

Characterizing the bilingual disadvantage in noun phrase production

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Running head: BILINGUAL NOUN PHRASE PRODUCTION

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Characterizing the bilingual disadvantage in noun phrase production

Abstract

Up to now, evidence on bilingual disadvantages in language production comes from tasks requiring single word retrieval. The present study aimed to assess whether there is a bilingual disadvantage in multiword utterances, and to determine the extent to which such effect is present in onset latencies, articulatory durations, or both. To do so, we tested two groups of Spanish speakers (monolinguals and early highly proficient bilinguals using their first and dominant language) each in two different production tasks: bare noun and noun phrase production. Onset latencies were longer for bilinguals relative to monolinguals in both production tasks. Regarding articulatory durations, we observed a clear bilingual disadvantage in noun phrase production and a strong tendency in bare noun production. These findings generalize the bilingual disadvantage in speech production to various performance measures (onset latency and articulatory duration of production) and beyond single words.

Keywords: Bilingualism; Language production; Noun phrases; Articulatory durations

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Although being able to communicate in two languages has obvious advantages, this ability comes at a cost, and bilinguals suffer certain linguistic disadvantages. Bilingual children appear to have reduced vocabulary sizes in each of their languages relative to monolinguals (Bialystok, Luk, Peets, & Yang, 2009; Oller, Pearson, & Cobo-Lewis, 2007), an effect that may even last up to adulthood (e.g., Portocarrero, Burright, & Donovan, 2007). Bilingual adult speakers show disadvantages in various speech production laboratory tasks (Bialystok, Craik, & Luk, 2008; Gollan & Silverberg, 2001; Gollan & Acenas, 2004; Gollan, Montoya, & Werner, 2002; Portocarrero et al., 2007; Rosselli et al., 2000; Rosselli & Ardila, 2002). For instance, in tasks that require simple picture naming bilinguals are slower and less accurate than monolinguals (Gollan, Montoya, Fennema-Notestine, & Morris, 2005; Gollan, Slattery, Goldenberg, Van Assche, Duyck, & Rayner, 2011; Kohnert, Hernandez, & Bates, 1998; Roberts, Garcia, Desrochers, & Hernandez, 2002). This naming disadvantage has been widely documented for the bilinguals' second language (L2). Remarkably, and most relevant for our purpose, only one previous study revealed that this disadvantage is present even in the bilinguals' first and dominant language (L1; Ivanova & Costa, 2008). Despite a growing body of research on the bilingual disadvantage, our knowledge about the generalisability of this phenomenon remains rather limited.

The present research aims at extending this knowledge in two important ways. First, up to now, all studies have explored the bilingual disadvantage in rather simplified experimental contexts, in which single word retrieval is required. We do not know whether the bilingual disadvantage is present also in contexts where multiple words have to be retrieved for production. It is fundamental to assess the generalisability of these effects observed in single word production, and to evaluate whether bilingualism

actually imposes a disadvantage in more complex speaking contexts. If it turns out that the bilingual disadvantage is minimized in more complex utterances where multiple linguistic processes are involved, the consequences of this disadvantage for the regular use of language might be negligible. By contrast, if such disadvantages are maximized in multiword utterances such as noun phrases, then the consequences of bilingualism for speech performance could be even more important than previously thought. Second, the bilingual disadvantage in online processing has been mostly demonstrated for the speed and accuracy with which words are retrieved from the lexicon. Little is known about whether bilingualism also affects how words are actually *produced*, something that can be done by considering other speech performance measures such as articulatory durations. In the current article we mainly take an empirical approach in which we aim to: a) assess the presence of a bilingual disadvantage in the production of multiword utterances, and b) assess the impact of bilingualism on articulatory durations.

As mentioned above, previous studies on bilingual disadvantages observed poorer performance in a weaker L2 when compared to L1 or monolingual speech. In the present study, we aim to compare monolingual speech performance to that of bilinguals producing speech in their first and dominant language. In other words, our focus is to extend evidence on speech production in L1 and to explore possible collateral disadvantages due to the mere presence of an L2.

Ivanova and Costa (2008) were the first to report naming disadvantages in this particular group of bilingual speakers. Their results showed a disadvantage in onset latencies of bare nouns for bilinguals speaking in L1 when compared to monolingual speakers. The present study takes up on this approach by exploring L1 disadvantages in noun phrase production and articulatory durations.

Although our primary goal at this stage is not to adjudicate between different theories of the bilingual disadvantage, we briefly introduce the two most relevant accounts. According to one of these accounts, the bilingual disadvantage is simply a frequency effect in disguise (Gollan, Montoya, Cera, & Sandoval, 2008). That is, bilinguals use each of their two languages less frequently than monolinguals use their unique language. Therefore frequency values of the bilingual's lexical items would be lower than those of monolingual's (for a similar idea see also Ben-Zeev, 1977). To the extent that word frequency influences the speed of word retrieval (Caramazza, Costa, Miozzo, & Bi, 2001; Jescheniak & Levelt, 1994; Navarrete, Basagni, Alario, & Costa, 2006; Oldfield & Wingfield, 1965), bilinguals should show a disadvantage in lexical access tasks such as picture naming, compared to monolinguals. An alternative but not mutually exclusive explanation assumes that part of the bilingual disadvantage stems from language control processes. Bilinguals have to constantly resolve potential competition between two languages during lexical access, slowing down lexical access when compared to monolinguals (Bialystok et al., 2008; Green, 1998; Linck, Kroll, & Sunderman, 2009; Luo, Luk, & Bialystok, 2010; Sandoval, Gollan, Ferreira, & Salmon, 2010).

According to these two accounts, one should expect that the bilingual disadvantage observed in single word retrieval is also present in the production of multiword utterances. As single word retrieval is slower in bilinguals than monolinguals – be it because of frequency of use or because of language control processes –, retrieval of several words is also expected to be slower in bilinguals.

Given previous results in the monolingual literature where single word production has been contrasted with noun phrase production, one could tentatively predict that the effects of bilingualism will be larger in the latter context. For example, a study by Alario, Costa, and Caramazza (2002a) showed that noun and adjective frequency effects (highly frequent words being produced faster than low frequent words) are both present in English noun phrase productions like “the blue kite”. According to the authors, the retrieval of all the elements of a noun phrase is already performed before the utterance is initiated (see Alario, Costa, & Caramazza, 2002b; and Levelt, 2002; for a discussion about the scope of speech planning). Thus, onset latencies in noun phrase production depend on how fast both the adjective and the noun are retrieved, a process which they describe as sequential retrieval (Alario et al., 2002a; Ayora & Alario, 2009; Costa & Caramazza, 2002; Janssen & Caramazza, 2011). In such a scenario, one would expect the bilingual disadvantage observed in single word retrieval to be larger in noun phrase production, as bilinguals might be slower in retrieving the different words that compose the utterance. In the present study we will be able to evaluate this prediction in the context of noun phrase production.

Moreover, it is important to consider that multiword productions requires more than only retrieving several words: For instance, in order to produce a simple noun phrase in Spanish like “el avión rojo” (“the red airplane”), speakers not only need to retrieve the two lexical items corresponding to the object (airplane) and the property (red) but also the grammatical gender of the noun, the correct determiner for that gender, the correct number agreement, and the order of the words according to the grammatical rules of Spanish (determiner + noun + adjective), among other properties.

Crucially, at present we do not know whether and how these extra-processes (e.g., grammatical and syntactic encoding) are affected by the linguistic competence, and hence how they may modulate the bilingual disadvantage in speech production.

Regarding the second objective of the present research, namely whether bilingualism affects articulatory durations, we can find some hints from a study conducted by Flege and Hojen (2004), in which late bilingual speakers took more time to articulate L2 productions than monolinguals (see also Guion, Flege, Liu, & Yeni-Komshian, 2000; Mackay & Flege, 2004, for similar results showing that late bilinguals using L2 had longer articulatory durations than early bilinguals). These studies mainly focused on how non-nativeness (using a late acquired L2) influences articulatory durations, in comparison with articulations by monolinguals or early bilinguals. Up to now, we lack knowledge on whether this disadvantage is also present in early highly proficient bilingual speakers producing speech in their L1. There are two independent motivations to predict the bilingualism effect on articulatory durations to be observed also in L1. First, word frequency correlates negatively with articulatory durations: the higher the word's frequency the shorter its articulatory duration (Gahl, 2008; Guion, 1995; Lavoie, 2002; Wright, 1979). If we assume, based on the frequency-of-use hypothesis, that the frequency values of the words for bilinguals are lower than for monolinguals, we should expect shorter durations for the latter group.¹ Second, some studies have revealed that the ease with which word retrieval is achieved may have an

¹ This argument is based on the assumption that frequency effects in articulatory durations arise from lexical access or articulatory routinization. Explanations of articulatory duration effects due to speakers' intelligibility (a measure of how comprehensible speech is) are not considered here.

impact not only on the speed with which utterances are initiated (onset latencies) but also on the corresponding articulatory durations (Balota, Boland, & Shields, 1989; Kawamoto, Kello, Jones, & Bame, 1998; Kawamoto, Kello, Higareda, & Vu, 1999; Kello, Plaut, & MacWhinney, 2000; Kello, 2004; although see Damian, 2003). Hence, given that word retrieval appears to be more costly for bilinguals in comparison to monolinguals, we may expect to find a trace of such difficulty in articulatory durations.

Finally, in addition to the above mentioned issues, we will also explore in the current experiments how the bilingualism effect could be modulated by two variables that have been shown to be relevant in the context of bilingual speech production: the word's lexical frequency and its cognate status. In a seminal paper Oldfield and Wingfield (1965) showed that speed of lexical retrieval is negatively correlated with word frequency, with comparatively longer naming times for low frequency words (i.e. naming speed is a linear function of the logarithm of word frequency). As stated above, one influential account of the bilingual naming disadvantage assumes lower lexical frequency values in bilinguals relative to monolinguals. For this reason, low-frequency words should suffer more from a reduction in language use than high frequency words. The prediction that follows is that the bilingual disadvantage, be it in latencies or in durations, should be more pronounced in low than high frequency words.

Our motivation to include a manipulation of cognate status in the present study is empirical in nature. Bilinguals name cognate words (translations with a high phonological overlap across languages) faster than non-cognates during bare noun production (Costa, Caramazza, & Sebastian-Galles, 2000), with large cognate effects in L2 production. Up to now, however, evidence on cognate effects in bilingual L1 speech

is still inconsistent (e.g., Costa et al., 2000; Ivanova & Costa, 2008). Moreover, it is unknown if such cognate effects also occur in more complex productions. Regarding the presence of cognate effects in articulatory durations, some preliminary data shows that cognate nouns had shorter articulatory durations than non-cognates, but only in the case of very low proficient L2 bilinguals (Jacobs, Gerfen, & Kroll, 2005). In the present study, we aimed at providing further evidence on cognate effects in naming times of single words, noun phrases, and their respective articulatory durations in a bilingual's L1. Doing so will help us to obtain a more general view on how cognate status affects bilingual L1 speech.

To recapitulate, we report two picture naming experiments involving monolingual and L1 bilingual speakers. Each speaker group was tested in Spanish, which was the first and dominant language of bilingual participants. In Experiment 1, participants had to produce bare nouns. This experiment should clarify whether previously observed disadvantages in bare noun production are robust and generalize to articulatory durations. Given that these results were affirmative, in Experiment 2 participants were asked to produce noun phrases in response to similar visual stimuli. This experiment should clarify whether bilingual disadvantages are present beyond bare noun productions. In each experiment, we measured onset latencies, error rates and articulatory durations of speech production.

Experiment 1: Bare noun production

Experiment 1 aims to replicate the previously observed disadvantage in the bilinguals' first and dominant language in onset latencies of bare noun production (Ivanova & Costa, 2008). Furthermore, we will extend the current findings by exploring if such disadvantage is carried over into speech execution by considering articulatory durations.

Method

Participants

Two groups of participants were recruited: 35 monolinguals and 35 Spanish-Catalan bilinguals. Participants were undergraduate students at the University of Murcia², Spain (monolingual group), or at the University of Barcelona and University Pompeu Fabra, Barcelona, Spain (bilingual group). Monolinguals grew up in Spanish speaking families and used only Spanish for daily communication. Bilinguals were highly proficient in Spanish and Catalan and had acquired their L1 (Spanish) from birth before being exposed to their L2 (Catalan). Importantly, all bilinguals were early highly proficient, but unbalanced speakers: Spanish was their dominant language (see Table 1 for language history and proficiency ratings). This means they all had Spanish speaking parents, used Spanish more often than Catalan in child – and adulthood, and rated themselves as being more comfortable when using Spanish than Catalan. None of the

² Given the bilingual education system and the continuous exposure to Spanish and Catalan, it is impossible to find monolingual speakers in the Barcelona area.

participants was fluent in any other language. All participants had normal or corrected-to-normal vision, and were matched on age (see Table 1). They received course credit or monetary reward (5 Euros) for participating in the experiment.

(TABLE 1 ABOUT HERE)

Materials

Stimuli consisted of 40 pictures of common objects, selected from Snodgrass and Vanderwart (1980) and the International Picture Naming Project (Szekely et al., 2004). Two groups of 20 pictures were created: twenty pictures had high frequency names ($M = 59.4$ occurrences per million, $SD = 62.8$; range: 15.4 – 278.0) with high familiarity ratings ($M = 6.3$; $SD = 0.8$) and 20 had low frequency names ($M = 4.0$ occurrences per million, $SD = 3.5$; range: 0.4 – 14.8; $p < .001$) with low familiarity ratings ($M = 5.5$; $SD = 1.1$; $p = .026$). Each frequency group comprised 10 cognate and 10 non-cognate nouns (see Appendix A for an overview of experimental items), which were matched for grammatical gender (5 feminine and 5 masculine nouns). Following previous psycholinguistic studies, cognate status was defined according to high or low phonological overlap between Spanish-Catalan translations. There was no gender mismatch across Spanish-Catalan translations. Cognates and non-cognates did not differ in familiarity ratings or lexical frequency in either group (all $F_s < 1$). Picture names across sets were matched for ratings of imageability, concreteness and word length measured in phonemes and syllables (all $F_s < 2.3$; $p_s > .100$). All picture name properties were obtained from the Spanish database “BuscaPalabras” (Davis & Perea,

2005). Pictures had black outlines and white surfaces and were presented 300 pixels wide x 300 pixels high on a white rectangle with a monitor resolution of 800 x 600 pixels.

Design and Procedure

Four experimental lists were created with each of the 40 pictures being presented four times. The order of presentation of the pictures was pseudo-randomized with the following restrictions: (a) the 160 pictures appeared in four successive sets of 40, with each picture presented only once per set; (b) picture names in two successive trials were neither semantically nor phonologically related. The same experimental lists were used for each speaker group. Participants within each group were randomly assigned to one of the four lists.

Participants were tested in a sound-proof room. Stimulus presentation and the software voice-key were controlled via DMDX (Forster & Forster, 2003). The sensitivity of the voice-key was adjusted for each participant. Each trial started with a fixation cross displayed at the centre of the computer screen for 500 ms. After a 300 ms blank screen, the picture of the object to name was displayed. The picture remained on the screen until either the voice key detected the response or a 2000 ms deadline was reached without any overt response detected. Recording time started with picture onset and lasted for 2000 ms from the triggering of the voice key. If no overt response was detected, the recording stopped after 2000 ms. The following trial began 700 ms after the recording period finished.

Following common practice in the picture naming literature, participants were first familiarised with the materials and the task. They were asked to name the 40 black-and-white pictures using bare nouns. If participants gave another name for the picture than the intended one, they were corrected by the experimenter at the end of the familiarization phase. In the testing phase, 160 pictures were presented (40 pictures repeated four times each). Participants were instructed to name the pictures as fast and as accurately as possible using bare nouns. Participants' responses were automatically recorded by the computer as digitized sound files, and errors were noted online by the experimenter. In total, the experiment lasted about 30 minutes.

Data analyses

All vocal response onset markers were visually checked offline with the software CheckVocal (Protopapas, 2007) and corrected if necessary. Articulatory durations were obtained by measuring the time between speech onset and offset. Onset latencies exceeding 3 standard deviations from the participant's mean were considered as outliers and excluded from further analysis. This led to a trimming of 2.1 % of the data for monolinguals ($SD = 2.7$) and bilinguals ($SD = 2.5$). Articulatory durations exceeding 3 standard deviations from the participant's mean were eliminated ($M = 0.1$ %, $SD = 0.2$ in both groups). Trials with incorrect responses or disfluent speech (stuttering, utterance repairs, etc.) were classified as errors (see below for analysis of naming errors) and excluded from latency and articulatory duration analyses.

Onset latencies, articulatory durations and error rates were analysed using Analyses of Variance (ANOVA) with participants and items as random factors. "Group" (monolinguals vs. bilinguals) was a between-participant and within-item

factor, “noun frequency” (from here onwards referred to as Frequency; high vs. low) and “noun cognate status” (from here onwards referred to as Cognate; non-cognates vs. cognates) were within-participant and between-item factors.³ The three-way interactions Group x Frequency x Cognate were not significant in any of the measures (all F s < 1) and hence are not discussed any further.

Results

Onset latencies

The detailed results of the ANOVA performed on onset latencies are reported in Table 2. The ANOVA revealed a significant main effect of Group (see Figure 1), revealing that monolinguals were faster in producing the same bare nouns than bilinguals.

The main effect of Frequency was significant, reflecting faster responses for high ($M = 655$ ms, $SD = 81$) than low frequency words ($M = 707$ ms, $SD = 90$). The main effect of Cognate was significant only in F_1 analysis: responses were faster for

³ In a first analysis, “repetition” was also entered as within participant and within item factor. The effect of repetition was significant in all analyses with shorter onset latencies and articulatory durations from repetition 1 to 4. Since repetition effects were not the main focus of the present study, we removed this factor from further analyses.

cognates ($M = 670$ ms, $SD = 80$) than non-cognates ($M = 692$ ms, $SD = 97$).⁴ Group did not interact with Frequency nor with Cognate. Frequency interacted with Cognate in F_1 analysis, showing that the difference between cognates and non-cognates was larger for low frequency ($M = 49$ ms, $SD = 40$) than high frequency words ($M = -4$ ms, $SD = 33$).

(FIGURE 1 ABOUT HERE)

(TABLE 2 ABOUT HERE)

Articulatory durations

The detailed results of the ANOVA performed on articulatory durations are reported in Table 3. The ANOVA revealed a significant main Group effect only in F_2 analysis (see Figure 2).

The main effect of Frequency was significant only in F_1 analysis, with shorter articulatory durations for high ($M = 403$ ms, $SD = 55$) than low frequency words ($M = 421$ ms, $SD = 57$). The main effect of Cognate was significant only in F_1 analysis, with longer articulatory durations for cognates ($M = 418$ ms, $SD = 57$) than non-cognates ($M = 406$ ms, $SD = 54$). The two-way interaction Group x Frequency was significant only

⁴ Note that cognate status effects refer to an interaction between cognate status and speaker group, not a main effect of cognate status alone (i.e. monolinguals serve as a baseline against which to compare cognate status effects in bilinguals).

BILINGUAL NOUN PHRASE PRODUCTION

in F_1 analysis, showing that the frequency effect was larger in bilinguals ($M = 20$ ms, $SD = 6$) than in monolinguals ($M = 15$ ms, $SD = 7$). The two-way interaction Group x Cognate was not significant. Frequency interacted with Cognate in F_1 analysis, showing that the difference between cognates and non-cognates was larger for low frequency ($M = 16$ ms, $SD = 13$) than high frequency words ($M = 10$ ms, $SD = 12$).

(FIGURE 2 ABOUT HERE)

(TABLE 3 ABOUT HERE)

Naming errors

The detailed results of the ANOVA performed on error rates are reported in Table 4. The ANOVA revealed no significant main effect of Group.

The main effect of Frequency was significant (high frequency: $M = 1.1$ %, $SD = 2.2$; low frequency: $M = 2.6$ %, $SD = 4.0$). The main effect of Cognate was not significant. Group did not interact with Frequency or Cognate. Frequency interacted with Cognate in F_1 analysis, showing that the difference in error rates between cognates and non-cognates was larger for low ($M = 1.7$ %, $SD = 4.5$) than high frequency words ($M = -0.4$ %, $SD = 3.0$).

(TABLE 4 ABOUT HERE)

Discussion

In bare noun production, monolinguals showed significantly shorter onset latencies than bilinguals. Our results replicate previous findings (Ivanova & Costa, 2008), indicating that the bilingual disadvantage in lexical access is a reliable and replicable phenomenon even for early highly proficient bilinguals producing speech in L1.

As commonly found in naming studies, faster onset latencies and better accuracy were observed for high than low frequency nouns. However, frequency did not interact with speaker group in either measure. This finding is at odds with previous studies showing larger frequency effects in L1 bilinguals than monolinguals for bare noun productions (Gollan et al., 2008; 2011; Ivanova & Costa, 2008). Although results on articulatory durations revealed a frequency effect and interaction with speaker group in F_1 analyses, the present results bare out a rather weak support for this hypothesis.

In addition, the noun's cognate status affected onset latencies and articulatory durations of bare nouns in F_1 analysis. Importantly, however, there was no interaction with speaker group in any of the naming measures. As mentioned in the Introduction, previously reported patterns of cognate effects in L1 productions are still inconsistent. For now, our results do not confirm the presence of cognate effects in a bilingual's L1 for bare nouns.

Moreover, our findings show a clear tendency for a bilingual disadvantage in articulatory durations of bare nouns. One explanation for the missing significance in F_1 analysis could be that articulatory durations of single words are very short in general

and possible effects could be masked by individual variations. Thus small differences in articulatory durations will be more difficult to detect when comparing across groups in a by participant analysis. Given that previous studies explored bilingual effects only in articulatory durations of more complex utterances (e.g., Flege & Hojen, 2004; MacKay & Flege, 2004), no further comparisons with bare noun production studies can be made. At this point we can speculate that, unlike the pervasive bilingual disadvantage in onset latencies, articulatory disadvantages for bilinguals become clearly apparent in production contexts of more than a single word. This suggestion is inspired by the results reported by Flege and Hojen (2004), in which an increase in the complexity of the utterance led to an increase in the differences in articulatory durations between monolinguals and late bilinguals using their L2. According to these authors, higher-order speech planning is one of the main factors contributing substantially to articulatory costs observed in bilingual speech. If bilingualism effects in articulatory durations depend on the complexity of the utterances, then we expect to find a clearly apparent bilingual disadvantage when more than a single word is produced. In Experiment 2 we will provide a test of this claim by assessing articulatory durations of noun phrase productions.

Experiment 2: Noun phrase naming

It is important to establish whether the bilingual disadvantage observed in bare noun production (Experiment 1) also occurs in more complex utterances that involve retrieval of several words and speech planning processes. Experiment 2 aims to explore

if this disadvantage can be generalized to multiword productions such as noun phrases. As in Experiment 1, we do so by assessing onset latencies and articulatory durations of noun phrase productions.

Method

Participants

Two groups of participants were recruited: 35 monolinguals and 35 Spanish-Catalan bilinguals. These new groups of participants had similar characteristics than in Experiment 1 (see Table 1). They received course credit for participating in the experiment.

Materials

The stimuli were the same as those of Experiment 1, except that the depicted object surfaces of the previously used black-and-white drawings were coloured in green, red, purple, or yellow. No object with unique natural colour, like animals or fruits, was used. Eight pictures with characteristics similar to the experimental items were used as practice trials.

Design and Procedure

The design was identical to Experiment 1, with the additional constraint that the same colour did not appear in two successive trials.

The procedure mirrored the one in Experiment 1, except that after familiarization, participants were asked to name the coloured versions of the eight practice pictures by uttering adjectival noun phrases of the form determiner + noun + adjective (e.g. “el avión rojo”, “the red airplane” in Spanish). In the testing phase, each of the 40 pictures appeared once in each of the four colours. Participants were instructed to name the pictures as fast and as accurately as possible, by using adjectival noun phrases including the definite determiner. The response deadline and recording time was extended from 2000 ms in Experiment 1 to 3000 ms to give more time to the participants to prepare and produce noun phrases. The experiment lasted about 40 minutes.

Data analyses

As in Experiment 1, all vocal response onset markers were visually checked offline with the software CheckVocal (Protopapas, 2007) and corrected if necessary. To evaluate the reliability of this procedure, 20 % of the monolingual and L1 bilingual recordings were independently checked by a naive rater. The two sets of checked onset latencies were highly correlated (monolinguals: $r[1025] = .999$, $p < .001$; absolute difference: $M = 3.42$ ms, $SD = 7.72$; bilinguals: $r[1048] = .998$, $p < .001$; absolute difference: $M = 4.57$ ms, $SD = 6.42$). Since the inter-rater variability was very low, the onset latencies of the entire sample checked by one rater were deemed reliable and used in the analyses.

Onset latencies exceeding 3 standard deviations from the participant’s mean were considered as outliers and excluded from further analyses. This led to a trimming

of 2.0 % of the data for monolinguals ($SD = 3.0$) and bilinguals ($SD = 2.8$). Articulatory durations exceeding 3 standard deviations from the participant's mean were also eliminated (monolinguals: $M = 1.1$ %, $SD = 0.8$; bilinguals: $M = 1.2$ %, $SD = 0.7$). Trials with incorrect responses or disfluent speech (stuttering, utterance repairs, etc.) were classified as errors (see below for analysis of naming errors) and excluded from latency and articulatory duration analyses. The design of the statistical analyses was identical to that used for Experiment 1.³ The three-way interactions Group x Frequency x Cognate were not significant in any of the measures (all F s < 1 , except for error analyses with F s < 1.73 , p s $> .193$) and hence are not discussed further.

Results

Onset latencies

The detailed results of the ANOVA performed on onset latencies are reported in Table 5. The ANOVA revealed a significant main effect of Group (see Figure 1), revealing that monolinguals were faster in producing the same noun phrases than bilinguals.

The main effect of Frequency was significant, with faster responses for utterances containing high ($M = 685$ ms, $SD = 96$) than low frequency nouns ($M = 744$ ms, $SD = 106$). The main effect of Cognate was also significant: responses were faster for utterances containing cognates ($M = 694$ ms, $SD = 98$) than non-cognates ($M = 736$ ms, $SD = 108$). The two-way interactions Group x Frequency and Group x Cognate were not significant. Frequency interacted with Cognate in F_1 analysis, showing that the

difference between cognates and non-cognates was larger for utterances containing low frequency ($M = 65$ ms, $SD = 48$) than high frequency nouns ($M = 18$ ms, $SD = 32$).

(TABLE 5 ABOUT HERE)

Articulatory durations

The detailed results of the ANOVA performed on articulatory durations are reported in Table 6. The ANOVA revealed a significant main effect of Group (see Figure 2) with monolinguals having shorter articulatory durations than bilinguals.

The main effect of Frequency was significant, with shorter articulatory durations for utterances containing high ($M = 810$ ms, $SD = 97$) than low frequency nouns ($M = 844$ ms, $SD = 98$). The main effect of Cognate was significant only in F_1 analysis, with longer articulatory durations for utterances containing cognates ($M = 833$ ms, $SD = 99$) than non-cognates ($M = 821$ ms, $SD = 99$). The two-way interactions Group x Frequency and Group x Cognate were not significant. Frequency interacted with Cognate in F_1 analysis, showing that the difference between cognates and non-cognates was larger for utterances containing high ($M = -20$ ms, $SD = 19$) than low frequency nouns ($M = -6$ ms, $SD = 20$).

(TABLE 6 ABOUT HERE)

Naming errors

The detailed results of the ANOVA performed on error rates are reported in Table 7. The ANOVA revealed no significant main effect of Group.

The main effect of Frequency was significant (high frequency: $M = 2.9\%$, $SD = 3.6$; low frequency: $M = 6.2\%$, $SD = 6.2$). The main effect of Cognate was significant in F_1 analysis (cognates: $M = 3.8\%$, $SD = 4.3$; non-cognates: $M = 5.4\%$, $SD = 6.1$). Group did not interact with Frequency or Cognate. Frequency interacted with Cognate in F_1 analysis, showing that the difference in error rates between cognates and non-cognates was larger for utterances with low ($M = 3.2\%$, $SD = 6.8$) than high frequency nouns ($M = <0.0\%$, $SD = 4.0$).

(TABLE 7 ABOUT HERE)

Discussion

In noun phrase production, monolinguals showed significantly shorter onset latencies than did bilinguals. This pattern of results generalizes the previously observed disadvantages in L1 bare noun production (Gollan et al., 2005; Ivanova & Costa, 2008) to multiword productions such as noun phrases.

A disadvantage over monolinguals was also observed in articulatory durations, extending to L1 the results from previous studies on L2 production contexts (Flege & Hojen, 2004). This means that bilinguals, even when using their L1, exhibit a cost compared to monolinguals in the articulation of noun phrases.

In addition, clear noun frequency effects were observed in onset latencies, articulatory durations, and accuracy rates. As in Experiment 1, this result confirms the sensitivity of our design to detect reliable differences in these naming measures. Once again, however, frequency did not interact with speaker group. Overall, these results are not in line with the predictions derived from the frequency-of-use hypothesis (Gollan et al., 2008; see the General Discussion section for a discussion of possible reasons for this discrepancy).

Regarding the manipulation of cognate status in noun phrase production, no conclusive results were obtained. Although there was a main effect of the noun's cognate status on onset latencies, articulatory durations, and accuracy rates (with the latter two being significant only in F_1 analyses), none of them interacted with speaker group. This means that in this and the previous experiments, differences between cognates and non-cognates were equally present for mono- and bilinguals. Therefore such differences cannot be attributed to the cognate status of the words but rather to some uncontrolled variable in the stimuli. While this suggests that L1 speakers may not be as sensitive to cognate status as L2 speakers have been shown to be, this hypothesis will have to be tested in further experiments including L2 speakers and materials for which cognate effects have been reported consistently.

General Discussion

The main goal of the present study was to advance in our knowledge of the phenomenology of the bilingual disadvantage in speech production. We did so by

BILINGUAL NOUN PHRASE PRODUCTION

assessing the effects of bilingualism on onset latencies and articulatory durations in bare noun and noun phrase production.

When looking at the general pattern of results we can appreciate the following observations:

- a) Onset latencies are longer in bilinguals' L1 speech production as compared to monolinguals'.
- b) Articulatory durations tend to be longer in bilinguals' L1 speech production as compared to monolinguals'.
- c) The pattern of results is qualitatively similar in bare noun and noun phrase productions, with stronger effects in the case of noun phrases.

Given these findings, the following empirical generalization can be made: the bilingual disadvantage is not only present in latency data of bare noun production but also in more complex utterances (adjectival noun phrases), and also in articulatory durations. This empirical conclusion provides clear positive answers to the main questions stated in the Introduction.

To gain further insight, we explored this general pattern of results by conducting an analysis in which the data of the two experiments were grouped together, and production task (bare nouns vs. noun phrases) was entered as a between participant and between item factor. No reliable interaction was observed between the main factors speaker group and production task, either in onset latencies, $F_1 < 1$, $p = .986$, or in articulatory durations, $F_1 < 2$, $p = .176$. This finding is consistent with the claim made

above that the pattern of results regarding speaker group effects was similar in the two production tasks.

Although the pattern was qualitatively similar in bare noun and noun phrase production, in the sense that a bilingual disadvantage was always apparent, it is important to note that one effect failed to reach significance in a by participant analysis. When looking at articulatory durations of bare nouns bilingualism effects were only significant in a by item analysis. As mentioned above, Flege and Hojen (2004) suggested that speaker group effects in articulatory durations arise to larger extents in utterances with increased complexity. Our findings are in line with this claim, as clear significant differences in articulatory durations between monolinguals and bilinguals were observed when producing noun phrases, not bare nouns.

Is the bilingual disadvantage larger in multiword than single word utterances?

As we mentioned in the Introduction, onset latencies *and* articulatory durations should be considered together in order to obtain a full picture of speech production behaviour. By doing so, possible trade-offs between these two performance measures can be detected.

Interestingly, a comparison of the onset latency results from Experiment 1 and 2 reveals that the disadvantage for bilinguals is of similar magnitude in bare noun and noun phrase production. The magnitude of the bilingual disadvantage in L1 speech production does not increase when the number of words to be produced increases (bare nouns: 54 ms slower vs. noun phrases: 53 ms slower). This observation is in contrast

with our predictions presented in the Introduction, according to which retrieval of multiple items should result in increased (i.e., accumulated) bilingual cost. We can advance two potential explanations for this unexpected observation. The first has to do with the experimental power of our study. In the noun phrase task a limited number of adjectives was used with a massive number of repetitions (each of the four adjectives repeated 40 times). Consequently it is possible that differences between monolinguals and bilinguals in the accessibility of these highly repeated words are minimized. Hence, there may only be a vanishing cost associated with adjective retrieval in these specific circumstances. The second explanation is theoretically more interesting and assumes that bilinguals start producing noun phrases with only partial retrieval of the phrase, i.e. without it being fully encoded yet. This would maintain relatively short speech onset latencies and lead to slower speech rates (longer articulatory durations) because of planning and articulation being conducted concurrently. Notice that because the noun occurs before the adjective, it is expected under this hypothesis that the relative ease of noun retrieval affects naming latencies while the adjective retrieval may not.

This hypothesis is in keeping with previous claims that the size of the speech planning unit in noun phrase production may be flexible (e.g., Ferreira & Swets, 2002; Meyer, 1996; Mortensen, Meyer, & Humphreys, 2008; Schriefers & Teruel, 1999; Wagner, Jescheniak, & Schriefers, 2010). That is, speakers may strategically modify the size of the planning unit, sometimes starting to produce utterances without having completed the retrieval of all lexical items involved in the noun phrase. Although the list of variables that affect the size of the planning unit remains to be clearly established, it is likely that such size is subject to a trade-off between keeping a proper speech rate

and keeping disfluency low. In cases in which lexical access is relatively difficult (e.g., in situations with additional cognitive load, see Wagner et al., 2010), speakers may reduce their scope of speech planning. Bilinguals using their L1 might be in such a situation, in which they opt for a reduced planning scope to catch up with their monolingual counterparts. Given that retrieval of lexical items is slower for bilinguals than monolinguals, bilinguals may start their articulations without having retrieved all the elements of the noun phrase, in order to keep the appropriate fluency in their dominant language. Furthermore, if we assume that relative advances of speech onset in bilinguals entail concurrent planning of later elements, then articulatory durations should be lengthened relative to monolinguals. Crucially, the present findings show that the bilingual disadvantage is larger in articulatory durations of noun phrases (55 ms) when compared to bare noun production (20 ms). This means that in multiword production the cost associated with L1 speech production relative to monolinguals becomes more apparent in articulatory durations than in onset latencies.

On the effects of cognate status and lexical frequency

As to the manipulation of cognate status, no speaker group by cognate status interaction was observed in onset latencies, articulatory durations or accuracy. Previous studies have shown that cognate effects in onset latencies tend to be larger for bilinguals using L2 than L1 (e.g., Costa et al., 2000; or see Ivanova & Costa, 2008, where cognate effects were present only in bilinguals using L2). In keeping with these observations, the bilingual participants of the present study (all producing speech in their L1) did not show cognate effects. Up to now, no published study has explored cognate effects in articulatory durations. Our results suggest that articulatory durations are longer for

cognates than non-cognates, but given that there was no significant interaction with speaker group, we desist from further elaborating this finding. Moreover, in both experiments, cognate status interacted with frequency in a way that cognate effects were larger when producing low than high frequency words. Such frequency modulation is well-attested for many psycholinguistic effects. Similar interactions have been observed in previous picture naming experiments, although the direction of the interaction varies across studies. The most probable explanation is that the main cognate effect and the frequency by cognate status interactions in the present study are linked to uncontrolled properties of the stimuli (see also Strijkers, Costa, & Thierry, 2010, for a similar argument). Further studies will have to provide more evidence on how cognate status affects L1 speech, and whether it might have a modest but significant influence on the time it takes to articulate an utterance.

Regarding the manipulation of frequency, the present results show that across both groups of speakers, utterances with high-frequency nouns were produced with shorter onset latencies and articulatory durations than those with low-frequency nouns in bare noun (cf. Oldfield & Wingfield, 1965; Wright, 1979) and noun phrase production (cf. Alario et al., 2002a). According to the frequency-of-use hypothesis, a bilingual disadvantage should occur in measures sensitive to frequency-of-use and, more importantly, larger frequency effects should emerge for bilinguals than monolinguals (Gollan et al., 2008). Apart from such an effect in F_1 analysis in the articulatory durations of bare nouns, our findings do not provide evidence consistent with the predictions derived from this theory. Overall, both groups of speakers showed a similar magnitude of the frequency effect in onset latencies and articulatory durations across both production tasks. This result is not in line with previous findings reported by

Gollan et al. (2008; 2011) and Ivanova and Costa (2008; but see Duyck, Vanderelst, Desmet, & Hartsuiker, 2008, for no difference in the size of the frequency effect between mono- and bilinguals in word recognition times). Note that previous discrepancies between these studies (i.e. larger frequency effects in L2 than in L1 in Gollan et al., 2008, 2011 versus the absence of such effect in Ivanova & Costa, 2008) have been attributed to the different language backgrounds of the participants and their bilingual environments. Participants tested in Gollan et al.'s studies were switched language bilinguals, meaning that they had first acquired their non-dominant language before becoming dominant in their second language. Therefore, although speaking in a presently non-dominant language, the contribution of age-of-acquisition (AoA) effects to naming latencies was probably larger in the first than second learnt language. Moreover, these studies were conducted with bilinguals living in different environments regarding the general presence of both languages. Bilinguals tested in Ivanova and Costa's study are continuously exposed to Catalan and Spanish which might relativize general dominance effects in either language. The present study and the one conducted by Ivanova and Costa tested participants with similar AoAs for their two languages and in the same language community. Moreover, the frequency bands for selecting the low and high frequency nouns used in the two studies were similar. Note however that the bilinguals tested in the present study reported to be slightly more dominant in Spanish and were less variable in their self-assessment ratings than in Ivanova and Costa (Table A and Table 1 in the present study). This might be a possible source of why the critical interaction of $M = 16$ ms ($SD = 9$) in Ivanova and Costa (2008) did not reach significance in the present study.

Conclusion

The empirical conclusion of the present study is that disadvantages associated with bilingualism are apparent in a variety of speech contexts and performance measures. In particular, such disadvantages were observed for the first time in multiword productions, not only in onset latencies but also in the articulatory durations of the utterances. Moreover, this bilingual disadvantage was present in early highly proficient bilinguals speaking in their first and dominant language. All together, these results point to the non-negligible impact of bilingual disadvantages in speech production. Future studies will have to describe in full detail the mechanisms that are sensitive to bilingualism in complex linguistic contexts.

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Appendix A

Picture material used in the experiments.

HF Picture names	English	LF Picture names	English
+ AVIÓN (Avió)	Airplane	+ BOMBILLA (Bombeta)	Light bulb
+ BALCÓN (Balcó)	Balcony	+ ESCOBA (Escombra)	Broom
+ BOLSA (Bossa)	Bag	+ GLOBO (Globus)	Balloon
+ ESCALERA (Escala)	Ladder	+ PATÍN (Patí)	Roller skate
+ FLOR (Flor)	Flower	+ PELUCA (Perruca)	Wig
+ PELOTA (Pilota)	Ball	+ PINCEL (Pinzell)	Paintbrush
+ PUERTA (Porta)	Door	+ REGADERA (Regadora)	Watering can
+ RELOJ (Relotge)	Watch	+ SIERRA (Serra)	Saw
+ TELÉFONO (Telèfon)	Telephone	+ TABURETE (Tamboret)	Stool
+ VESTIDO (Vestit)	Dress	+ VIOLÍN (Violí)	Violin
CUCHILLO (Ganivet)	Knife	CALCETÍN (Mitjó)	Sock
ESPEJO (Mirall)	Mirror	CEPILLO (Raspall)	Brush
HILO (Fil)	Spool of thread	COLCHÓN (Matalas)	Matress
HOJA (Fulla)	Leaf	COLUMPIO (Gronxador)	Swing
HUEVO (Ou)	Egg	CORCHO (Suro)	Cork
MANCHA (Taca)	Stain	HACHA (Destral)	Axe
MESA (Taula)	Table	HOZ (Falç)	Sickle
SILLA (Cadira)	Chair	HUCHA (Guardiola)	Piggy bank
SOMBRERO (Barret)	Hat	MULETA (Crossa)	Crutch
VENTANA (Finestra)	Window	PEONZA (Baldufa)	Top

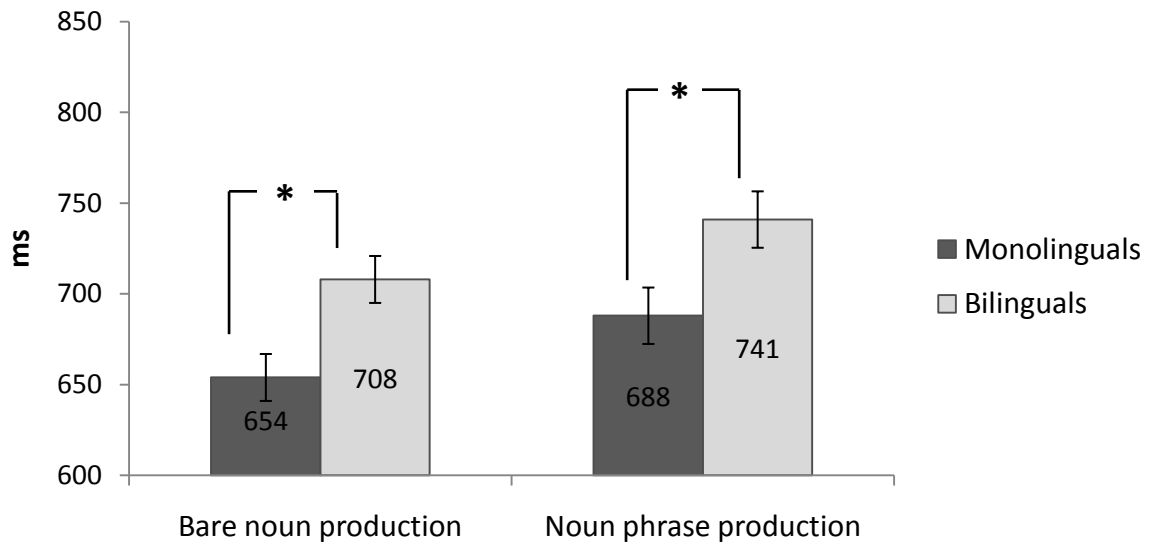
Note: HF = high frequency; LF = low frequency; + = cognate words. Catalan translations are given in brackets.

Figure Captions

Figure 1: Mean onset latencies for monolingual and bilingual speakers in bare noun production (Experiment 1) and noun phrase production (Experiment 2). Error bars indicate the standard error of the mean.

Figure 2: Mean articulatory durations for monolingual and bilingual speakers in bare noun production (Experiment 1) and noun phrase production (Experiment 2). Error bars indicate the standard error of the mean.

Onset latencies



Articulatory durations

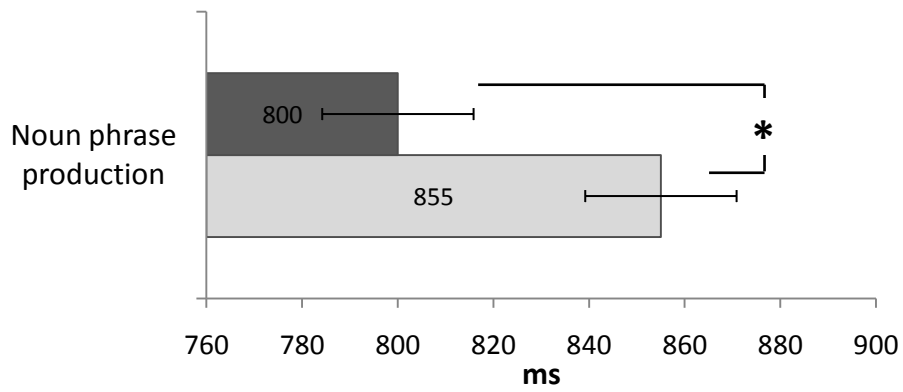
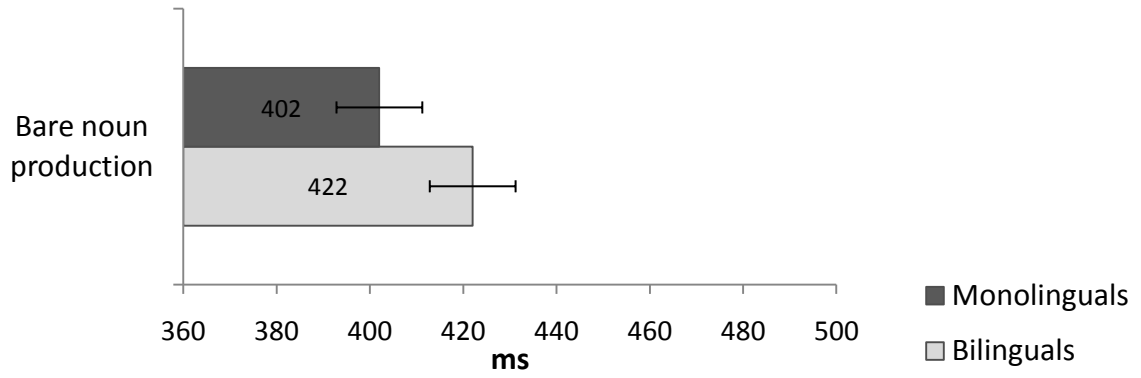


Table 1Means (*M*) and standard deviations (*SD*) for participant self-report ratings.

	Experiment 1: Bare noun production				Experiment 2: Noun phrase production			
	35 Spanish		35 Spanish-Catalan		35 Spanish		35 Spanish-Catalan	
	monolinguals		bilinguals		monolinguals		bilinguals	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Age	20.3	2.4	21.1	3.0	21	2.5	21	2.7
Percent daily use of Spanish	100 ^a	0.0	79.6	11	100 ^a	0.4	78	15
Age exposed to Spanish	0.03	0.2	0.00	0.0	0.0	0.0	0.0	0.0
Age speaking Spanish	1.33	0.6	1.63 ^b	0.7	1.4 ^a	0.6	1.1	0.2
Age exposed to Catalan	–	–	3.43	2.1	–	–	4.8	4.8
Age speaking Catalan	–	–	4.67	2.1	–	–	5.6	4.6
Age exposed to other language	7.74	1.3	8.94 ^b	3.2	7.2	2.9	6.9	2.6
Spanish proficiency	3.95	0.2	3.99 ^c	0.0	4.0	0.1	4.0 ^c	0.0
Catalan proficiency	–	–	3.85	0.3	–	–	3.7	0.4
Other language proficiency	2.00	0.7	2.62	0.7	2.0	0.9	2.4	0.8

Note: The measure “Percent daily use of Spanish” was obtained by asking participants to estimate their daily language use of Spanish, Catalan, and any other language with the constraint that their sum equals 100 percent. “Age exposed to Spanish/Catalan” refers to the mean age at which participants were continuously exposed to these languages. “Age speaking Spanish/Catalan” refers to the mean age at which participants started to speak these languages. “Age exposed to other language” refers to the mean age at which participants started formal instruction in a foreign language, in a classroom setting. Proficiency ratings are on a 1–4 scale, where 1 indicates “very little knowledge of the language” and 4 indicates “native proficiency”. Proficiency values represent the average of the participants’ responses in four domains (speech comprehension, speech production, reading, and writing).

^a indicates significant differences between monolinguals and Spanish-Catalan bilinguals at the $p < .01$ level.

^b indicates significant differences between Spanish-Catalan bilinguals across experiments at the $p < .01$ level.

^c indicates significant differences between proficiency ratings of Spanish and Catalan at the $p < .02$ level.

Table 2

Results for onset latencies in bare noun production

2 x 2 x 2 ANOVA		dfn	dfd	F	MSE	<i>p</i>	η_p^2
Group	F_1	1	68	8.6	23419	<u>.005</u>	.11
	F_2	1	36	176.4	312	<u><.001</u>	.83
Frequency	F_1	1	68	191.0	980	<u><.001</u>	.74
	F_2	1	36	11.3	5023	<u>.002</u>	.24
Cognate	F_1	1	68	41.8	825	<u><.001</u>	.38
	F_2	1	36	2.2	5023	.146	.06
Group x Frequency	F_1	1	68	2.4	2309	.130	.03
	F_2	1	36	2.9	312	.097	.08
Group x Cognate	F_1	1	68	0.2	825	.700	<.01
	F_2	1	36	<0.1	312	.848	<.01
Frequency x Cognate	F_1	1	68	87.0	567	<u><.001</u>	.56
	F_2	1	36	3.4	5023	.075	.09

Note: Group (monolinguals vs. bilinguals); Frequency (high vs. low frequency nouns); Cognate (cognate vs. non-cognate nouns). Statistical significance at the $p < 0.05$ level is underlined.

Table 3

Results for articulatory durations in bare noun production

2 x 2 x 2 ANOVA		dfn	dfd	F	MSE	<i>p</i>	η_p^2
Group	F_1	1	68	2.2	11849	.142	.03
	F_2	1	36	216.5	34	<u><.001</u>	.86
Frequency	F_1	1	68	486.5	46	<u><.001</u>	.88
	F_2	1	36	0.6	10149	.430	.02
Cognate	F_1	1	68	136.9	83	<u><.001</u>	.67
	F_2	1	36	0.3	10149	.583	.01
Group x Frequency	F_1	1	68	11.0	46	<u>.001</u>	.01
	F_2	1	36	2.3	34	.143	.06
Group x Cognate	F_1	1	68	0.1	83	.720	<.01
	F_2	1	36	<0.1	34	.964	<.01
Frequency x Cognate	F_1	1	68	9.9	71	<u>.002</u>	.13
	F_2	1	36	<0.1	10149	.897	<.01

Note: Group (monolinguals vs. bilinguals); Frequency (high vs. low frequency nouns); Cognate (cognate vs. non-cognate nouns). Statistical significance at the $p < 0.05$ level is underlined.

Table 4

Results for error rates in bare noun production

2 x 2 x 2 ANOVA		dfn	dfd	F	MSE	<i>p</i>	η_p^2
Group	F_1	1	68	0.7	15.6	.393	.01
	F_2	1	36	1.3	2.9	.256	.04
Frequency	F_1	1	68	14.6	10.9	<u><.001</u>	.18
	F_2	1	36	5.7	8.6	<u>.022</u>	.14
Cognate	F_1	1	68	3.0	9.3	.088	<.01
	F_2	1	36	1.1	8.6	.307	.03
Group x Frequency	F_1	1	68	0.2	10.9	.628	.03
	F_2	1	36	0.4	2.9	.549	.01
Group x Cognate	F_1	1	68	0.3	9.3	.597	<.01
	F_2	1	36	0.4	2.9	.550	.01
Frequency x Cognate	F_1	1	68	14.3	5.6	<u><.001</u>	.17
	F_2	1	36	2.9	8.6	.095	.08

Note: Group (monolinguals vs. bilinguals); Frequency (high vs. low frequency nouns); Cognate (cognate vs. non-cognate nouns). Statistical significance at the $p < 0.05$ level is underlined.

Table 5

Results for onset latencies in noun phrase production

2 x 2 x 2 ANOVA		dfn	dfd	F	MSE	<i>p</i>	η_p^2
Group	F_1	1	68	5.9	33812	<u>.018</u>	.08
	F_2	1	36	208.4	276	<u><.001</u>	.83
Frequency	F_1	1	68	236.1	1056	<u><.001</u>	.78
	F_2	1	36	11.3	7339	<u>.002</u>	.24
Cognate	F_1	1	68	127.1	967	<u><.001</u>	.65
	F_2	1	36	5.3	7339	<u>.028</u>	.13
Group x Frequency	F_1	1	68	0.2	1056	.648	<.01
	F_2	1	36	0.1	276	.790	<.01
Group x Cognate	F_1	1	68	2.0	967	.161	.03
	F_2	1	36	3.2	276	.080	.08
Frequency x Cognate	F_1	1	68	58.0	671	<u><.001</u>	.46
	F_2	1	36	1.9	7339	.181	.05

Note: Group (monolinguals vs. bilinguals); Frequency (high vs. low frequency nouns); Cognate (cognate vs. non-cognate nouns). Statistical significance at the $p < 0.05$ level is underlined.

Table 6

Results for articulatory durations in noun phrase production

2 x 2 x 2 ANOVA		dfn	dfd	F	MSE	<i>p</i>	η_p^2
Group	F_1	1	68	5.9	35056	<u>.017</u>	.08
	F_2	1	36	564.6	102	<u><.001</u>	.94
Frequency	F_1	1	68	585.0	134	<u><.001</u>	.90
	F_2	1	36	4.5	4710	<u>.042</u>	.11
Cognate	F_1	1	68	52.5	211	<u><.001</u>	.44
	F_2	1	36	0.8	4710	.391	.02
Group x Frequency	F_1	1	68	1.1	134	.290	.02
	F_2	1	36	0.2	102	.677	.01
Group x Cognate	F_1	1	68	<0.1	211	.950	<.01
	F_2	1	36	<0.1	102	.938	<.01
Frequency x Cognate	F_1	1	68	18.6	183	<u><.001</u>	.22
	F_2	1	36	0.2	4710	.681	.01

Note: Group (monolinguals vs. bilinguals); Frequency (high vs. low frequency nouns); Cognate (cognate vs. non-cognate nouns). Statistical significance at the $p < 0.05$ level is underlined.

Table 7

Results for error rates in noun phrase production

2 x 2 x 2 ANOVA		dfn	dfd	F	MSE	<i>p</i>	η_p^2
Group	F_1	1	68	0.6	47.6	.431	.01
	F_2	1	36	1.4	7.3	.251	.04
Frequency	F_1	1	68	38.9	20.2	<u><.001</u>	.36
	F_2	1	36	9.9	24.2	<u>.003</u>	.22
Cognate	F_1	1	68	15.3	11.9	<u><.001</u>	.18
	F_2	1	36	2.3	24.2	.142	.06
Group x Frequency	F_1	1	68	0.1	20.2	.795	<.01
	F_2	1	36	0.1	7.3	.765	<.01
Group x Cognate	F_1	1	68	1.1	11.9	.300	.02
	F_2	1	36	0.6	7.3	.447	.02
Frequency x Cognate	F_1	1	68	9.1	19.2	<u>.004</u>	.12
	F_2	1	36	2.2	24.2	.150	.06

Note: Group (monolinguals vs. bilinguals); Frequency (high vs. low frequency nouns); Cognate (cognate vs. non-cognate nouns). Statistical significance at the $p < 0.05$ level is underlined.