Ecological validity and bilingual language control: Voluntary language switching between sentences

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Abstract

Few language switching studies have found conditions in which there is no significant cost to switching languages. Since language-switch costs are a measure of language control, this could be seen as evidence for the ubiquity of this process in bilingual language production. However, one claim is that ecologically valid bilingual contexts lead to small or even absent switch costs. To further investigate this, we examined voluntary language switching between sentences. This ecologically more valid setup (compared to the more prominent involuntary language switching setup with single word production) resulted in switch costs for sentences produced in the second language, but no significant switch costs for sentences produced in the first language, whereas involuntary language switching between sentences resulted in substantial switch costs across both languages. These results indicate that more ecologically valid contexts can lead to circumstances that might require little to no language control.

(words: 145)

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A notable aim in the language switching literature has been to uncover conditions that do not require any cost to switch between languages relative to staying in the same language. Unfortunately, few studies have succeeded in this pursuit (e.g., Blanco-Elorrieta & Pylkkänen, 2017; Declerck & Philipp, 2015a; Gullifer et al., 2013; Kleinman & Gollan, 2016). Since language-switch costs are considered a measure of cross-language interference resolution, typically called the language control process, this lack of success in finding conditions devoid of switch costs could be taken as evidence that language control is a ubiquitous process during bilingual language production. However, a recent review article indicated that more ecologically valid contexts (e.g., voluntary instead of instructed language switching) lend themselves to small or even absent language-switch costs (Blanco-Elorrieta & Pylkkänen, 2018). In the current study, we set out to further investigate this claim by letting Spanish-English bilinguals voluntarily switch languages between sentences. The main research question was whether bilinguals would still experience a cost from switching languages in this more ecologically valid context.

Language switching typically relies on bilinguals naming pictures or digits in their two languages (for a review, see Declerck & Philipp, 2015b). In the voluntary variant (Blanco-Elorrieta & Pylkkänen, 2017; de Bruin et al., 2018, 2020; Gollan et al., 2014; Gollan & Ferreira, 2009; Gross & Kaushanskaya, 2015; Grunden et al., 2020; Jevtović et al., 2019; Kleinman & Gollan, 2016; Liu et al., 2020), bilingual participants can choose which language to use on each trial. In the more prominent cued variant (e.g., Christoffels et al., 2007; Costa & Santesteban, 2004; Declerck et al., 2012; Meuter & Allport, 1999; Peeters & Dijkstra, 2018), on the other hand, a cue (e.g., differently colored frames around each stimulus) is presented alongside each stimulus to indicate which language the stimulus should be named in.

A typical observation in cued language switching studies is that it is more difficult to switch languages across trials (i.e., switch trials) than using the same language as in the previous trial (repetition trials; e.g., Costa & Santesteban, 2004; Declerck et al., 2012; Meuter & Allport, 1999). These switch costs are generally explained with inhibition of the non-target language persisting into the following trial (e.g., Green, 1998; Meuter & Allport, 1999). Performance is worse in switch trials because the persisting inhibition of the previously non-target language, which has become the target language, needs to be overcome. Meanwhile, during repetition trials, no persisting inhibition is present, so performance will be better than in switch trials.

While most voluntary language switching studies have also observed switch costs, a substantial portion of these studies did not observe such a pattern (Blanco-Elorrieta & Pylkkänen, 2017; Reverberi et al., 2018; Experiment 2 in Gollan & Ferreira, 2009; see also Kleinman & Gollan, 2016; additional analysis in Gollan et al., 2014). In Reverberi and colleagues (2018), for instance, German-English bilinguals performed a picture naming task while voluntarily language switching between their two languages, which did not result in significant switch costs. Along similar lines, several, but not all (de Bruin et al., 2018; Experiment 1 in Gollan et al., 2014), studies that compared voluntary and cued language switching observed smaller switch costs during voluntary language switching (Blanco-Elorrieta & Pylkkänen, 2017; Jevtović et al., 2019; for a trend, see Experiment 2 in Gollan et al., 2014). The presence of smaller switch costs during voluntary as opposed to cued language switching is in line with the assumptions of the adaptive control hypothesis (Green & Abutalebi, 2013). According to the adaptive control hypothesis, less control processes are required when in a voluntary than in a cued language switching context because in the former bilinguals can just choose the most highly activated words without the explicit need to inhibit the other language whereas that does not hold true in the latter. Since switch costs are assumed to be an index of language control (Declerck & Philipp, 2015b; Green, 1998), they should be smaller during voluntary than during cued language switching.

A related measure of language control, and more specifically of inhibitory control, are asymmetrical switch costs (e.g., Meuter and Allport, 1999; Philipp et al., 2007). Asymmetrical switch costs usually entail larger switch costs in the first language (L1) than in the second language (L2). This asymmetry is typically explained by a larger L1 than L2 activation, since the former is, for example, used more in daily life. Consequently, more language control will be required to inhibit L1 during L2 production than vice versa, and thus more language control will persist when switching from L2 to L1 than when switching from L1 to L2.

Whereas the asymmetrical switch cost pattern is observed fairly often in cued language switching studies (e.g., Meuter and Allport, 1999; Philipp et al., 2007), no asymmetrical switch costs have been found in voluntary language switching studies (e.g., de Bruin et al., 2018, 2020; Gollan et al., 2014; Grunden et al., 2020; Jevtović et al., 2019). More direct evidence for this claim comes from Jevtović et al. (2019), who found that voluntary language switching reduces asymmetrical switch costs relative to cued language switching when comparing both language switching variants (however, see de Bruin et al., 2018; Gollan et al., 2014). Gollan and Ferreira (2009) explained the absence of asymmetrical switch costs during voluntary language switching based on the tendency bilinguals have to name “easier” words in their L2. In turn, L1 and L2 activation might be more similar. Since asymmetrical switch costs are assumed to be due to a larger L1 than L2 activation (e.g., Meuter & Allport, 1999; Philipp et al., 2007), more similar L1 and L2 activation should lead to symmetrical switch costs during voluntary language switching.

Yet, voluntary language switching is not the only more ecologically valid characteristic that can possibly result in absent switch costs. Several studies that relied on language switching between sentences, instead of between single words, have also shown no substantial switch costs (e.g., Bultena et al., 2015; Gullifer et al., 2013). One example is the study of Gullifer and colleagues (2013) in which Spanish-English bilinguals silently read written sentences. One marked word in the middle of each sentence had to be named out loud. The language of the sentences changed predictably after every second sentence. While studies with a similar predictable language switching setup, but without any sentence context, typically show switch costs (e.g., Jackson et al., 2001; Reynolds et al., 2016), no such cost was observed in Gullifer et al. (2013).

One probable explanation for sentence production to result in smaller, or even absent, switch costs relative to single word production is that less cross-language interference occurs in the former. A prominent example in line with this claim comes from the cognate facilitation effect, which entails faster responses for words that are highly similar across languages (e.g., Costa et al., 2000; Hoshino & Kroll, 2008; Rosselli et al., 2012) and has been used as a measure of cross-language activation. This facilitation effect, while robust in single word production studies (e.g., Costa et al., 2000; Hoshino & Kroll, 2008; Rosselli et al., 2012), is sometimes absent in the context of sentences (e.g., Schwartz & Kroll, 2006; Starreveld et al., 2014; for a meta-analysis, see Lauro & Schwartz, 2017), especially for sentences with high semantic constraint. Such a decrease in cross-language activation suggests that less cross-language interference resolution might be required in a sentence context, and thus could lead to smaller, or even absent, switch costs.

Nevertheless, it should be noted that several studies that investigated language switching between sentences did show switch costs, and some even found asymmetrical switch costs (e.g., Declerck et al., 2017, 2021; Tarłowski et al., 2013). Declerck and colleagues (2021) presented networks to French-English bilinguals that consisted of seven pictures connected by three types of lines (straight, diagonal, and curved lines). The task consisted of describing the route of a dot over this network. In addition, a frame was presented around the pictures. The color of the frame (blue or green) indicated in which language the bilinguals would have to describe that particular part of the route. The results showed that more filled pauses, which are vocalizations that allow the speaker to fill in a gap during speaking (e.g., *er*, *um*, and *uh*) and are a measure of increased cognitive load (e.g., Hartsuiker & Notebaert, 2010; Sugiura et al., 2020), occurred in switch trials than in repetition trials, thus providing evidence for switch costs when switching languages between sentences. Moreover, these switch costs were larger in L1 than L2 (i.e., asymmetrical switch costs). Hence, it might just be that less language control is necessary when language switching between sentences than between isolated words, but that some instances, for example when sentences must be produced out loud based on pictures (and not based on written words), still require substantial control processes.

In the current study, we set out to investigate whether switch costs can be observed when combining voluntary language switching with sentence production. Put differently, we examined whether language control, measured by switch costs, is required in this highly ecologically valid context of language production, as this context might reduce the necessity for language control to the point that no switch costs will be observed. To investigate this issue, we let Spanish-English bilingual participants voluntarily switch between their two languages in the network description task while noting their filled pauses (cf. Declerck et al., 2021). Additionally, we also asked the participants to perform the same task, but with language cues. The latter would serve as a baseline, since previous studies with the network task have reliably shown switch costs during cued language switching between sentences (Declerck et al., 2017, 2021).

Method

Participants

Along the lines of previous language switching studies that relied on the network description task (Declerck et al., 2017, 2021), we tested twenty-seven bilinguals. These were native Spanish speakers, that spoke English as a second language. Nineteen of these participants spoke one or more additional languages (i.e., Catalan [n = 1], Dutch [n = 2], French [n = 9], German [n = 8], Italian [n = 4], Japanese [n = 1], Portuguese [n = 1], and/or Slovene [n = 1]).

One participant was excluded due to experimenter error. The remaining 26 participants were on average 30.4 years old (SD = 7.5) and consisted of 15 women. After completing the experiment, the participants filled in a questionnaire about their Spanish and English language history, use, and self-proficiency (see Table 1). In addition, they were asked to rate how often they switch languages within a regular conversation from 1 (*never*) to 5 (*very often*). The participants averaged 3.6 (SD = 1.1). Finally, they also completed an English vocabulary test (i.e., LexTale; Lemhöfer & Broersma, 2012). This test consisted of a lexical decision task, for which the participants scored on average 80.4% (SD = 9.4). This puts the participants into the "advanced/proficient users" category, akin to C1-C2 CEF (Common European Framework) levels (Lemhöfer & Broersma, 2012).

Table 1. Overview of the demographic information (SD in brackets). The information consists of the average age-of-acquisition of English and the number of years of formal English schooling. Furthermore, the average self-rated scores for speaking and writing for both languages is given, with 1 being *very bad* and 7 being *very good*, as well as the average time either language was used during childhood and currently.

	Spanish	English
Age-of-acquisition	N/A	8.7 (5.3)
Years of formal schooling	N/A	9.9 (4.6)
Speaking	6.7 (0.5)	5.7 (1.3)
Writing	6.5 (0.8)	5.6 (1.4)
Used during childhood (%)	82.7 (16.1)	13.9 (13.6)
Currently used (%)	51.9 (29.0)	32.7 (24.8)

Stimuli

A network description task was used in the current study, similar to that of Declerck et al. (2017, 2021; for monolingual variants of this task see, e.g., Hartsuiker & Notebaert, 2010; Oomen & Postma, 2001). In total 18 experimental networks were presented with seven unique pictures each (see Figure 1 for an example), for a total of 126 pictures (cf. Declerck et al. 2017, 2021). None of the pictures referred to a cognate word between Spanish (average frequency per million: 93; Cuetos et al., 2012) and English (average frequency per million: 127; Brysbaert & New, 2009).

The seven pictures in each network were all connected by lines. A red dot moved across each network of pictures and lines for 55 seconds. In this time, the red dot moved nine times between pictures. The task of the participants was to describe each of these nine transitions in each network using complete sentences that consisted of the direction (up, down, left, or right), the type of line (upper, lower, right or left curved line, diagonal line, or straight line), and the picture (e.g., "*The dot goes right over the straight line to the egg.*").

In the cued language switching section, a blue or green colored frame accompanied each upcoming picture, to indicate the language that the participants had to produce the sentence in to describe that specific segment of the red dot's path. In the voluntary language switching section, which consisted of the other half of the networks, no colored frames were presented with the upcoming pictures, as participants were free to describe each segment of the red dot's path in their language of choice.

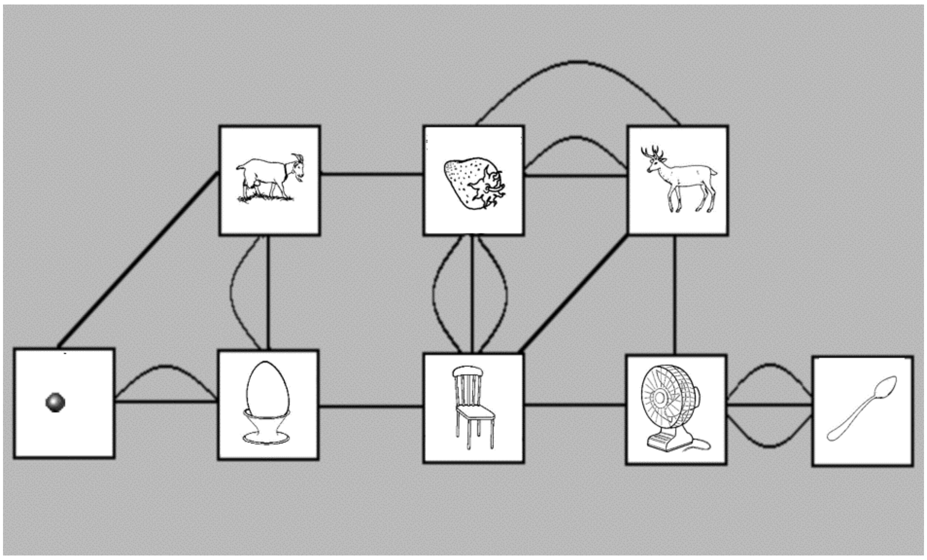

Figure 1. Example of a network.

Procedure

The experiment consisted of two sections: a voluntary and a cued language switching section, the order of which was counterbalanced across participants. The voluntary language switching section started with the following instructions: “In this part of the task, you can freely choose at every picture whether to produce the sentence in Spanish or English. Please use both languages.” (see also e.g., de Bruin et al., 2018, 2020). After the instructions, an example of how the task should be performed was given. This was followed by two practice networks. Unlike the experimental networks, the practice networks consisted of five, instead of seven, pictures, all of which did not occur in the experimental networks. Finally, the participants performed nine experimental networks.

The cued language switching section started with instructions regarding which language they should use on each trial: A green frame around the picture indicated that they should respond in Spanish and a blue frame around the picture indicated that they should respond in English. Each cue appeared when the red dot was in the middle of the preceding picture, and it disappeared two seconds after the next color frame appeared. Similar to the voluntary language switching section, the instructions were followed by an example, two practice networks, and nine experimental networks. Along the lines of the switch rate observed in previous voluntary language switching studies (e.g., de Bruin et al., 2020; Gollan & Ferreira, 2009), we chose a 37% switch rate in the cued language switching section and half the sentences had to be produced in Spanish.

It should be noted that the networks were also counterbalanced across participants. Put differently, half of the participants saw a specific network in the voluntary language switching section, whereas the other half saw it in the cued language switching section.

Analysis

Coding of the filled pauses was done by the first author. To this end, the following definition was used to determine filled pauses: any vocalization during speech that does not represent words (e.g., *er*, *um*, and *uh*).

The first sentence of each network was excluded from analyses, since this was neither a language repetition nor switch. Additionally, the following sentences were excluded: sentences produced in the wrong language in the cued language switching block, sentences that contained an intra-sentential language switch[1], and when no response was given (5.3% of data).

The binomial data was analyzed using a logistic mixed model (Jaeger, 2008) with random effects for participants and items with a maximal random effects structure (Barr et al., 2013).[2] Fixed effects comprised Language (L1 = -0.5; L2 = +0.5), Trial type (repetition trials = -0.5; switch trials = +0.5), Language switching variant (cued language switching = -0.5; voluntary language switching = +0.5), and their interactions.

Results

Switch rate in voluntary language switching

Before delving into the main analysis, an overview of the switch rate in voluntary language switching is given: A higher switch rate in the voluntary language switching section

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[1] We also ran an analysis based on error rates. However, before delving into this analysis, it should be noted that participants were told that in the voluntary language switching task they could use any language that they wanted. So, participants could actually use another language in a sentence for one (or several) word(s), and it would not be problematic according to the task at hand. While this only happened very infrequently, and we took these sentences out of the analyses, this means that the most informative error type in language switching studies, namely language errors, could not be taken into account.

The main effect of Language was not significant, $b = 0.176$, SE = 0.135, $z = 1.306$, $p = .191$. Trial type was significant, $b = 0.653$, SE = 0.126, $z = 5.197$, $p < .001$, with more errors during switch trials (13.8%) than during repetition trials (7.1%). Language switching variant was also significant, $b = 0.755$, SE = 0.190, $z = 3.982$, $p < .001$, with more errors during cued (13.6%) than during voluntary (6.4%) language switching. The interaction between Language and Trial type was significant, $b = 0.634$, SE = 0.248, $z = 2.551$, $p = .011$, with larger L2 (8.2%) than L1 (4.9%) switch costs. The interaction between Language and Language switching variant was not significant, $b = 0.072$, SE = 0.256, $z = 0.281$, $p = .779$. The interaction between Trial type and Language switching variant was significant, $b = 1.294$, SE = 0.251, $z = 5.158$, $p < .001$, with larger switch costs in cued (14.4%) than in voluntary language switching (0.1%). Finally, also the three-way interaction was significant, $b = 1.048$, SE = 0.496, $z = 2.115$, $p = .035$, with similar L1 (14.9%) and L2 (13.8%) switch costs during cued language switching and larger L2 (3.1%) than L1 (-3.8%) switch costs during voluntary language switching.

[2] The following strategy was used in case of an issue with the fully randomised model (cf. Barr et al., 2013; Matuschek et al., 2017): First, random effects for the item-specific random slopes were excluded, starting with the higher-order interactions. If the issue was not resolved, the higher-order interactions of the participant-specific random slopes were excluded. If this does not resolve the issue, the lower-order terms were removed, again starting with the item-specific random slopes before moving on to the participant-specific random slopes.

was observed (47.3%) than in the cued language switching section.[3] This switch rate was higher for L1 sentences (52.2%) than L2 sentences (43.1%).[4]

Filled pauses

As can be seen in Table 2, a significant effect of language was observed, with more filled pauses in L2 sentences (20.1%) than in L1 sentences (11.7%; see Table 3). Trial type was also significant, with more filled pauses during switch trials (18.5%) than during repetition trials (14.3%), indicating that switch costs were observed. Finally, a three-way interaction was observed.[5]

*Table 2. b-, z-*values, and standard errors of main analysis.

Factors	*b*-value	SE	*z*-value	*p*-values
Language	0.780	0.109	7.178	< .001
Trial type	0.368	0.110	3.357	< .001
Language switching variant	0.143	0.105	1.369	.171
Language x Trial type	0.114	0.216	0.527	.598
Language x Language switching variant	0.236	0.217	1.088	.277
Trial type x Language switching variant	0.030	0.218	0.140	.889
Language x Trial type x Language switching variant	0.946	0.436	2.170	.030

[3] To exclude the possibility that any switch cost differences between voluntary and cued language switching were due to a difference in switch rate, we conducted an analysis with the addition of switch rate as a continuous (centered) variable. The results showed no three-way interaction between Trial type, Language switching variant, and switch rate, b = 0.001, SE = 0.016, z = 0.618, p = .537. Furthermore, the four-way interaction between Language, Trial type, Language switching variant, and switch rate was also not significant, b = 0.034, SE = 0.030, z = 1.135, p = .256. So, it seems unlikely that switch rate caused any switch cost differences between voluntary and cued language switching.

[4] It should be noted that we are not the first voluntary language switching paper that has a switch rate around 47%. Jevtović et al., (2019) found a 50.8% switch rate in Spanish and 40.7% in Basque, whereas de Bruin et al. (2018) observed a 49.8% switch rate in Spanish and 38.0% in Basque.

[5] In an exploratory analysis, along the lines of Kleinman and Gollan (2016), we also included the following continuous variable: Block type order (Voluntary first = -0.5; Cued first = 0.5). The results showed no significant four-way interaction between Language, Trial type, Language switching variant and Block type order, b = 0.352, SE = 0.886, z = 0.397, p = .691. However, there was a trend towards larger cued switch costs (7.1%) than voluntary switch costs (5.3%) when performing cued language switching first, whereas smaller cued switch costs (0%) than voluntary switch costs (4.7%) were observed when performing voluntary language switching first, b = 0.814, SE = 0.449, z = 1.814, p = .070.

Table 3. Overall mean filled pauses in percentages (SE in parenthesis) as a function of Language (Spanish; English), Trial type (repetition trials; switch trials), and Language switching variant (cued language switching; voluntary language switching).

	Cued language switching		Voluntary language switching	
Trial type	L1	L2	L1	L2
Switch	14.1 (2.0)	23.7 (3.8)	12.1 (2.5)	24.4 (4.6)
Repetition	9.6 (3.0)	20.8 (4.4)	12.0 (2.6)	14.1 (3.2)
Switch costs	4.5	2.9	0.1	10.3

To further investigate the three-way interaction, separate analyses were conducted on the two language switching variants with the factors Language and Trial type. In the cued language switching data, the main effect of Language was significant, $b = 0.917$, SE = 0.160, $z = 5.715$, $p < .001$, with more filled pauses in L2 sentences (21.9%) than in L1 sentences (11.2%). Moreover, Trial type was also significant, $b = 0.371$, SE = 0.160, $z = 2.315$, $p = .021$, with more filled pauses during switch trials (19.0%) than during repetition trials (15.3%). The interaction between these two effects was not significant, $b = 0.297$, SE = 0.318, $z = 0.934$, $p = .350$.

In the voluntary language switching data, the main effect of Language was significant, $b = 0.667$, SE = 0.146, $z = 4.556$, $p < .001$, with more filled pauses in L2 sentences (18.5%) than in L1 sentences (12.1%). Moreover, Trial type was also significant, $b = 0.370$, SE = 0.149, $z = 2.474$, $p = .013$, with more filled pauses during switch trials (18.2%) than during repetition trials (13.2%). The interaction was also significant, $b = 0.588$, SE = 0.292, $z = 2.011$, $p = .044$, with larger switch costs in L2 sentences (10.3%; $b = 0.654$, SE = 0.197, $z = 3.319$, $p < .001$) than in L1 sentences (0.1%; $b = 0.162$, SE = 0.226, $z = 0.720$, $p = .472$).

Discussion

In the current study, we set out to investigate whether switch costs could be observed while bilinguals voluntarily switched languages between sentences. This was compared to cued language switching between sentences. The results showed that voluntary language switching was costly, but only in L2 sentences. With respect to the difference between voluntary and cued language switching, we only observed a difference in asymmetrical switch costs, with larger L2 than L1 switch costs during voluntary language switching and similar switch costs across the two languages during cued language switching.

Switch costs

Along the lines of previous language switching studies that relied on the network description task with French-English (Declerck et al., 2017) and Dutch-French (Declerck et al., 2021) bilinguals, the current study showed switch costs with Spanish-English bilinguals during cued language switching. Importantly, we also observed overall switch costs during voluntary language switching. This indicates that switch costs can still occur, even when switching voluntarily between sentences. However, this was only the case for L2 switch costs, since no significant L1 switch costs were observed. As switch costs are a measure of language control, not observing significant L1 switch costs might be due to voluntary language switching and/or sentence production requiring less language control than cued language switching and/or picture naming, respectively (see introduction for a discussion on these topics). Since significant L1 switch costs were observed during cued language switching in the current study, which also required sentence production, one might be inclined to deduce that it is mainly voluntary language switching that reduced L1 switch costs to the point that they were not significant. However, it might very well be that the more ecologically valid context created by combining both voluntary language switching and sentence production was the main cause for this pattern. The latter claim seems more probable, as most voluntary language switching studies that relied on single-word picture naming (i.e., not in a sentence context) did observe switch costs (e.g., de Bruin et al., 2018, 2020; Gollan et al., 2014; Grunden et al., 2020).

It should be noted, though, that filled pauses have only sparsely been used in the context of language switching (cf. Declerck et al., 2021 and the current study). Hence, presently little is known about this dysfluency measure within the context of language switching. So, while we did not observe significant L1 switch costs in the current study, this could be due to filled pauses being not very sensitive to L1 switching or language switching in general. Future research with filled pauses will have to indicate to what extent this dysfluency measure, or any other dysfluency measure (e.g., Fraundorf & Watson, 2014; Hartsuiker & Notebaert, 2010), is fit as a dependent measure during language switching.

Asymmetrical switch costs

Finding larger L2 than L1 switching costs during voluntary language switching might seem unexpected, as it is the opposite pattern found in most language switching studies that observe asymmetrical switch costs (i.e., L1 switch costs > L2 switch costs; e.g., Meuter and Allport, 1999; Philipp et al., 2007). Note that this is not the first study to find such a pattern (e.g., Bonfieni et al., 2019; Declerck & Philipp, 2015c; Declerck et al., 2015; Liu et al., 2019; Ma et al., 2016; Timmer et al., 2019; Zheng, et al., 2020). Studies that have observed larger L2 than L1 switch costs tend to assume that a higher L2 activation, relative to L1 activation, within the context of mixed language blocks (for instance due to proactive L1 inhibition; e.g., Declerck et al., 2015; Zheng et al., 2020) and/or a high L2 proficiency and exposure (e.g., Bonfieni et al., 2019) is responsible for this pattern, as this might make it more difficult to overcome the persisting inhibition on L2 when switching from L1 to L2 than overcoming the persisting inhibition on L1 when switching from L2 to L1 (cf. Green, 1998; Meuter & Allport, 1999). This could also have been the case in our study, since the bilinguals tested for this study scored high on an objective L2 proficiency task and had a relatively high current L2 exposure (see Table 2). However, it could be argued that there was a larger number of filled pauses in L2 than in L1, and not a similar number of filled pauses in L1 and L2 or a reversed language dominance effect (cf. worse L1 than L2 performance in mixed language blocks), as one might expect if participants had a higher L2 than L1 activation within this context and high L2 proficiency/exposure. Yet, we know that the (reversed) language dominance effect is far from robust in mixed language blocks (e.g., Declerck, 2020; Gade et al., 2021). Hence, participants might still have had a relatively high L2 activation and proficiency/exposure, without this being reflected in the Language factor.

An alternative explanation is that participants produced "harder" responses (e.g., sentences with a picture depicting a relatively low frequency word in both languages) in their L1 during voluntary language switching (cf. Gollan & Ferreira, 2009), because this is the more dominant language and thus should be easier to produce these "harder" sentences in. In turn, the relative activation of L2 might be higher than that of L1 for the set of words used in the voluntary language switching section. Consequently, more language control will be required to inhibit L2 during L1 production than vice versa, and thus more language control will persist when switching from L1 to L2 than when switching from L2 to L1 (cf. Green, 1998; Meuter & Allport, 1999). This explanation has the benefit that it can also explain why no similar asymmetrical switch cost pattern was observed during cued language switching, since in the latter context, participants could not choose to produce "harder" responses in their L1.

A final possibility is that L1 was the default language (cf. Gollan & Goldrick, 2016; Li & Gollan, 2021) during voluntary language switching, since switching away from the default language is more difficult than switching to it (Gollan & Goldrick, 2018). In turn, this could have led to larger L2 than L1 switch costs. However, this seems unlikely in the current study. About half (45%) of the sentences were produced in L1 in the voluntary language switching networks. Hence, there does not seem to be much of a default language as about half of the trials were in one language or the other, and the little difference there is indicates that the L1 was actually used less frequently than the L2, making it unlikely that L1 was the default language during voluntary language switching.

Conclusion

Taken together, in the current study we observed substantial L2 switch costs when Spanish-English bilinguals could voluntarily switch languages between sentences. However, no such cost occurred for L1 sentences. These results indicate that voluntary language switching between sentences can lead to non-significant switch costs, but this might not be the case in all conditions.

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