment 2, we will test whether the Basque-Spanish early bilinguals’ L2 processing strategies are affected by the ones implemented in L1 syntactic processing. According to the “autonomous L2 syntactic processing” hypothesis, L1 syntax does not interact with L2 syntactic processing, and thus the Basque-Spanish bilinguals’ processing pattern would resemble that of the Spanish native speakers tested in Experiment 1. However, the “L1 and L2 syntactic processes interaction” hypothesis assumes that L1 syntactic processing strategies interfere with L2 processing. Hence, different processing patterns would be expected from the Basque-Spanish bilinguals and the Spanish native speakers. The results of Experiment 2 showed that Basque-Spanish bilinguals process Spanish DPs in a different way as native speakers do, supporting the notion of interactivity between L1 and L2 syntax. Thus, in Experiment 3 we will investigate whether L1 syntax interferes with the processing of L2 structures when the syntactic properties of both the target and non-target languages are similar. For that purpose, a group of Catalan-Spanish bilingual speakers were asked to produce Spanish DPs. Results showed that their L2 processing strategies largely resemble those of Spanish native speakers. Further discussion of these results will be deferred to the General Discussion section.

4.1. Method, Population and Materials

Population. Four different groups of sixteen participants each were tested along Experiments 1 to 3. In Experiment 1 two groups of native speakers were selected: 1) Basque
native speakers; and 2) Spanish native speakers. In Experiments 2 and 3 two groups of early bilinguals with Spanish as their L2 were selected: Basque-Spanish bilinguals (Experiment 2) and Catalan-Spanish bilinguals (Experiment 3). The Basque native speakers and the Basque-Spanish bilinguals were students of Basque Philology at the University of the Basque Country, whereas the Spanish native speakers and the Catalan-Spanish bilinguals were students of Psychology at the University of Barcelona. Both bilingual groups were highly proficient in Spanish, and had acquired it early in life (before the age of 4, in kindergarten / school). Both the Basque-Spanish and Catalan-Spanish bilinguals had grown up in predominantly, if not completely, Basque or Catalan speaking families, and they attended Basque or Catalan schools. However, they had been passively exposed to Spanish since birth, listening to it on TV, radio, in the street, etc. They started their formal learning of Spanish at the age of 3 or 4, in school. Hence, although Spanish is their L2, as they had grown up in Spanish-dominant communities, these bilinguals had a good proficiency level in their L2, and they can be considered early and highly-proficient balanced bilinguals.

**Materials.** We selected 39 pictures: 23 of these pictures have a feminine gender name in Spanish and Catalan, and 16, a masculine gender name in these two languages (Basque does not mark grammatical gender) (see Appendix). 10 additional pictures were selected to be used as warm-up pictures. The main variable we manipulated was the advanced information provided to the participants (hereafter “Prime Condition”): Noun prime (the picture of the object was presented before the target picture itself) and Number prime (“one single dot” or “two dots” were presented to prime the singular or the plural numbers respectively). Each picture had to be named producing either a singular DP (a unique picture of the target object was presented) or a plural DP (two pictures of the target object were presented) in the two prime conditions. As a result, each picture was presented 4 times along the experiment in the following conditions: a) noun prime, singular DP target condition; b) noun prime, plural DP target condition; c) number prime, singular DP target condition; and d) number prime, plural DP target condition.

Stimuli were presented in two main blocks in which the grammatical gender of the Spanish nouns remained constant. We divided the items in such a way as to minimize the possible

---

2 It is worth noting that these two groups of participants were either Basque-Spanish or Spanish-Catalan bilinguals. This is because there are no completely monolingual adult Basque speakers, as all of them speak either Spanish or French as their L2. Hence, in order to take a similar group for the Spanish native speakers, we decided to test Spanish-Catalan bilinguals instead of Spanish monolingual speakers.
DOES L1 SYNTAX AFFECT L2 PROCESSING?

differences between the tasks that Spanish and Basque native speakers had to perform. Since Basque does not mark gender, they only had to choose between two possible determiner form candidates (–a and –ak morphemes, for singular and plural forms, respectively). Maintaining the noun gender constant within blocks, Spanish speakers only had to choose between the singular and plural forms in each of the masculine and feminine blocks (la and las in the feminine block and el and los in the masculine block, for singular and plural, respectively). Within a block, each picture appeared once in each of the four experimental conditions. Each block started with the presentation of five warm-up trial pictures. Thus, 97 trials were presented in the feminine block, and 69 in the masculine one. Two randomizations per block were constructed as follows: a) each block was divided in 4 sub-blocks containing all the experimental pictures in one of the four experimental conditions (10 for each condition); b) no more than three consecutive trials with the same number or prime conditions were presented; and c) no more than two trials of the same experimental condition were presented consecutively. The blocks' presentation order was counterbalanced across participants.

Procedure. Participants were tested individually in a soundproof booth. The Basque Native speakers where tested in Basque, whereas the other three groups where tested in Spanish. Before the experiment, each subject received a booklet with the pictures and their corresponding names written below. They were instructed to name the pictures with “definite determiner + noun” DPs (e.g. Basque speakers had to say sagarra or sagarrak and Spanish speakers had to say la manzana or las manzanas for the singular and plural forms of the picture of an apple, respectively). Next, pictures were presented on a computer screen and participants were asked to name them with singular DP structures. If a participant used an unexpected name, the experimenter corrected her and asked to pronounce the correct name. Finally, and before the experiment proper, participants were advised that number or noun information on each of the target pictures was going to be presented in advance before the proper presentation of the target. They were explicitly instructed not to start giving any answer until they saw the target picture, and to answer as fast and as accurately as they could. Additionally, before each block, participants performing the task in Spanish were informed of the gender of the pictures’ nouns that would be presented in it. After that, the experiment started.

Each trial had the following structure. First, a fixation point (an asterisk) was shown in the center of the screen for 500 ms. Second, the advanced information was presented for 350 ms,
followed by a mask (six vertical lines presented in the middle of the screen) presented for 100 ms. Then the target picture was presented for 2500 ms or until a response was provided. After that, the next trial started automatically. Response latencies were measured from the onset of the stimulus to the beginning of the naming response. Response latencies were measured by means of a voice key. The session lasted for approximately 35 min.

**Analyses.** Three types of responses were scored as errors: (a) production of names differing from those designated by the experimenter, (b) verbal disfluencies (stuttering, utterance repairs, and production of nonverbal sounds that triggered the voice key), and (c) recording failures. Erroneous responses and outliers (i.e., responses exceeding 3 standard deviations) were excluded from the analyses of response latencies. In the error analyses, only significant results will be reported.

### 4.2. Experiment 1: Basque and Spanish DP’s processing by Native speakers

The main objective of this experiment was to test the way both Basque and Spanish native speakers’ produce DPs with definite determiner + noun structures. Due to the incremental nature of speech production and the main word order differences between these Basque and Spanish DPs, we expected that the noun or number advanced pieces of information would affect differently the production of Spanish or Basque DPs. The main word order differences between Spanish and Basque DP structures is expected to lead to different processing strategies in the following way: Basque speakers would benefit more than the Spanish speakers from the noun priming condition. This is because in Basque DPs the noun precedes the determiner, while in Spanish, the determiner precedes the noun. In contrast, Spanish speakers would benefit more than Basques from the number priming condition, as this condition would allow them to start the determiner selection processes. In Basque, number is marked at the end of the DP, and thus, number advanced information would not provide a great benefit on Basque DP production.

Importantly, this experiment allowed us to prove the sensitivity of the AIP to show processing differences on the production of different syntactic structures.

**Results and Discussion.**

The percentage of eliminated data from the final analysis reached the 4.33% (2.96% errors,
DOES L1 SYNTAX AFFECT L2 PROCESSING?

1.37% outliers) for Basque Native speakers and the 6.65% (5.41% errors, 1.24% outliers) for Spanish Native speakers. In the error analysis, Basque Native speakers made more errors in the number than noun prime condition ($F_{1}(1,15) = 10, p=.006; F_{2}(1,38) = 4.09, p=.05$), and Basque Native speakers made more errors than Spanish native speakers ($F_{1}(1,30) = 8.88, p=.006; F_{2}(1,38) = 9.65, p=.004$) (see table 1).

In the naming latencies analysis, both groups of participants were faster when naming pictures in the noun than the number prime conditions, as indicated by the significant Prime effects (Basque: $F_{1}(1,15) = 142.87, p<.001; F_{2}(1,38) = 956.52, p<.001$; Spanish: $F_{1}(1,15) = 55.46, p<.001; F_{2}(1,38) = 320.26, p<.001$). In the joint analysis conducted with the data of these two groups, the Prime effect ($F_{1}(1,30) = 196.02, p<.001; F_{2}(1,38) = 840.35, p<.001$) was significant, whereas the Group effect was only significant in the item analysis ($F_{1} < 1; F_{2}(1,38) = 16.16, p<.001$). More importantly, the interaction between Prime and Group was highly significant ($F_{1}(1,30) = 23.12, p<.001; F_{2}(1,38) = 287.2, p<.001$).

Table 1. Mean reaction time (ms) and Error percentage (% E) for the Basque and Spanish native speakers (Experiment 1), and for the Basque-Spanish (Experiment 2) and Catalan-Spanish (Experiment 3) highly proficient early bilinguals.

<table>
<thead>
<tr>
<th>Native Speakers</th>
<th>Basque-Spanish Bilinguals</th>
<th>Catalan-Spanish Bilinguals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$L1$ Basque $L1$ Spanish</td>
<td>$L2$ Spanish $L2$ Spanish</td>
</tr>
<tr>
<td></td>
<td>(Experiment 1)</td>
<td>(Experiment 2)</td>
</tr>
<tr>
<td>Number prime</td>
<td>Mean 5.4</td>
<td>Mean 6.7</td>
</tr>
<tr>
<td>Object prime</td>
<td>487 3.4</td>
<td>521 6.6</td>
</tr>
<tr>
<td>Difference</td>
<td>204 99</td>
<td>136 104</td>
</tr>
</tbody>
</table>

As predicted, the RTs of both groups of native speakers were faster in the noun than the number prime conditions. In the case of Spanish speakers, this is motivated by the fact that they have to wait until they access the noun’s syntactic gender information to select the proper determiner (Caramazza et al., 2002). In the case of Basque speakers, this is mainly led by the Noun + Determiner word order of Basque DPs. However, whereas Basque speakers’ response latencies were 202 ms faster in noun than number prime condition, this difference is
reduced to 99 ms in the case of Spanish speakers. Hence, we interpret this pattern of results as an indicator of the use of different syntactic processing strategies by Basque and Spanish speakers. These results showed that the AIP is sensitive enough to show processing differences in the production of DPs with different word orders. Thus, now we are able to test whether L1 syntax affects L2 processing. However, although it is not our main aim, let us first speculate on how the Basque and Spanish DP processing differences arise.

Due to the incremental nature of language production, the production of Basque DPs would start as soon as the phonological form of the first element, the noun, had been processed, without waiting for the end of the retrieval and processing of the determiner’s lexical entry. However, in the case of Spanish DPs, the retrieval and processing of the first element, the determiner, may have to wait at least until the noun’s syntactic properties (e.g. gender) have been retrieved. As a consequence, in Spanish, the start of articulation would be delayed until the syntactic information of the DP’s head constituent has been processed. Additionally, the number primes could be more relevant to advance the production processes of Spanish DPs than of Basque DPs, since the determiner is the first element in the former language, and the last in the latter. Taken together, these speculative reasons based on the word order difference could be leading to the different processing patterns of Spanish and Basque DPs by native speakers.

4.3. Experiment 2: Does L1 syntax affect L2 production? The case of Basque-Spanish bilinguals

In order to investigate whether L1 syntax affects L2 processing, Basque-Spanish highly proficient early bilinguals were asked to perform the picture naming task in their L2, Spanish. The way they processed L2 DPs was compared to that of Spanish native speakers in Experiment 1.

Results and Discussion.

7.37% of the data was discarded (6.25% errors, 1.12% outliers). The analysis of response latencies showed that participants were faster naming noun than number primed pictures ($F(1,15) = 262.67, p<.001; F(1,38) = 704.16, p<.001$). The joint analysis of the data of the Basque-Spanish bilinguals and Spanish Native speakers (Experiment 1) showed a significant
Prime effect \((F1(1,30) = 224.31, p<.001; F2(1,38) = 603.46, p<.001)\). The Group effect did not reach significance \((F1(1,30) < 1; F2(1,38) = 3.08, p=.087)\). But, more importantly, a significant Prime X Group two-way interaction was found \((F1(1,30) = 5.79, p=.022; F2(1,38) = 57.86, p<.001)\).

These results clearly indicate that the processing of Spanish DPs of Basque-Spanish early bilinguals differs from that of Spanish native speakers. This is because, although they also showed a larger benefit from noun than number priming, their naming performance indicates that different processing strategies were being used by these bilingual speakers: whereas Spanish native speakers’ RTs were 99 ms faster in noun than prime condition, this difference is of 136 ms in the case of Basque-Spanish bilinguals. Thus, the Basque-Spanish bilinguals’ naming pattern goes in the same direction as that showed by Basque native speakers. Still, the joint analyses we performed with the results of these two groups showed that Basque-Spanish bilinguals were not using L1 processing strategies to produce L2 DPs (the two-way Prime X Group interaction was significant: \(F1(1,30) = 12.02, p=.002; F2(1,38) = 134.88, p<.001\)). Consequently, we conclude that the different processing patterns showed by Spanish native speakers and Basque-Spanish bilinguals while producing Spanish DPs reveals that L1 syntax interacts with L2 structures processing.

However, one could argue that the differential processing showed by bilinguals in respect to native speakers is just due to them being bilingual, and not by an interaction between L1 and L2 syntactic systems. The knowledge of an L1 might lead to the development of L2 learning strategies different from those used by native speakers. That is, it might be supposed that the L1 interference on L2 acquisition processes causes bilinguals to develop L2 processing strategies different from those of native speakers, regardless of the similarities between their two languages’ linguistic systems. Hence, according to this assumption, the bilinguals should always show processing differences while producing sentences in their L2 with respect to the processing strategies used by native speakers.

4.4. Experiment 3: Does syntactic similarity play a role in L1 and L2 syntactic systems’ interaction processes? The case of Catalan-Spanish bilinguals

The main objective of this experiment was to test whether bilinguals’ L2 processing would always differ from that of native speakers. For that purpose, we tested the production of
Spanish DPs by a group of Catalan-Spanish highly proficient early bilinguals. Spanish and Catalan DPs are syntactically similar, and consequently, this would allow bilinguals to use L1 processing strategies to process L2 structures. Thus, in this experiment we explored the performance of a group of bilinguals while producing L2 DPs with the same syntactic structure as the DPs of their native language. If the processing of Spanish DPs of Basque-Spanish bilinguals differed from that of the native speakers because of the sheer fact of the former being bilinguals, then we would expect the same differences to be shown by any bilingual population, and in particular, by speakers of two languages that share the same syntactic rule: head-initial parameter. Conversely, if L1 syntactic properties play a role in bilingual DP processing, we would expect the performance of the Catalan-Spanish bilinguals to resemble more that of the Spanish native speakers.

Results and Discussion.

A total of 8.01% (6.25% errors, 1.76% outliers) of the data was discarded from the final analysis. As in previous groups, Catalan-Spanish bilinguals also showed faster response latencies for noun than number prime trials ($F_1(1,15) = 129.72, p<.001; F_2(1,38) = 572.7, p<.001$). Two different joint analyses were conducted to compare the pattern of results of Catalan-Spanish bilinguals with those showed by Spanish Native speakers (Experiment 1) and Basque-Spanish bilinguals (Experiment 2). Interestingly, no significant Prime X Group two-way interaction was found in the former analysis (both $F$s < 1). However, in the latter case, the two-way interaction was significant ($F_1(1,30) = 7.06, p=.013; F_2(1,38) = 64.87, p<.001$). These results clearly reveal that the Catalan-Spanish bilinguals’ processing pattern of Spanish DPs is very similar to that of the Spanish Native speakers. This is because both groups showed larger benefit from noun than number priming, and, importantly, both groups showed the same amount of benefit differences between noun and prime conditions: 99 and 104 ms for Spanish native speakers and Catalan-Spanish bilinguals, respectively. However, this pattern clearly differs from that showed by the Basque-Spanish bilingual speakers (see figure 1). As a consequence, we conclude that the differences showed by Basque-Spanish bilinguals and Spanish native speakers while processing Spanish DPs was not due to any difference in the way they acquired Spanish. In contrast, these results suggest that these differences stem from the interference of Basque syntax with Spanish DPs processing. However, in the case of Catalan-Spanish bilinguals, because of the syntactic similarities between these two languages, L1 syntax would not interfere with L2 processing. In fact, one could assume that Catalan-
Spanish bilinguals are using L1 processing strategies to produce L2 structures.

Figure 1. (B) Mean RT differences between the production of Spanish DPs with Noun and Number Primes (in ms) by Spanish native speakers (L1, Exp. 1), Basque-Spanish bilinguals (L2, Exp. 2) and Catalan-Spanish bilinguals (L2, Exp. 3).

5. General Discussion

The correct production of DPs like *the bridge* implies the use of some syntactic knowledge that early and late bilinguals must appropriately acquired. However, in this article we have shown that the syntactic properties of early bilinguals’ L1 DPs affect their L2 DP processing strategies. This is because, differences have been found in the way early bilinguals and native speakers process DPs like *the bridge*. However, our results indicate that these differences only arise when L1 and L2 syntax differ, but not when they are similar.

Our results fit well with the findings already reported in L2 comprehension. It has been shown that bilinguals’ L2 comprehension processes differ from those of native speakers, even when L2 has been acquired early in life and no performance differences are found between bilinguals and native speakers (Weber-Fox & Neville, 1996). In our study, bilinguals were asked to produce short syntactic structures in which they do not normally make mistakes. Thus, no differences could be expected between the ways in which both native speakers and early bilinguals process this type of structures. Nevertheless, results show that when L1 and L2 differ in word order, different processing strategies are followed by bilingual speakers. These results agree with those reported by Nicol and Greth (2003), which showed that late Spanish-English bilinguals follow L1 processing strategies while producing subject-verb agreement in their L2 (English). Nicol and Greth interpreted these findings as an indicator
that late bilingual speakers have developed specific syntactic (e.g., subject-verb agreement) processing strategies in their native language, and they apply these same strategies when speaking in their L2. However, a main difference between our results and those of Nicol and Greth is that while they showed that Spanish-English late bilinguals use L1 processing strategies to produce L2 structures, our results further indicate an interference of L1 with L2 processing strategies in early bilinguals’ DP production. This is because the processing strategies used by Basque-Spanish bilinguals to produce Spanish DPs were different from those of Spanish native speakers, but also from those showed by Basque native speakers producing Basque DPs. However, no interference of L1 with L2 syntactic processing was observed in the case of Catalan-Spanish bilinguals. What do these results suggest?

As mentioned in the introduction, the work of both Meijer & Fox Tree (2003) and Hartsuiker, Pickering and Veltkamp (2004) revealed the existence of cross-linguistic syntactic priming effects in Spanish-English early and late bilingual speakers (see also Loebell & Bock, 2003). Hartsuiker and collaborators interpreted these results as an indication that some syntactic representations might be shared across languages. Similarly, following this rationale, our results here might indicate that some syntactic processing strategies are shared across languages. That is, bilinguals might share L1 and L2 processing strategies whenever the same processing strategies could be used to produce syntactically similar structures in their two languages. As a result, no interference effects of L1 over L2 syntactic processing would occur, and hence the similar processing patterns showed by both Catalan-Spanish and Spanish native speakers producing Spanish DPs. However, when differences exist between the syntactic structures of L1 and L2 representations, different processing strategies should be used. As a result, L1 syntax would interfere with the processing of L2 structures, leading to differences in the processing patterns of bilinguals and native speakers. This is what occurs in the case of Basque-Spanish bilinguals.

This work provides further evidence for the way in which bilingual speakers process L2 syntax. Here we have studied the L2 production of a bilingual population that is characterized by a highly accurate L2 performance: highly proficient early bilingual speakers. However, despite their accurate L2 performance, our results with Basque-Spanish bilinguals revealed that the L2 syntactic structures’ production is affected by the L1 syntactic system. However, the results obtained with Catalan-Spanish bilinguals suggest that such an effect is only present when different syntactic processing strategies are used in the production of L1 and L2
syntactic representations. This suggests that syntactic processing strategies might be shared across languages. Additionally, these results challenge the hypothesis that the different performance of Basque–Spanish bilinguals in relation to that of Spanish native speakers would stem from their bilingual condition.

In summary, we have shown that the syntactic properties of L1 affect the processing of L2 structures. More interestingly, our results reveal that this is even true for highly proficient bilinguals producing very simple L2 structures (i.e., DPs). This suggests that the representation and processing of L2 syntax is heavily dependent on the previously established L1 system.

6. References


Mikel Santesteban Insausti
Dept. Psicología Bàsica & Parc Científic. Universitat de Barcelona.
Edifici Docent. Hospital de Sant Joan de Déu. C/ Santa Rosa, 39-57, planta 4ª
08950 Esplugues - Barcelona
e-mail: msantesteban@ub.edu

APPENDIX. Materials employed in all the experiments
The names of the pictures used along all the experiments are listed here following the next form: Basque Name/Spanish Name/English Translation.
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Izarra / Estrella / Star</td>
<td>15.</td>
</tr>
<tr>
<td>3.</td>
<td>Udarea / Pera / Pear</td>
<td>16.</td>
</tr>
<tr>
<td>4.</td>
<td>Behia / Vaca / Cow</td>
<td>17.</td>
</tr>
<tr>
<td>5.</td>
<td>Marrubia / Fresa / Strawberry</td>
<td>18.</td>
</tr>
<tr>
<td>6.</td>
<td>Mahaia / Mesa / Table</td>
<td>19.</td>
</tr>
<tr>
<td>8.</td>
<td>Leihoa / Ventana / Window</td>
<td>21.</td>
</tr>
<tr>
<td>9.</td>
<td>Eguzkia / Sol / Sun</td>
<td>22.</td>
</tr>
<tr>
<td>11.</td>
<td>Oilarra / Gallo / Rooster</td>
<td>24.</td>
</tr>
<tr>
<td>27.</td>
<td>Tipula / Cebolla / Onion</td>
<td></td>
</tr>
<tr>
<td>28.</td>
<td>Soínekoia / Vestido / Dress</td>
<td></td>
</tr>
<tr>
<td>29.</td>
<td>Hezurra / Hueso / Bone</td>
<td></td>
</tr>
<tr>
<td>30.</td>
<td>Txerria / Cerdo / Pig</td>
<td></td>
</tr>
<tr>
<td>31.</td>
<td>Eskua / Mano / Hand</td>
<td></td>
</tr>
<tr>
<td>32.</td>
<td>Etxea / Casa / House</td>
<td></td>
</tr>
<tr>
<td>33.</td>
<td>Zuhaitza / Árbol / Tree</td>
<td></td>
</tr>
<tr>
<td>34.</td>
<td>Ahoa / Boca / Mouth</td>
<td></td>
</tr>
<tr>
<td>35.</td>
<td>Giltza / Llave / Key</td>
<td></td>
</tr>
<tr>
<td>36.</td>
<td>Ardia / Oveja / Sheep</td>
<td></td>
</tr>
<tr>
<td>37.</td>
<td>Hodeia / Nube / Cloud</td>
<td></td>
</tr>
<tr>
<td>38.</td>
<td>Ohea / Cama / Bed</td>
<td></td>
</tr>
<tr>
<td>39.</td>
<td>Txoria / Pájaro / Bird</td>
<td></td>
</tr>
</tbody>
</table>