

Running head: Bilingual inhibition

The concept of inhibition in bilingual control

Mathieu Declerck¹ and Iring Koch²

¹ Vrije Universiteit Brussel, Brussels, Belgium

² RWTH Aachen University, Aachen, Germany

©American Psychological Association, 2022. This paper is not the copy of record and may not exactly replicate the authoritative document published in the APA journal. The final article is available, upon publication, at: <https://doi.org/10.1037/rev0000367>

Authors' Note

Correspondence concerning this article should be addressed to Mathieu Declerck, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Elsene, Belgium. Email: mathieu.declerck@vub.ac.be
Information Iring Koch: RWTH Aachen University, Jaegerstrasse 17-19, 52066 Aachen, Germany. Email: koch@psych.rwth-aachen.de

Abstract

To achieve fluent language processing as a bilingual, a dominant theoretical framework assumes that the non-target language is inhibited. This assumption is based on several empirical effects that are typically explained with inhibitory control. In the current article, we discuss four prominent effects linked to bilingual inhibition in language production (i.e., asymmetrical switch costs, n-2 language repetition costs, reversed language dominance, and the blocked language order effect). We argue that these effects require more empirical examination in order to arrive at a firmer basis for the assumption that inhibition plays a major role during bilingual language control. In particular, the empirical replicability of the phenomena themselves needs to be established more firmly, the underlying theoretical assumptions need further elaboration, and alternative explanations of the empirical effects need to be scrutinized. In turn, we conclude that inhibitory control may provide a coherent framework for bilingual language production while outlining the challenges that the inhibition account still needs to face.

Keywords: Bilingualism; Inhibition; Language control

Given that over half the world's population is proficient in two or more languages (e.g., Grosjean, 2010), it is an imperative endeavour to not only investigate how monolinguals process language (e.g., Hahn et al., 2021; van Gompel et al., 2019), but also how bilinguals are able to process language. One clear distinction between language processing in monolinguals and bilinguals is that the latter activate words in the target language and the non-target language in parallel (e.g., Costa et al., 2000; Giezen & Emmorey, 2016; Meade et al., 2018; Thierry & Wu, 2007). In turn, this is assumed to result in interference from the non-target language during target language processing. For language to be effectively and fluently processed by bilinguals, this cross-language interference needs to be resolved. Cross-language interference resolution is accomplished through a process called language control (e.g., Calabria et al., 2018; Crinion et al., 2006; Declerck & Philipp, 2015a; Green, 1998; Green & Abutalebi, 2013).

Language control is typically assumed to consist of two processes (e.g., Declerck, 2020; Ma et al., 2016; Peeters & Dijkstra, 2018; Seo & Prat, 2019; Wu & Struys, 2021). Most studies of language control investigated *reactive* language control, which entails a control process that is implemented when cross-language interference is detected. This would be the case, for example, when a specific word needs to be understood that is known to cause cross-language interference (e.g., a homograph, which is a word that has the same form across languages, but has a different meaning, such as “gift” for a Dutch-German bilingual, which means gift in Dutch and poison in German). On the other hand, *proactive*¹ language control is implemented as an anticipation of any cross-language interference. For example, when producing consistently in the second language (L2), first language (L1) words might be co-activated, resulting in substantial L1

¹ When referring to *proactive* in this article, it will refer to proactive control like it is used in the cognitive control literature, where it denotes processes that act from the present into the future (i.e., anticipation, preparation), not to proactive interference like it is used in the memory literature, where it denotes the influence of the past on the present.

interference. Hence, proactive language control of L1 during L2 processing might be necessary in this context to change baseline activation of L1 and L2 and thus the degree of cross-language interference when using L2.

In the last two decades, both reactive and proactive language control processes have mainly been explained with inhibitory control in bilingual language processing situations (e.g., Green, 1998; Kroll et al., 2008). Inhibitory control entails that the activation of the non-target language is inhibited. This should result in less cross-language interference and in a higher chance that words from the target language will be selected. The inhibition account of language control is very attractive since it provides a coherent framework to explain most empirical effects that have been linked to language control. In this review, we will discuss the most prominent empirical effects that are taken as indicators of bilingual inhibitory control that led to this consensus. Regarding reactive inhibitory control, we will discuss asymmetrical switch costs and n-2 language repetition costs, whereas in the context of proactive inhibitory control, we will discuss reversed language dominance and the blocked language order effect (for an overview of the empirical effects discussed here, see Table 1).

Table 1. Overview of the four empirical effects discussed in this review.

Effect	Reactive or Proactive?	Description	Inhibitory account	Alternative, non-inhibitory account(s)
Asymmetrical switch costs	Measure for reactive inhibitory control	Larger L1 switch costs than L2 switch costs	Persisting and proportional inhibition	- Persisting and proportional activation - First language repeat benefit - Response selection
N-2 language repetition costs	Measure for reactive inhibitory control	Worse performance in language A in ABA than CBA sequences	Persisting and dissipating inhibition	Partial feature repetition interference
Reversed language dominance	Measure for proactive inhibitory control	Worse L1 than L2 performance in mixed language blocks	Proactive inhibition on the first language	- Proactive activation of the second language - Language-specific selection thresholds
Blocked language order effect	Measure for proactive inhibitory control	Worse performance in single language blocks after performing in a single language block of another language	Persisting proactive inhibition	Persisting proactive activation

In doing so, we will argue that there are critical issues that need to be settled before we can arrive at a deeper understanding of how inhibition is implemented to reduce cross-language interference. More specifically, we will discuss three lines of arguments that need to be addressed in the context of the four, above-mentioned, prominent empirical effects that have been used as indicators of bilingual inhibitory control:

1. Replicability of the empirical effects.² Knowledge about how reliably an effect is observed across studies is crucial to draw any meaningful conclusions (cf. Nosek et al., 2022). Moreover, most of the bilingual language processing models that rely on inhibitory control (e.g., Declerck et al., 2015; Grainger et al., 2010; Green, 1998) assume that inhibitory control is implemented in most contexts that require bilingual language processing (for more information on these models, see below). Hence, we will discuss recent findings concerning the replicability of the four empirical effects that are taken to suggest underlying inhibitory processes, together with the conditions that might lead to the occurrence or absence of said effects.
2. Underlying assumptions of the inhibition account of the empirical effects. To explain effects with inhibition, underlying assumptions are generally required. The evidence, or lack thereof, regarding these underlying assumptions will be discussed.
3. Alternative explanation(s) of the empirical effects. Most empirical effects used as an indicator of bilingual inhibition have alternative explanations that do not require an inhibition process. We will discuss these in detail together with any evidence in favor and against these alternative explanations.

In the current review, we mostly focus on behavioral evidence from language production studies regarding these empirical effects, since the majority of studies examining bilingual inhibition have been behavioral studies of language production. However, since some event-related potential (ERP) studies had a strong impact on our current understanding of bilingual inhibitory control, we will also discuss an ERP component that has been related to bilingual inhibitory control, namely the N2 component. Moreover, to provide a more complete picture, we

² This refers to whether an empirical effect can be replicated relatively consistently across studies, not whether an empirical effect has a high intraindividual reliability.

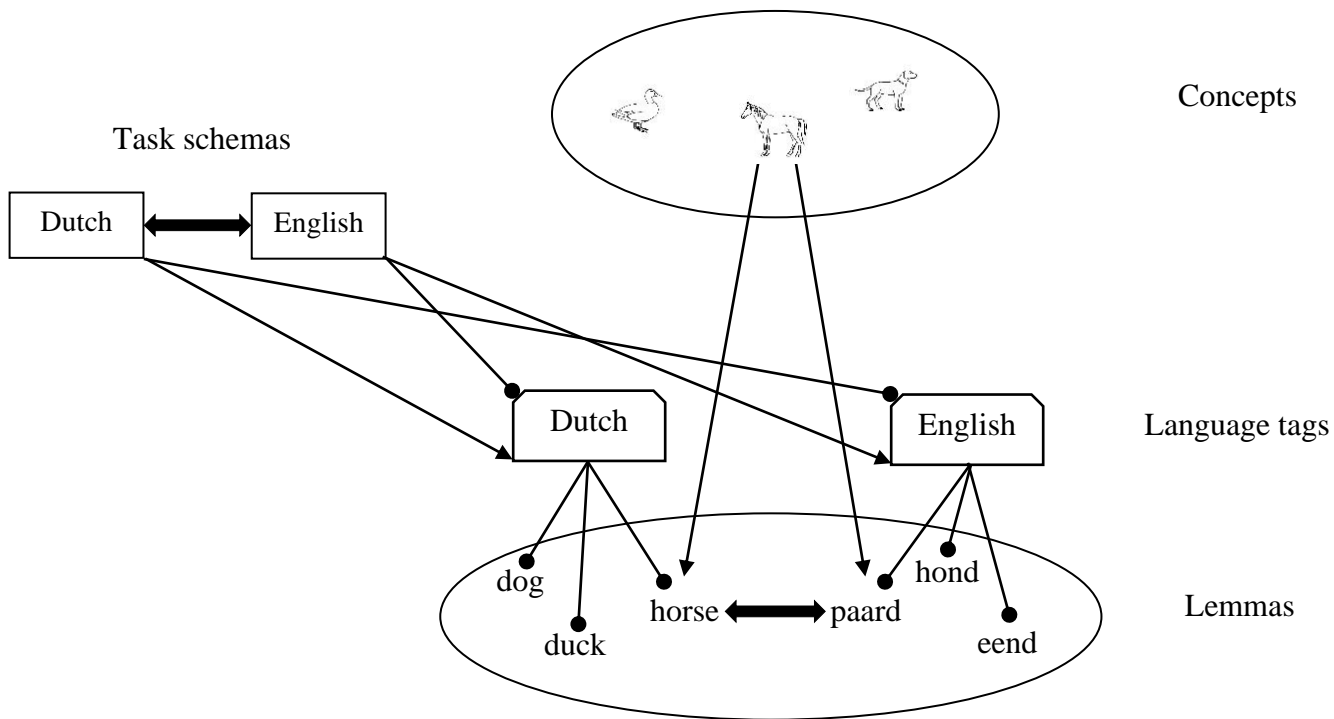
will also touch on the research revolving around inhibitory control during bilingual language comprehension, even though the evidence for the four empirical effects is much scarcer in comprehension studies than in production studies (see section “Inhibitory phenomena in bilingual language comprehension”).

Taken together, this review provides a necessary update on the discussion surrounding bilingual inhibitory control. Moreover, this review goes beyond previous reviews of language control (e.g., Abutalebi & Green, 2007; Bobb & Wodniecka, 2013; Calabria et al., 2018; Declerck & Philipp, 2015a; Kroll et al., 2008) by organizing this review systematically according to four major empirical effects supposed to index bilingual inhibition (asymmetrical switch costs, n-2 language repetition costs, reversed language dominance, blocked language order effect; see below), covering both language production and language comprehension, and separating the assessment of the empirical replicability of the effects themselves from the assessment of the evidence in support of their underlying theoretical assumptions. In doing so, we raise and discuss open questions that still need to be addressed in the context of bilingual inhibition. In turn, one of the main objectives of this review is to inspire new research, eventually leading to more clarity regarding the role of inhibition during bilingual language processing.

Models of bilingual language processing

The most prominent bilingual language processing model that relies on inhibition is the Inhibitory Control Model (ICM; Green, 1998; see also Green, 1986). According to the ICM, inhibition is first implemented between task schemas. These are higher-order representations (so-called “mental devices”) used to accomplish a goal, such as speaking in a specific language (for a visual depiction, see Figure 1). Next, the task schemas influence their corresponding language representation (“language tags”), which are mental representations of each language. Once the

concepts activate each lemma representation and its translation-equivalent lemma representation, each language tag will inhibit the lemma representations of the other, non-target language.



Note: Two-headed arrows mean interference resolution between languages; single arrowheads mean activation; circleheads mean inhibition. For the sake of visual clarity, we did not include any two-headed arrows between any translation equivalents other than that between the target word and its translation equivalent (i.e., horse and paard). This figure is adapted from Declerck et al. (2015).

Figure 1. Visual illustration of the inhibitory control model with an example of a Dutch-English bilingual.

In addition to the characteristics of inhibitory control described here, there is one other assumption of inhibitory control that permeates throughout most bilingual inhibition models that have built on the framework of the ICM (e.g., Abutalebi & Green, 2013; Declerck, Koch et al., 2015; see also Schwieter & Sunderman, 2008) and the literature at large. This assumption is that

bilingual inhibitory control is proportional to the amount of non-target language activation and thus responds adaptively to the degree of cross-language interference. Hence, more inhibitory control is assumed to be implemented when the activation of the non-target language is higher.

There are also specific differences between the ICM and more recent models that rely on inhibitory control. For instance, Declerck et al. (2015) did not assume that inhibitory control occurs between task schemas, but instead proposed inhibitory control to occur between language tags. Schwieter and Sunderman (2008) proposed that inhibitory control is implemented by second language learners in most circumstances, whereas highly proficient bilinguals only implement inhibition in specific situations (cf. Costa et al., 2006). The latter would seem to contradict with the ICM, since that model suggests that regardless of language proficiency, bilinguals rely on inhibitory control in most linguistic situations.

Despite the prominence of models of bilingual language processing that rely on inhibitory control, there are also models that do not rely on inhibition of the non-target language. Some models have proposed that only words in the target language can be selected (e.g., Costa et al., 1999; Roelofs, 1998), which would render the issue of inhibitory control redundant to some degree. Other models assume that increased activation of the target language should result in fluent bilingual language processing without too many cross-language errors (e.g., La Heij, 2005; Poulisse & Bongaerts, 1994; see also Blanco-Elorrieta & Caramazza, 2021). La Heij (2005), for example, proposed that a language representation, at the conceptual level, provides additional activation to words of the target language. This should usually lead to target language words being selected.

Even though there are different theoretical views on control during bilingual language processing, the idea that language control mainly relies on inhibition during bilingual language

processing currently appears to be the dominant view. To give some quantitative evidence for this impression, we would like to point out that the model of Green (1998) received over 1,000 citations on Web of Science (1,178 citations, as of March 7, 2021).

To test these models regarding their assumptions about language control, most studies have relied on the language switching paradigm. In the next section we will introduce this paradigm in more detail to set the stage for a discussion of the relevant inhibitory phenomena that can be obtained with said paradigm.

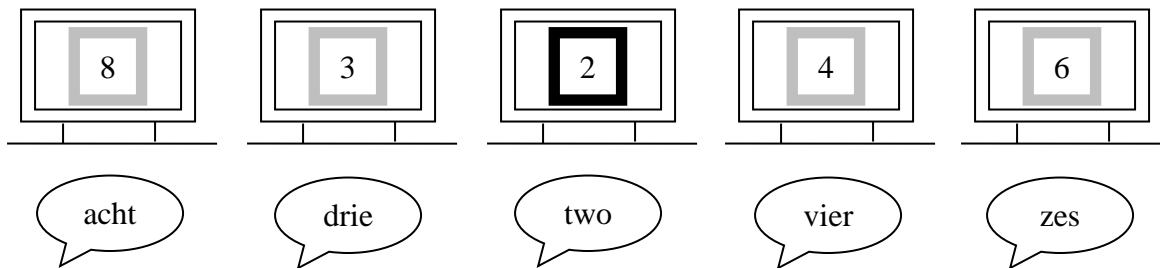
The language switching paradigm

The major paradigm to investigate language control in general, and bilingual inhibitory control specifically, is the language switching paradigm. There are three major variants: Most studies that rely on the language switching paradigm to examine inhibitory control use the *cued language switching* variant (e.g., Costa & Santesteban, 2004; Meuter & Allport, 1999; Philipp et al., 2007). During cued language switching, bilinguals name stimuli, which typically consist of pictures or digits, in one or the other language. The stimulus is accompanied by a language cue (e.g., differently colored frames around the stimulus; see Figure 2), which indicates the specific language that the bilingual participant should use to produce the name of the stimulus in the current trial.

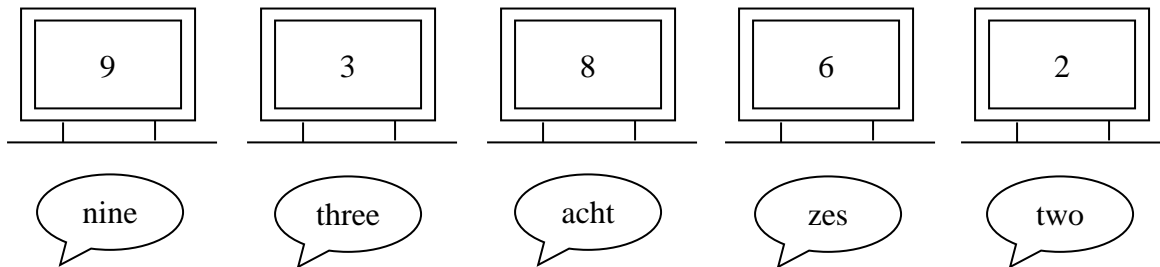
The other two variants also usually employ pictures or digits as target stimuli for naming. However, these variants do not rely on language cues to indicate which language the participants should use on any given trial. Instead, with the *alternating language switching* variant, the bilingual participants name the stimuli in the same language for a specific run of trials (often for two trials), after which they switch to the other language for the same number of trials (i.e., A-A-

B-B-A-A-etc., with A and B referring to trials in different languages; e.g., Declerck, Koch et al., 2015; Jackson et al., 2001; Reynolds et al., 2016).

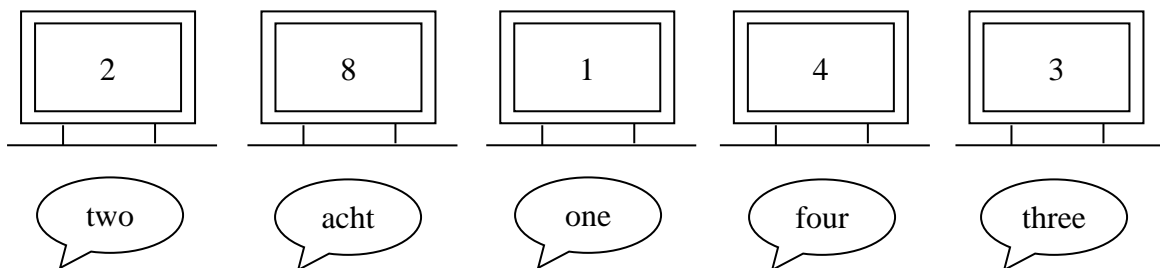
Cued language switching:



Alternating language switching:



Voluntary language switching:



Note: The language sequence in the cued language switching example was: L1-L1-L2-L1-L1; in the alternating language switching example: L2-L2-L1-L1-L2; in the voluntary language switching example: L2-L1-L2-L2-L2.

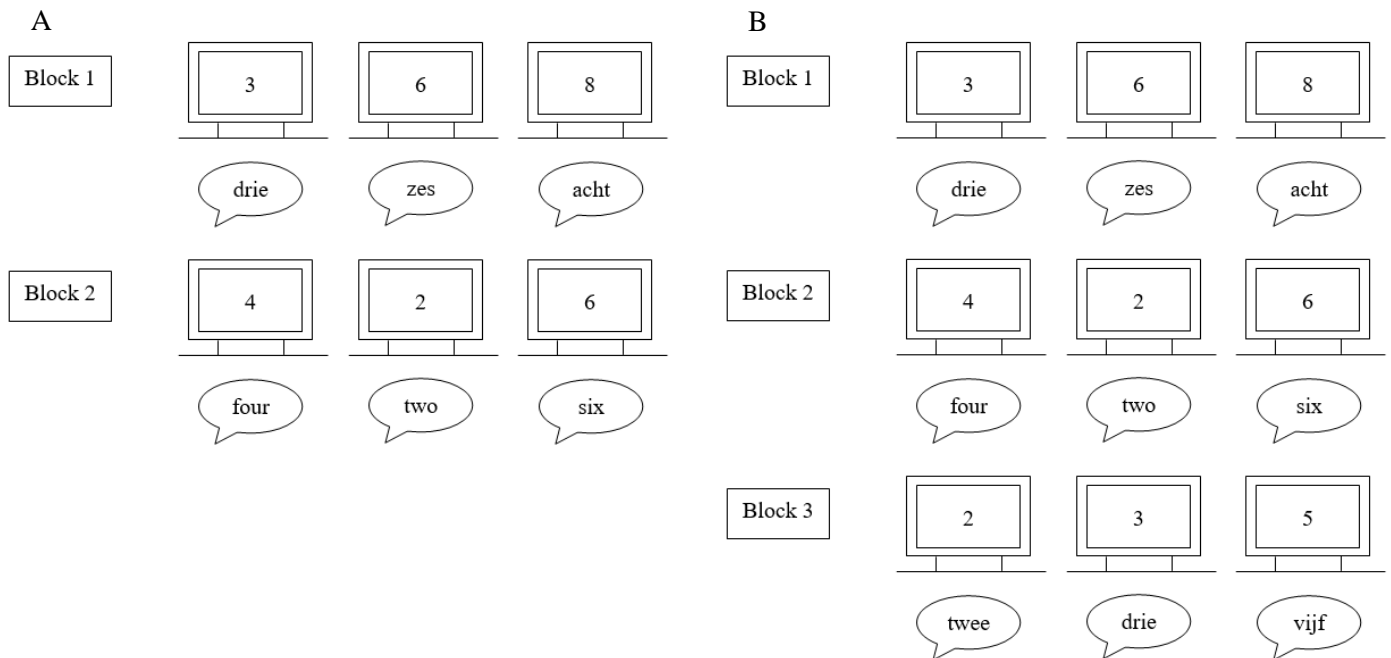
Figure 2. Examples of the experimental setup of cued language switching, alternating language switching, and voluntary language switching, for Dutch-English bilinguals.

Finally, the *voluntary language switching* variant (e.g., Blanco-Elorrieta & Pyllkänen, 2017; Liu, Tong, et al., 2020; Gollan & Ferreira, 2007) generally allows bilingual participants to freely choose which language to use on every trial. However, sometimes there is the stipulation that each language should be chosen with roughly equal frequency.

Regardless of the type of language-switching variant, the basic finding in studies that implement the language switching paradigm is the so-called language switch cost, which entails worse performance in trials that require a language switch relative to language repetitions (e.g., Costa & Santesteban, 2004; Meuter & Allport, 1999). This switch cost in language switching is arguably among the most replicable empirical findings in contemporary bilingualism research (cf. Gade et al., 2021).

In addition to these three variants of the language switching paradigm that require relatively frequent language switches, there is a fourth variant, which represents a language switching paradigm with a different time scale. This paradigm requires very few language switches as participants switch between single language blocks of different languages. In one variant of this paradigm, half of the bilinguals first perform in a single-language block with language A, followed by performing in a single-language block with language B (see panel A in Figure 3), and vice versa for the other half of the bilingual participants. The result usually shows that performance is worse in the second block than in the first block (e.g., Branzi et al., 2014). Another variant of this paradigm relies on three single-language blocks, in which language A is used in the first and third block, and language B is used in the second block (see panel B in Figure 3). The main finding with this setup is typically worse performance in Block 3 than in Block 1 (e.g., Branzi et al., 2014; Degani et al., 2020). This so-called blocked language order

effect represents another type of language switch cost and will be further discussed below (see section “Blocked language order effect”).



Note: In these examples, with Dutch-English bilinguals performing a digit naming task, L1 was used in Block 1 and Block 3, whereas L2 was used in Block 2.

Figure 3. An example for Dutch-English bilinguals of the two main experimental setups to obtain the blocked language order effect: (panel A) comparing performance in Block 2 to Block 1 and (panel B) comparing performance in Block 3 to Block 1.

In what follows, we discuss four major empirical effects taken to represent inhibitory phenomena using the language switching paradigm, explaining the basic finding and its modulation by relevant factors. We then focus on the feasibility of the inhibitory control account and its potential non-inhibitory alternative accounts.

Inhibitory Phenomena in Bilingual Language Production

The first empirical effect of four related to bilingual inhibition that we will discuss in this review article are *asymmetrical switch costs*, which entail larger switch costs for L1 than for L2. The second effect is the *n-2 language repetition cost* (i.e., worse performance when switching back to a language that was recently switched out of relative to when that language was switched out of longer ago), which has been taken to reflect the aftereffects of persisting inhibition. Next to these two measures of reactive inhibitory control, the third and fourth empirical effect that will be discussed here have been linked to proactive inhibitory control. More specifically, the third empirical effect is the *reversed language dominance effect* in mixed-language conditions (i.e., worse L1 than L2 performance in mixed-language conditions). Finally, we discuss the *blocked language order effect*, which denotes the finding that performance is worse in a single-language block when it was preceded by a single-language block in another target language.

Asymmetrical switch costs

Larger switch costs for L1 than for L2 (i.e., asymmetrical switch costs) are by far the most prominent effect that has been used to suggest bilingual inhibitory control. Meuter and Allport (1999) were the first to report this pattern using a cued language switching paradigm. In this seminal study, 16 bilinguals were tested that spoke English as their first or second language in combination with one of five other European languages. The experiment consisted of naming digits 1-9, based on a language cue (i.e., a blue or yellow rectangle), in 200 lists of 5-14 trials. The authors observed larger costs for switching to the more dominant language than to the less dominant language, relative to staying in the same language. Put differently, L1 switch costs were larger than L2 switch costs.

Replicability of asymmetrical switch costs. Asymmetrical switch costs have been observed in picture naming (e.g., Costa & Santesteban, 2004; Kaufmann et al., 2018; Olson,

2016; see also Kirk et al., 2021), digit naming (e.g., Ma et al., 2016; Meuter & Allport, 1999; Zhu et al., 2020), and reading aloud (Filippi et al., 2014; Macizo et al., 2012; Reynolds et al., 2016) studies. Hence, this effect does not seem to be restricted to specific task conditions. So, at first sight, asymmetrical switch costs seem like a replicable empirical phenomenon.

Yet, many studies where an asymmetrical switch cost pattern would be expected did not observe such an effect (e.g., Christoffels et al., 2007; Declerck et al., 2012; Ivanova & Hernandez, 2021; Kang et al., 2018; Slevc et al., 2016). Moreover, several recent studies even found larger L2 than L1 switch costs (Bonfieni et al., 2019; Declerck, Stephan et al., 2015; Liu, Timmer et al., 2019; Timmer et al., 2019; Zheng, Roelofs, Erkan et al., 2020; see also de Bruin et al., 2020; Declerck & Philipp, 2015b; Jevtović et al., 2019; Wu & Struys, 2021). This erratic pattern has led previous review articles to the conclusion that asymmetrical switch costs, as an empirical effect, are not replicable across studies (Bobb & Wodniecka, 2013; Declerck & Philipp, 2015a).

This lack of replicability was confirmed by a recent meta-analysis in which overall no substantial evidence was observed for asymmetrical switch costs across 73 pertinent language production studies (Gade et al., 2021). This meta-analysis also investigated the influence of several possible moderating factors, such as the paradigm variant and language proficiency ratio. However, no convincing evidence was found for replicable asymmetrical switch costs in any of these additional analyses. It should be noted though that the possible moderating factors of asymmetrical switch costs are difficult to objectively quantify, such as language proficiency/balancing across studies (cf. de Bruin, 2019; Surrain & Luk, 2019), or are heavily biased in the literature, such as the type of language-switching paradigm.

Even though the literature, and thus the data in the meta-analysis, is heavily biased regarding the type of language-switching paradigm, it might be surprising not to observe a modulation of this factor on asymmetrical switch costs in the meta-analysis. Voluntary language switching typically did not show asymmetrical switch costs (de Bruin et al., 2018, 2020; Gollan & Ferreira, 2009; Gollan et al., 2014; Gross & Kaushanskaya, 2015; Grunden et al., 2020; Jevtović et al., 2019). The absence of asymmetrical switch costs in voluntary language switching was explained by Gollan and Ferreira (2009) by assuming that bilinguals in this context tend to implement L1 proactive inhibitory control and mainly produce “easier” words (e.g., high frequency words) in their L2. The L1 proactive inhibitory control should reduce the L1 activation level and by mainly producing “easier” words in their L2, the L1 activation level should be reduced relatively to the L2 activation level, at least for these specific words. In turn, this should lead to a more similar activation level across the languages, which should lead to symmetrical switch costs. An alternative, but not mutually exclusive, explanation is that the studies that investigated voluntary language switching mostly relied on very proficient bilinguals, who have been shown to produce symmetrical switch costs in some previous studies (e.g., Costa et al., 2006; Costa & Santesteban, 2004).

While most voluntary language switching studies show symmetrical switch costs, it should be noted that a recent voluntary language switching paradigm did show larger L1 than L2 switch costs in the context of bilingual language production (Liu et al., 2021; for a trend along the same lines, see Experiment 1 in Gollan et al., 2014). Hence, language dominance could affect voluntary language switch costs to some degree.

Other factors that have been considered as potential modulators of asymmetrical switch costs in the past did not affect the asymmetrical switch cost pattern in recent studies. For

example, both a longer cue-to-stimulus interval (Verhoef et al., 2009) and more balanced language proficiency (Meuter & Allport, 1999) have long been assumed to reduce asymmetrical switch costs. Yet, recent studies did not provide evidence that these manipulations affected asymmetrical switch costs (e.g., Declerck, Kleinman et al., 2020; Khateb et al., 2017; Ma et al., 2016; for more detailed information, see the following two sections). This indicates that the overall pattern seems rather difficult to understand across studies. Though, given the existence of well-powered studies showing asymmetrical switch costs (e.g., Dias et al., 2017; Ma et al., 2016), it remains important to better understand the boundary conditions for this potentially important empirical phenomenon.

In sum, even though the asymmetry of language switch costs has been reported in various studies, it is by no means a highly stable and replicable empirical phenomenon. Therefore, before accepting this asymmetry as a critical benchmark finding for bilingual inhibitory control, it seems more cautious to take this effect as an important phenomenon whose boundary conditions still need further exploration.

Inhibitory account of asymmetrical switch costs and its underlying assumptions. The observation of asymmetrical language switch costs could be explained with inhibitory control (e.g., Green, 1998; Meuter & Allport, 1999) by assuming that the competing language is suppressed while performing in the target language and that this suppression persists to some degree and needs to be overcome when switching into that previously suppressed language. Much less (if any) persisting inhibition has to be overcome in repetition trials. Consequently, it should be more difficult to switch from one language to another than to stay in the same language because of persisting inhibition.

Next to the assumption of persisting inhibition, the other, distinct assumption of the inhibition account of asymmetrical switch costs is based on the notion that language control is proportional to the degree of activation of the competing language. Proportional inhibition will lead to more inhibition of L1 during a L2 trial than vice versa, because L1 is assumed to have a larger base activation due to more exposure. Since more inhibition of L1 is used during L2 trials, more inhibition will persist when L1 is used subsequently, and thus make it more difficult to switch back into L1 than into L2. Consequently, switch costs should be asymmetrical across languages, with larger L1 than L2 switch costs (e.g., Liu, Jiao et al., 2019; Ma et al., 2016; Macizo et al., 2012; Meuter & Allport, 1999; Philipp et al., 2007; for a review, see Bobb & Wodniecka, 2013). The notion of proportional inhibition can also be explained by several models of bilingual language processing (e.g., Green & Abutalebi, 2013). According to such models, inhibitory control is initiated by activation of the non-target language. Any activation of the non-target language will result in conflict with the target language. Once this conflict has been detected by a conflict monitoring process (for reviews, see Botvinick et al., 2001; Schuch et al., 2019), it will send a signal to initiate the inhibitory control process and regulate how much control is required based on the activation level of the non-target language.

Some studies have sought evidence for the inhibition account of asymmetrical switch costs by investigating the relation of non-linguistic inhibition phenomena to (asymmetrical) language-switch costs (e.g., Jylkkä et al., 2021; Jylkkä, Lehtonen, Lindholm et al., 2018; Li et al., 2021; Linck et al., 2012, 2020; Liu et al., 2014). These studies typically examined the relationship between asymmetrical switch costs and the Simon effect, which they took as a measure of non-linguistic inhibition. In the Simon task (Simon & Rudell, 1967; for reviews, see Cespón et al., 2020; Dolk et al., 2014; Hommel, 2011; Lu & Proctor, 1995), participants respond

to a non-spatial stimulus attribute (e.g., color) presented at the left or right side by giving a response on the spatially corresponding, “congruent” side (e.g., a stimulus on the left side of the screen that requires a response from a button on the left) or on the incongruent side (e.g., a stimulus on the left side of the screen that requires a response from a button on the right). The Simon effect consists of worse performance when stimulus and response location are on different sides (i.e., incongruent) relative to when they are on the same side (i.e., congruent). This congruency effect is considered a measure of non-linguistic inhibition, according to the language switching studies that used this effect, because it allows insight into inhibition of a co-activated response that is not task-relevant (e.g., Linck et al., 2012; Li et al., 2021). In turn, if there is a connection between the Simon effect and (asymmetrical) switch costs, this would indicate that the latter would also, at least to some degree, rely on inhibition. The language switching study of Linck and colleagues (2012), for instance, found that a smaller Simon effect in English-French-Spanish trilinguals was associated with smaller L1 switch costs, whereas no such effect was observed for L2 or L3 switch costs. These findings were interpreted as suggesting that bilinguals with more efficient inhibition skills, measured by the Simon effect, would also show smaller switch costs, suggesting that switch costs rely on inhibition. The authors further assumed that this is especially the case for L1 switch costs as inhibition is even more crucial for L1 than for L2 or L3 switch costs (cf. Green, 1998; Meuter & Allport, 1999).

However, these findings do not provide unequivocal evidence that asymmetrical switch costs rely on inhibition. First, it is unclear to what extent (if at all) the Simon effect is due to inhibitory control (for a discussion, see Cespón et al., 2020; Lu & Proctor, 1995). Second, not all studies found a similar connection between the Simon effect and asymmetrical switch costs (de Bruin et al., 2014; Jylkkä et al., 2021; Jylkkä, Lehtonen, Lindholm et al., 2018; Li et al., 2021).

Li and colleagues (2021), for instance, found an opposite pattern to that of Linck et al. (2012), with a larger Simon effect in Chinese-English bilinguals being associated with smaller L1 switch costs and smaller asymmetrical switch costs.

Additional evidence for the inhibition account of asymmetrical switch costs has been sought with ERP studies. ERP studies that investigated bilingual inhibition typically relied on the N2 component. This is an ERP component with a negative-going peak that usually occurs between 200 and 350 ms after target stimulus presentation, mainly over anterior sites (e.g., Jackson et al., 2001). The N2 has been related to response inhibition based on ERP studies with the go/no-go paradigm, where a larger negativity is observed during no-go trials than during go trials in an early time window (i.e., between 200-350 ms; e.g., Falkenstein et al., 1999). However, there is also an alternative account of the N2, suggesting that it indexes interference detection and thus the triggering signal for inhibition (i.e., conflict monitoring; Donkers & van Boxtel, 2004; Nieuwenhuis et al., 2003) instead of representing the neurocognitive signature of inhibition itself. Because interference detection and inhibition should be intrinsically connected, it is difficult to determine which of these two separate, but connected processes the N2 allows insight into. So, ERP research with the N2 currently do not provide conclusive evidence for bilingual inhibitory control.

Nevertheless, asymmetrical switch costs have been observed with the N2 component (e.g., Jackson et al., 2001), showing a larger N2 component when switching from L1 to L2 than when switching from L2 to L1. According to the inhibition account, this would entail that more inhibition has to be implemented to inhibit L1 during L2 than vice versa. However, the N2-related asymmetrical switch cost pattern is similarly obscure as the asymmetrical switch cost pattern observed with behavioral measures. Whereas some studies have observed a larger switch-

related N2 in L2 than in L1 (Jackson et al., 2001; Verhoef et al., 2009), other studies found no such pattern (Kang et al., 2020; Peeters & Dijkstra, 2018; Zheng, Roelofs, Erkan et al., 2020) or the opposite pattern (Massa et al., 2020). Kang et al. (2020), for instance, asked Chinese-English bilinguals to name pictures in either language in a cued language switching paradigm. Their results showed no significant difference regarding the overall L1 and L2 switch-related N2. It should also be noted that some studies did not even observe a switch-related N2 effect (i.e., larger negativity when switching between languages than when staying in the same language across trials; Martin et al., 2013; Peeters, 2020; Peeters & Dijkstra, 2018; Timmer et al., 2019) or observed a larger N2 for repetition trials than for switch trials (Christoffels et al., 2007). Hence, switch costs and their asymmetry do not seem to be replicable with respect to the N2.

Another clear path to determine whether asymmetrical switch costs could be an index of inhibitory control would be to explore whether the two underlying assumptions of this account prove to be viable. As described above, the two main assumptions are that inhibition persists over time and that it is proportional to the degree of non-target language activation (e.g., Declerck & Grainger, 2017; Verhoef et al., 2009). Unfortunately, these two underlying assumptions have only been examined by a few studies, which we discuss next.

Most studies that investigated proportional inhibitory control relied on language dominance and language proficiency. Several studies have shown that highly proficient bilinguals show symmetrical switch costs, whereas language learners show asymmetrical switch costs (e.g., Costa & Santesteban, 2004; Martin et al., 2013; Santesteban & Costa, 2016; see also Calabria et al., 2012; Costa et al., 2006; Schwieter & Sunderman, 2008). However, even highly proficient bilinguals typically use one of their languages more often than the other, and thus should not be perfectly balanced bilinguals. So, we might still observe asymmetrical switch costs

with highly proficient bilinguals according to the inhibitory account of asymmetrical switch costs. Though, the asymmetrical switch costs should be smaller for highly proficient bilinguals than second language learners, since the base activation of L1 and L2 should be more similar for highly proficient bilinguals. However, the highly proficient bilinguals in the studies of Costa and colleagues, for instance, typically showed symmetrical switch costs (e.g., Costa et al., 2006; Costa & Santesteban, 2004), even though they were not balanced bilinguals since they still showed overall differences in their language dominance. To make sense of these results, Costa and Santesteban (2004) proposed that highly proficient bilinguals do not rely on inhibitory control, but on a language-specific selection process that only allows target-language words to be selected. Yet, later studies have suggested that highly proficient bilinguals can and do implement inhibition (Costa et al., 2006; Declerck, Kleinman et al., 2020; Declerck, Thoma et al., 2015), which makes it difficult to draw any clear conclusions.

Moreover, while some studies observed a difference in asymmetrical switch costs based on language proficiency (e.g., Filippi et al., 2014; Schwieter & Sunderman, 2008), this was not the case in all studies. Meuter and Allport (1999) subdivided their participants in a high and low proficiency group based on their relative language dominance results. The results showed no significant differences in asymmetrical switch costs between the two groups. Yet, each group consisted of only eight participants, so that this analysis might have been statistically underpowered. More recently, Bonfieni and colleagues (2019) used self-ratings to examine the effect of L2 proficiency, age of acquisition, and exposure on asymmetrical switch costs. Their results showed that asymmetrical switch costs were not affected by L2 proficiency or age of acquisition (for a similar result, see Costa et al., 2006). There was an effect of L2 exposure on asymmetrical switch costs, with more L2 exposure resulting in larger L2 switch costs than L1

switch costs. Along the same lines, Bultena et al. (2015) examined how L2 proficiency, measured by a vocabulary test (Meara, 2006), affected language switching in a sentence context. The results showed no relationship between L2 proficiency and asymmetrical switch costs. Furthermore, Declerck, Kleinman et al. (2020) re-analyzed data of 414 English-Spanish bilinguals (see Kleinman & Gollan, 2016, 2018) and found, based on an objective measure (i.e., MINT; Gollan et al., 2012), no effect of the degree of language balancing on asymmetrical switch costs.

Summarizing the research on proportional inhibition, it is not clear how language proficiency and language dominance relate to the asymmetry of language switch costs. Hence, there is little consistent evidence for the theoretical assumption of proportional inhibition beyond the evidence for asymmetrical switch costs itself, but the consistency of this empirical phenomenon itself is also still unclear.

The other underlying assumption of the inhibition account of asymmetrical switch costs is that inhibition persists over time. Persisting inhibition is typically defined as an involuntary after-effect of the implemented inhibition because inhibition may dissipate slowly and thus persists into the next trial(s). One way to investigate this issue would be to examine whether the strength of language control on trial n is in line with the strength of language control on trial $n-1$. Yet, little to no studies have been conducted based on this logic. Declerck and Philipp (2015b) found that phonological priming of the first phoneme across trials (i.e., from trial $n-1$ to trial n) caused larger asymmetrical switch costs on trial n and a reversed asymmetrical switch cost pattern on trial $n+1$. While these findings could be interpreted as evidence that language control persists to some degree, it is unclear when and why a reversal of asymmetrical switch costs should occur.

Recent studies with bimodal bilinguals (i.e., bilinguals that are proficient in a spoken language and a sign language) seem to provide evidence against persisting inhibition to account for asymmetrical switch costs (Blanco-Elorrieta et al., 2018; Emmorey et al., 2020; Kaufmann & Philipp, 2017; see also Liu, Zhang et al., 2020). Emmorey et al. (2020), for instance, found no cost when switching from a vocal response or a signed response into a code-blend (i.e., parallel production of a spoken and signed word) relative to staying in either the same vocal or signed language. This finding goes against the notion of persisting inhibitory control. For example, when producing solely a vocal response, the sign language should be inhibited. When the next trial requires a code-blend, the inhibition on sign language that persists from the previous trial should make these parallel responses more difficult. When staying in either vocal or signed language, no such persisting inhibition should be overcome. It should be noted though that it is not entirely clear yet how these results with bimodal bilinguals relate to unimodal language control. Some studies have found evidence for shared underlying mechanisms between unimodal and bimodal language control (Dias et al., 2017), but others found evidence for substantial differences (Declerck et al., 2021b; Kaufman et al., 2018) that were linked to language control influencing different processing stages for unimodal (i.e., lemma level) and bimodal (i.e., output [modality] level) bilinguals.

So, the evidence of whether inhibitory control persists over time seems equivocal, which is probably due to only few studies actually providing insight into this topic. Hence, more research should give us a clearer sense of the temporal dynamics of how (and if) inhibitory control persists over time.

Alternative accounts of asymmetrical switch costs. Given that the empirical evidence for the basic assumptions of the inhibitory account (i.e., proportional inhibition and persisting

inhibition) does not provide unequivocal empirical support, it is perhaps not surprising that there are also several alternative explanations of asymmetrical switch costs in the bilingual language control literature (and in the non-linguistic cognitive control literature; e.g., Schneider & Anderson, 2010; Yeung & Monsell, 2003; for a review, see Koch et al., 2010) that do not necessarily involve inhibition.

Based on non-linguistic accounts of asymmetrical switch costs, Philipp et al. (2007) proposed that, next to inhibition, persisting activation could also play a role. So, when processing a language on trial *n*, more activation will go to that language to make sure that words in the target language will be selected. This increase of language activation will persist into the next trial, making it a more considerable competitor, and possibly interfering to a higher degree. Hence, persisting activation would explain why switching languages is more difficult than remaining in the same language across trials (cf. switch costs). To explain the asymmetry of switch costs across languages, the authors suggested that L2 trials require a larger increase of activation than L1 trials, since the latter has a larger base activation. Hence, more additional activation will persist when switching from L2 to L1 than vice versa. Consequently, L2 will become a stronger competitor when switching to L1, and thus it should be more difficult to switch back to L1 than to L2 because of larger persisting L2 activation.

Importantly, one inconsistency of the persisting activation account, and of the inhibition account alike, is that sometimes the overall language dominance pattern in mixed-language blocks is reversed, with better overall L2 performance than L1 performance (for a more in depth discussion, see the section “Reversed language dominance” below). In the inhibition framework, this reversed language dominance effect is assumed to be due to proactive L1 inhibition, which leads to less L1 interference during L2 trials in mixed-language conditions. It is difficult to

reconcile the idea of L2 requiring more additional activation (or L1 requiring more inhibition) when L2 is already the more strongly activated language. Yet, this “L1 slowing” is exactly what several studies with asymmetrical switch costs have shown (e.g., Costa & Santesteban, 2004; Schwieter & Sunderman, 2008), suggesting that L1 is no longer the dominant language in mixed-language blocks, so that language dominance can no longer be used as a major explanatory construct for asymmetrical language switch costs in mixed-language blocks. This inconsistency stills awaits resolution.

Another account of asymmetrical switch costs comes from Verhoef and colleagues (2009). These authors argued that there is no interference during L1 repetition trials, whereas the other trial types (i.e., L1 switch trials and both L2 switch and repetition trials) would all suffer from cross-language interference. This should lead to overall faster L1 repetition trials than L2 repetition trials and thus to asymmetrical switch costs because the large L1 repetition benefit increases the performance difference between switch and repeat trials (i.e., the switch costs). The explanation of Verhoef and colleagues is based on the finding that switch costs were asymmetrical with a short cue-to-stimulus interval, whereas switch costs became symmetrical with a long cue-to-stimulus interval, which increases the time for proactive control in terms of preparation for a language switch. Moreover, their data showed that increasing the cue-to-stimulus interval did not affect L1 repetition trials but improved performance specifically in L1 switch, L2 switch, and L2 repetition trials. This finding was interpreted to indicate that only L1 repetition trials, in a language switching context, do not suffer from cross-language interference.

However, other studies that examined the influence of the cue-to-stimulus interval found no significant effect on the asymmetry of switch costs (Costa & Santesteban, 2004; Festman & Mosca, 2016; Fink & Goldrick, 2015; Graham & Lavric, 2021; Khateb et al., 2017; Lavric et al.,

2019; Ma et al., 2016; Mosca & Classhen, 2016; Philipp et al., 2007; Stasenko et al., 2017) or even an opposite pattern, with larger asymmetrical switch costs when the cue-to-stimulus interval was long (Declerck, Ivanova et al., 2020). Fink and Goldrick (2015) also examined whether the cue-to-stimulus manipulation influenced L1 repetition trials. Unlike Verhoef et al. (2009), Fink and Goldrick (2015) found improved performance for L1 repetition trials with a longer cue-to-stimulus interval. In light of the overall evidence, it seems unlikely that asymmetrical switch costs are mainly due to a specific L1-repetition benefit.

A third account of asymmetrical switch costs comes from Finkbeiner et al. (2006). These authors first set out to test whether inhibition is implemented during bilingual language production by letting participants name digits in their L1 and L2 and pictures solely in their L1 (Experiment 1) or name digits in their L1 and L2 and name the number of dots solely in their L1 (Experiment 2). They reasoned that in the task switching literature, switch costs are usually observed when a stimulus can be used for both tasks (i.e., bivalent stimuli) but switch costs tend to be less replicable when the target stimuli are specific to one task (i.e., univalent stimuli; for a review, see Kiesel et al., 2010). According to most bilingual models that rely on inhibitory control (e.g., Green, 1998; Grainger et al., 2010), on the other hand, inhibition of the non-target language should be implemented regardless of whether the stimulus is univalent or bivalent. So, any language-switch costs found with univalent stimuli would not be due to specific characteristics of the switching paradigm, and would be expected according to bilingual models that rely on inhibition. The results of Finkbeiner et al. (2006) showed that asymmetrical switch costs can be observed with the bivalent digit stimuli but no switch costs were observed with the univalent stimuli that were solely named in L1, seemingly providing evidence against bilingual models that rely on inhibitory control.

Though, several studies have observed switch costs and even asymmetrical switch costs with “true” univalent linguistic stimuli (i.e., written words; e.g., Filippi et al., 2014; Macizo et al., 2012; Reynolds et al., 2016; Slevc et al., 2016), unlike the univalent stimuli in Finkbeiner et al. (2006) (i.e., pictures and dots) that could not be used in both languages but might still activate responses in both languages. Macizo et al. (2012), for example, let Spanish-English bilinguals read written words out loud. Their results showed that switch costs and their asymmetry across languages can be observed with univalent stimuli. Furthermore, Peeters et al. (2014) and Gambi and Hartsuiker (2016) let bilinguals perform a comprehension task in both L1 and L2 and a production task in only one language. Their results showed language switch costs in the production task, even though only one language was used in this condition. Unlike Finkbeiner et al. (2006) and Gambi and Hartsuiker (2016), Peeters et al. (2014) asked their bilinguals to perform the picture naming task in a L1 block and a L2 block. Using this setup, they even observed asymmetrical switch costs in the production task. So, contrary to Finkbeiner et al. (2006), switch costs, and even asymmetrical switch costs, can be found when bilinguals use only one language in a specific condition.

Putting aside these more recent findings that are inconsistent with the findings of Finkbeiner et al. (2006), Finkbeiner and colleagues proposed a novel account of asymmetrical switch costs. According to the response selection account, both translation-equivalent words are activated when naming bivalent stimuli in a mixed language block. In a repetition trial, the response selection criteria to select the L1 or L2 word are merely reused from the previous trial, and thus production in this trial type is fast. Moreover, because L1 words tend to be available for production more quickly, they will also be produced faster in repetition trials. In switch trials, it takes time to determine the correct response selection criteria, and thus there should be a cost to

switching languages, relative to repeating languages across trials. In turn, to prevent errors, initial fast responses in a difficult context, such as switch trials, would be rejected. Because L1 should lead to faster responses than L2, this should lead to more initial responses in L1 switch trials being rejected and thus responses would be slower for L1 switch trials than for L2 switch trials. Together, this should result in asymmetrical switch costs. This account was confirmed by Finkbeiner et al. in a monolingual task switching experiment, in which the participants had to switch between naming the word or the ink color of the word, with the main manipulation being that words were used that are typically produced fast (i.e., with a higher frequency, less letters, and more semantic senses) vs. slow. While the overall main effect of fast vs. slow words was not significant, larger switch costs were observed with words that should be produced faster.

One consideration about the asymmetrical switch costs account of Finkbeiner and colleagues (2006), which applies to the persisting activation and inhibition account alike, is that Finkbeiner et al.'s account is unable to explain finding both a reversed language dominance pattern and asymmetrical switch costs in the same experiment. If there is a reversed language dominance pattern, then L2 performance should lead to faster responses than L1. This should lead to a larger number of L2 responses being rejected during switch trials, leading to a reversed asymmetrical switch cost pattern, with larger L2 than L1 switch costs. While such a pattern has been observed in a few studies (Declerck, Stephan et al., 2015; Zheng, Roelofs, Erkan et al., 2020), it is definitely not the norm (e.g., Christoffels et al., 2007; Costa & Santesteban, 2004; Schwieter & Sunderman, 2008). So, the account proposed by Finkbeiner et al. (2006) is faced with empirical inconsistencies.

Summary. Asymmetrical switch costs represent a highly interesting finding and is often taken as empirical support for inhibitory bilingual control. However, as we have discussed, the

effect itself is less replicable than often thought. Also, the evidence for the underlying assumptions of the inhibition account of asymmetrical switch costs is less clear than desirable, and there are competing non-inhibitory alternative accounts that, on the surface at least, could also explain the effect without the notion of inhibition. Therefore, asymmetrical switch costs may represent a less decisive marker of inhibitory control than often thought. Yet, the inhibitory control account offers a coherent framework for the explanation of a variety of empirical effects beyond asymmetric switch costs. A particularly convincing inhibitory effect has been demonstrated in terms of a n-2 repetition costs when switching between three languages.

N-2 language repetition costs

N-2 language repetition costs can be examined in conditions that require switching between three languages within a mixed-language block. This allows the researcher to compare performance in two types of trials: trial A at the end of an ABA sequence and at the end of a CBA sequence, where A, B, and C represent different languages. Philipp et al. (2007) were the first to examine this effect. In their study, trilinguals named digits 1-9 in a mixed-language block with three languages. They found that performance in n-2 language repetition trials (ABA sequence) was worse than in n-2 language switch trials (CBA sequence). Since then, several studies have also reported n-2 language repetition costs (Babcock & Vallesi, 2015; Branzi et al., 2016; Declerck et al., 2021; Declerck, Thoma et al., 2015; Declerck & Philipp, 2018; Guo, Liu et al., 2013; Philipp et al., 2007; Philipp & Koch, 2009; Timmer et al., 2018).

Replicability of n-2 language repetition costs. Given that the number of studies that assessed n-2 language repetition costs is still limited, no meta-analysis has yet been performed. We can note that most production studies do observe such a cost. To our knowledge, so far only one language production study showed no significant n-2 language repetition costs with either

reaction times or error rates (Guo, Ma et al., 2013), but this ERP study did show n-2 language repetition costs in the N2. So, relative to the switch-cost asymmetry, n-2 language repetition costs seem to represent a quite consistent empirical effect. We now turn to the inhibitory account of n-2 language repetition costs and its underlying assumptions.

Inhibitory account of n-2 language repetition costs and its underlying assumptions.

According to the inhibitory account of n-2 language repetition costs, switching from language A to language B in an ABA sequence requires inhibition of language A. This inhibition of language A would persist into the following trial, making it difficult to switch back from language B to language A. The CBA sequence thus represents a control condition, in which participants will also have switched away from language A, and thus inhibited this language, but this happened with a longer lag in terms of time (and trials). Hence, due to dissipation of the inhibition of language A, less inhibition has to be overcome in a CBA sequence. In turn, performance on language A in a CBA sequence should be better than in a ABA sequence. Note that the potential influence of dissipating inhibition, which hinges on a longer elapsed time between the two last times language A has been used within a CBA than an ABA sequence, is difficult to tease apart from the number of interfering trials, which might itself have an effect on the relative activation pattern across languages.

Little research has sought to validate that n-2 language repetition costs rely on inhibitory control. For instance, only the ERP study of Guo, Ma et al. (2013) has set out to examine the corresponding N2 correlate. In this study, Uighur-Chinese-English trilinguals were asked to name digits (1-9) based on geometric shape cues (diamond, square, or triangle) that indicated which language should be used. As mentioned before, no behavioral n-2 language repetition costs were observed in this study. However, a larger N2 was observed for language A in ABA

sequences than in CBA sequences (i.e., a n-2 language repetition effect). This seems to suggest a connection between n-2 language repetition costs and inhibition.

Also little to no research has gone into the underlying assumptions of the inhibitory account of n-2 language repetition costs, which are persisting and dissipating inhibition (e.g., Declerck, Schuch et al., 2021; Koch et al., 2010). From the asymmetrical switch cost literature, we already know that there is no straightforward evidence for the notion of persisting inhibition. Unlike with asymmetric switch costs, we are not aware of studies that allow any insight into persisting inhibition with n-2 language repetition costs. Furthermore, we also know of no n-2 language repetition cost studies that investigated dissipating inhibition. So, currently it seems as if these two underlying assumptions (i.e., persisting and dissipating inhibition) remain untested with n-2 language repetition costs.

In addition, one could also argue that reactive inhibition should be proportional to the degree of non-target language activation (cf. Green, 1998), so that one should expect that this effect is strongest for the more dominant language(s) relative to the less dominant languages. Interestingly, most studies showed that n-2 language repetition costs are generally observed in both dominant and less dominant languages. Furthermore, the to-be-expected ordinal language dominance pattern is often not observed (see rightmost column of Table 2). In fact, as can be seen in Table 2, three experiments are consistent with this pattern, two experiments contradict this pattern, and five experiments do not show a clear difference in n-2 language repetition costs across languages. Hence, these data cannot be taken to represent unequivocal evidence in favor of the notion of proportional inhibition.

Table 2. Overview of n-2 language repetition cost studies that examined the effect of language on n-2 language repetition costs.

Study	N-2 language repetition costs			
	L1 vs. L2	L1 vs. L3	L2 vs. L3	L1 ≥ L2 ≥ L3
Babcock & Vallesi (2015)	L1 < L2	L1 < L3	L2 = L3	×
Declerck, Thoma, Koch, & Philipp (2015)	L1 = L2	L1 > L3	L2 > L3	✓
Declerck & Philipp (2018) – picture naming	L1 = L2	L1 = L3	L2 = L3	=
Declerck & Philipp (2018) – reading aloud	L1 = L2	L1 = L3	L2 = L3	=
Guo, Liu, Chen, & Li (2013) – Experiment 1	L1 = L2	L1 > L3	L2 = L3	✓
Guo, Liu, Chen, & Li (2013) – Experiment 2	L1 = L2	L1 = L3	L2 > L3	✓
Guo, Ma, & Liu (2013)	L1 = L2	L1 = L3	L2 = L3	=
Philipp, Gade, & Koch (2007)	L1 > L2	L1 > L3	L2 < L3	×
Philipp & Koch (2009) – Experiment 1	L1 = L2	L1 = L3	L2 = L3	=
Philipp & Koch (2009) – Experiment 2	L1 = L2	L1 = L3	L2 = L3	=

The larger, smaller, equal, larger than or equal to, smaller than or equal to signs in the first three columns relate to the relative size of n-2 language repetition costs (in reaction times) between the two indicated languages. The check (✓), cross (×), and equal (=) signs in the last column relate to whether more dominant language(s) showed a larger n-2 language repetition cost, an opposite pattern was found, or no n-2 language repetition cost difference was observed between the three languages, respectively. It should also be noted that not all n-2 language repetition cost studies were added to this table, as some of these studies did not investigate the effect of language on n-2 language repetition costs.

Alternative accounts of n-2 language repetition costs. The advantage of n-2 language repetition costs relative to asymmetrical switch costs is that an alternative account in terms of persisting activation would predict the opposite of n-2 language repetition costs. More specifically, it would predict n-2 language repetition benefits due to persisting residual activation of the language in trial n-2, despite the intervening language switch. But this has never been observed, so that n-2 language repetition costs can firmly exclude this alternative activation-based account. Hence, n-2 language repetition costs seem to represent a more straightforward marker of bilingual inhibition, and until now there is no alternative account of n-2 language repetition costs next to the inhibition account.

It should be noted that n-2 repetition costs have also been observed in many studies focusing on task switching with non-linguistic tasks (see Koch et al., 2010, for a review). In such studies, participants switch between simple classification tasks, such as color vs. size vs. shape of target stimuli, typically using only two different response keys (for general reviews, see Kiesel et al., 2010; Koch et al., 2018; Vandierendonck et al., 2010). Interestingly, recent non-linguistic studies regarding n-2 repetition costs from Grange and colleagues (e.g., Grange et al., 2017; Kowalczyk & Grange, 2020) suggested that there is also a contribution from feature repetitions across trials, which might lead to interference due to episodic retrieval (see Frings et al., 2020, for a recent review). The episodic retrieval account proposes that during any given trial, all perceptual (e.g., cue and stimulus) and action (i.e., response) representations are stored together in episodic memory. So, when producing a response based on a specific stimulus and a cue for task A, all these representations will be connected in episodic memory. Whenever one of these characteristics is activated in a subsequent trial (e.g., cue for task A in our example), all previously corresponding perceptual and action representations (e.g., the corresponding response and stimulus that were last used with the cue for task A) will also be reactivated to some degree (as “event files”; cf. Hommel et al., 2001). If one or more perceptual or action characteristics are different, then this will lead to worse performance due to a retrieval mismatch. However, a retrieval mismatch, leading to worse performance, might occur during both ABA and CBA sequences. So, similar to the inhibition account, dissipation of the episodic memory trace will lead to less interference during CBA sequences and thus lead to better performance than in ABA sequences. Because this retrieval-based interference is not necessarily based on inhibition, this might represent a non-inhibitory account for at least a part of the n-2 task repetition costs, even

though studies so far showed remaining n-2 task repetition costs even when feature repetitions had been taken into account.

However, it should be taken into account that feature repetitions in task switching usually refer to response repetitions across trials, which can produce a feature match or mismatch with the previous task. In comparison, in typical language switching studies, there is a much larger set of responses. For example, while most task-switching studies used only two responses, language switching studies often used naming task, so that, for instance, with the digits 1-9 there are 27 different responses (9 in each of the three languages). Thus, the role of response repetitions in n-2 language repetition costs should be small at best.

Furthermore, studies comparing language switching and task switching indicate that there is no straightforward mapping of the processes involved in these two paradigms (e.g., Declerck et al., 2017, 2021a; Calabria et al., 2012, 2015; Jylkkä, Lehtonen, Lindholm et al., 2018; Stasenko et al., 2017; Vaughn et al., 2021; see also Bialystok et al., 2004; Paap et al., 2017; Paap & Greenberg, 2013). For instance, Declerck and colleagues (2017) found no switch cost difference when directly comparing language- and task-switching, whereas Calabria et al. (2015) found no age effect on task-switch costs but a decrease of language-switch costs with increasing age. So, the former implies an overlap between language switching and task switching, whereas the latter does not (for a recent review on this topic, see Calabria et al., 2019).

Given these issues, and because no bilingual/multilingual study has done research into this, it is not clear yet to what degree episodic retrieval plays a role in n-2 language repetition costs. Though, there is some evidence that n-2 language repetition costs can occur beyond episodic retrieval effects. In a study by Philipp and Koch (2009), German-English-French trilinguals were asked to switch between these three languages in mixed-language blocks. In

Experiment 1, the target language on every trial was probed by one of two cues (i.e., different shapes, such as a diamond and a cross, on which a stimulus was presented). In addition, there was no repetition from the stimulus on trial n to the stimuli on trial $n-1$ and trial $n-2$. Their results showed that even when different cues were used for language A in an ABA sequence, performance was still worse than in a CBA sequence. So, even when the cue, stimulus, and thus also response, were different in the first and second presentation of language A in an ABA sequence, $n-2$ language repetition costs could still be observed. If $n-2$ language repetition costs would be solely due to episodic retrieval, then no such effect would be expected in this experiment. Nevertheless, it would be desirable to examine the potential role of feature repetitions and episodic retrieval processes in language switching in more detail.

Summary. $N-2$ language repetition costs seem to be a strong candidate for being a marker of inhibitory control during bilingual language production, as it is assessed in naming tasks. So far there is no established alternative theoretical account that does not rely on inhibitory control. Furthermore, the effect seems to be empirically replicable, but more research and support from meta-analyses is needed to substantiate this further. Yet, given its utility as an assessment of inhibitory control in bilingual processing, we would like to note that the cognitive processes underlying the dissipation of inhibition over time (or number of trials) as well as a better understanding of when inhibition is proportional to the degree of cross-language interference still await further research.

So far, we have mainly discussed effects that have been explained with reactive inhibition, which is a control process that responds to language competition in a given trial, as assessed by the rather short-term after-effects of this reactive inhibitory control process (i.e., in terms of trial lags of 1 or 2). In what follows, we will discuss two empirical effects that have

been related to proactive inhibition (i.e., reversed language dominance and the blocked language order effect)³, which is the inhibitory control processes implemented *in anticipation* of, rather than in response to, any cross-language interference and that generally have a longer time scale (i.e., whole blocks of trials instead of single trials).

Reversed language dominance

The third prominent effect related to bilingual inhibition that will be discussed here is the reversed language dominance effect, which entails worse L1 than L2 performance in mixed-language blocks. Christoffels and colleagues (2007) were one of the first to observe such a pattern with German-Dutch bilinguals. These bilinguals had to name pictures in single-language blocks and mixed-language blocks. Their results showed the typical pattern of better L1 than L2 performance in single-language blocks. In mixed-language blocks, however, they found the opposite pattern, with better overall L2 than L1 performance. The latter reversed language dominance effect has been observed in a number of language switching studies (e.g., Christoffels et al., 2016; Li & Gollan, 2018; Mofrad et al., 2020; Stasenko et al., 2021; Verhoef et al., 2010; Wong & Maurer, 2021; Zheng, Roelofs, & Lemhöfer, 2020).

Replicability of the reversed language dominance effect. Many studies have observed a reversed language dominance pattern (e.g., Christoffels et al., 2007; Costa & Santesteban, 2004; Heikooop et al., 2016; Tarlowski et al., 2012). Yet, a similar number of studies observed either a standard language dominance effect (i.e., better performance in L1 than in L2; e.g., Ma et al., 2016; Wang et al., 2009) or similar L1 and L2 performance (e.g., Calabria et al., 2015; Prior & Gollan, 2011) in mixed-language blocks. So, it is not surprising that a recent meta-analysis (Gade et al., 2021) did not find substantial evidence for a replicable reversed language

³ Please note that “reactive inhibitory control” and “proactive inhibitory control” here relates to how bilingual inhibitory control is implemented according to the inhibition account of said effect.

dominance effect across 73 studies. This constrains the utility of this effect as an indicator for theory testing.

Declerck (2020) proposed that the lacking empirical replicability of the reversed language dominance effect might be due to the reversed language dominance effect representing only an extreme case on a continuum, with the reversed language dominance effect at one end of the continuum and better L1 than L2 performance at the other end. In turn, it could be that the language dominance pattern in a mixed-language context is different than in single-language context due to proactive inhibition, but that still no reversed language dominance effect is observed. Taking this idea into account, a more sensitive marker was proposed that assessed the language dominance pattern in mixed-language blocks and compared it against the language dominance pattern observed in single-language blocks (see also Declerck, Kleinman et al., 2020).

While the reversed language dominance effect does not seem to be very replicable across studies, several studies identified key variables that seem relevant for observing the reversed language dominance effect. For example, Timmer et al. (2019) found that a mixed-language context with mostly L1 trials led to a reversed language dominance effect, whereas that was not the case when there were mostly L2 trials. Kleinman and Gollan (2018) found that the occurrence of the reversed language dominance pattern relies on the number of trials in the mixed-language block. Based on the data of a large group of English-Spanish bilinguals, they found that the language dominance reversed to a larger degree the further the participants progressed in the mixed-language block. This suggests that the reversed language dominance effect reflects an adaptive response to the language context. Based on the same data set, Declerck, Kleinman, et al. (2020) found that more balanced bilinguals are also more likely to

show a reversed language dominance effect. Though, less balanced bilinguals actually reverse language dominance more relative to that in single-language blocks. These two findings were explained by the idea that more balanced bilinguals already have similar L1 and L2 activation, and thus it is easier for the L2 to outperform L1. Hence, even though the replicability of the reversed language dominance effect is not clear, the role of (recent) exposure in defining the boundary conditions for this effect to occur represents a promising avenue for further research into this effect and its underlying mechanisms.

Inhibitory account of the reversed language dominance effect and its underlying assumption. One account of the reversed language dominance effect states that it may index sustained inhibition of L1 in mixed-language conditions. More specifically, by proactively inhibiting L1 throughout a mixed-language block, L1 and L2 activation will be more similar in a mixed-language context, which should improve overall performance.

Interestingly, most ERP studies did not find an overall language difference with the N2 component (e.g., Christoffels et al., 2007; Kang et al., 2020; Martin et al., 2013) and thus no reversed language dominance effect. However, Kang et al. (2018) did show that a larger N2 was elicited with Chinese-English bilinguals in L1 Chinese trials than in L2 English trials in a mixed-language block. So, some limited ERP evidence has been observed in favor of the reversed language dominance pattern with the N2 component, but the evidence is scarce.

The main underlying assumption of the inhibitory account of the reversed language dominance effect is that similar activation levels of L1 and L2 result in optimal overall performance in mixed-language blocks (e.g., Declerck, Kleinman et al., 2020; Gollan & Ferreira, 2009). This underlying assumption has only recently been examined (Declerck, Kleinman, et al., 2020), using the already mentioned database of 414 English-Spanish bilinguals. More

specifically, a bootstrap analysis was performed on this data set, which showed that the best overall performance in mixed-language blocks was obtained by bilinguals that were 18 ms faster in L1 than in L2, with confidence intervals between -3.7 ms and 41 ms. These results indicate that a reversed language dominance effect seems to be correlated with worse overall performance in mixed-language blocks, and that the most optimal overall performance might very well be reached when performance in both languages is similar, since the confidence interval included zero.

This underlying assumption also brings a discrepancy into focus, namely that the reversed language dominance does not actually reflect similar activation levels of L1 and L2, even though the inhibition account relies on this assumption. It has been speculated that this pattern can be explained with unintentional overshooting of L1 proactive inhibition due to an inability of the language process to gauge the precise amount of inhibition required in any situation (Declerck, Kleinman, et al., 2020; Gollan & Ferreira, 2009), but this speculation awaits further examination.

Alternative accounts of the reversed language dominance effect. As a recurrent theme in this review, we can also devise a similar, but distinct, explanation of the inhibition account in the shape of an activation account of the reversed language dominance effect: It might be that there is a sustained increase of L2 activation in mixed-language blocks that should result in more similar L1 and L2 activation levels (Declerck, Thoma, et al., 2015).⁴

A study by Christoffels and colleagues (2016) gives some preliminary hints along the lines of the activation account of the reversed language dominance effect. In this study, Dutch-English bilinguals had to name pictures in single-language blocks (pretest), followed by a mixed-

⁴ Similar to the inhibition account, where dissipation of inhibition is assumed to occur over time (e.g., Philipp et al., 2007) because otherwise inhibition of a specific language could be cumulative to the point where words from that language would probably never be selected, one could assume that activation dissipates with time.

language block, and then another set of single-language blocks (posttest). Unlike most studies, the reversed language dominance effect was examined in the single-language blocks. The pattern of the pretest showed a normal language dominance effect for single-language blocks (i.e., better L1 than L2 performance), whereas a reversed language dominance effect was found in the posttest (i.e., worse L1 than L2 performance) similar to the language pattern in the mixed-language block. The authors assumed that because a reversed language dominance effect occurred in the mixed-language block, this persisted into the following posttest single-language blocks. If the reversed language dominance effect is due to additional L2 activation, then one would assume to find improved L2 performance in the posttest relative to the pretest. The results of two experiments showed exactly this pattern, namely an improvement of L2 performance in the posttest relative to the pretest (between 106 and 67 ms), whereas L1 performance improved far less (Experiment 1) or even decreased (Experiment 2). Unfortunately, no detailed statistical information along these lines was given in the article, so that the degree to which additional L2 activation contributes to the reversed language dominance effect remains unclear.

Unlike the inhibition and activation account, Costa and Santesteban (2004) proposed that the reversed language dominance is due to the capability to establish different selection thresholds for every language separately. Hence, by having a relatively higher selection threshold for L1 than L2, a reversed language dominance pattern should be observed. Though, since Costa and Santesteban (2004) assumed that only highly proficient bilinguals are able to change the selection thresholds for each language, a reversed language dominance pattern should only be observed with highly proficient bilinguals, which does not seem to be the case (e.g., Costa & Santesteban, 2004, Experiment 1; Liu et al, 2016; Zhu & Sowman, 2020). Therefore, the

assumption that language proficiency is a major factor in the occurrence/absence of the reversed language dominance effect, as suggested by Costa and Santesteban (2004), seems unlikely.

Summary. The reversed language dominance effect represents a highly interesting empirical phenomenon. Yet, it does not seem to be empirically very replicable. The degree of L2 exposure relative to L1 seems to be a relevant variable for the emergence of reversed language dominance, but more research is needed to clarify the specific role of exposure. Moreover, a non-inhibitory account in terms of increased L2 activation cannot be ruled out easily. At this point it seems that more research is required before the reversed language dominance effect can be taken as clear evidence for inhibitory control during bilingual language processing.

Blocked language order effect

Another empirical effect potentially related to proactive inhibition is the blocked language order effect. This effect entails that single-language block performance is worse after performing in a single-language block in another language. For example, in the study of Branzi et al. (2014), Catalan-Spanish bilinguals named pictures in three consecutive single-language blocks. Half of the participants had to name pictures in Catalan in the first and third block, and in the second block in Spanish, and vice versa for the other half of the participants. Their results showed worse performance in the second block relative to the first block across participants, next to worse performance in the third block relative to the first block within participants.

Replicability of the blocked language order effect. As can be seen in Table 3 (see also Table A.2 in Wodniecka, Casado et al., 2020), a number of studies have reported the blocked language order effect (Branzi et al., 2014; Degani et al., 2020; Guo et al., 2011; Kreiner & Degani, 2015; Misra et al., 2012; Van Assche et al., 2013; Wodniecka, Szewczyk et al., 2020; for an overview, see Declerck, 2020; Wodniecka, Casado et al., 2020). Because the number of

blocked language order studies is still limited, it is not clear yet to what degree the blocked language order effect is replicable. Yet, even with this relatively small number of studies, some relevant variables with respect to the occurrence/absence of the blocked language order effect have been identified.

For example, the blocked language order effect is mainly observed in L1 (i.e., when a single L1 block is preceded by a single L2 block), whereas this is not always the case for L2 (Branzi et al., 2013; Van Assche et al., 2013; however, see Kreiner & Degani, 2015). Moreover, the blocked language order effect is typically not observed when the same stimuli are used across the single language blocks (Branzi et al., 2013; Misra et al., 2012). That is, the blocked language order effect has been demonstrated with non-repeating stimuli, but a reversed, facilitatory effect has been observed with repeating stimuli across blocks, which has been explained with positive stimulus repetition priming that counteract the influence of language inhibition (e.g., Misra et al., 2012).

Table 3. Overview of blocked language order studies with a focus on the blocked language order effect relative to language (L1 and L2) and whether the stimuli were new or repeated.

Study	Methodology	L1 new	L1 repeated	L2 new	L2 repeated
Branzi et al. (2014): Block 1 vs. 2	First and third single language block in the same language, and the second single language block in another language	✓	=	=	✗
Branzi et al. (2014): Block 1 vs. 3		✓	N/A	=	N/A
Guo et al. (2011)	Two consecutive single language blocks in different languages (followed by two mixed language blocks)	N/A	=	N/A	=
Misra et al. (2012): Block 1 vs. 3	Two consecutive single language blocks in one language followed by two consecutive single language blocks in the other language	N/A	=	N/A	✗
Misra et al. (2012): Block 1 vs. 4		N/A	✗	N/A	✗
Wodniecka, Szewczyk et al. (2020)	Two consecutive single L1 blocks followed by a break and then a single L2 block that preceded a single L1 block (The two L1 blocks after an L1 or L2 block were compared)	✓	✓	N/A	N/A

The check (✓), cross (✗), and equal (=) signs relate to whether a blocked language order effect was found, an opposite pattern was found, or no difference was observed between the two blocks (in reaction times), respectively. It should also be noted that not all blocked language order studies were added to this table, we only added those studies that analyzed the blocked language order effect in terms of reaction times.

Inhibitory account of the blocked language order effect and its underlying assumption.

The blocked language order effect can be explained with proactive inhibition by assuming that performing consistently in one language (e.g., L2) will instigate proactive inhibition of the other language (L1; Declerck, 2020). This proactive inhibition is assumed to persist into the next single-language block that requires the processing of that specific language (e.g., L1).

Consequently, performance in the first single-language block will be better than in a second block if that block was preceded by a block with a different language (e.g., Branzi et al., 2014).

It should be noted that a similar account could also be given based on reactive inhibitory control. It might be that inhibition of the non-target language accumulates throughout a single language block. In turn, when switching to another language in the next block, this accumulated inhibition will persist (cf. Green, 1998). While this should result in a blocked language order effect, it would mean that the persisting inhibition that follows reactive language control is substantial in both size and duration.

So far three studies have examined the blocked language order effect with ERPs (Branzi et al., 2014; Misra et al., 2012; Wodniecka, Szewczyk et al., 2020). Yet, the results are not consistent across studies. In Misra et al.'s (2012) study, a group of unbalanced Chinese-English bilinguals performed in two L1 blocks followed by two L2 blocks, and another group of unbalanced Chinese-English bilinguals performed in two L2 blocks followed by two L1 blocks. By comparing Block 1 vs. Block 3 across groups, they observed a larger N2 during the third L1 block than in the first L1 block, whereas a larger N2 occurred in the first L2 block than in the third L2 block, with a broad scalp distribution. While this effect interacted with laterality, no significant effect of the N2 component was observed when examining block order at each hemisphere separately, so that the data pattern remained somewhat obscure. ERP studies conducted after the study of Misra and colleagues either did not observe a larger N2 after a single language block in another language (Branzi et al., 2014) or interpreted the N2 blocked language order effect in terms of an N300 (Wodniecka, Szewczyk et al., 2020), which is a negative peak that usually occurs between 250 and 400 ms and is associated with difficulty to interpret pictures and relatedness to the previous stimulus (e.g., Holcomb & McPherson, 1994;

West & Holcomb, 2002), instead of the N2 (for issues of the N2 component with respect to the inhibitory account of the blocked language order effect, see Wodniecka, Szewczyk et al., 2020). Hence, the N2 blocked language order pattern across studies is all but straightforward.

While not explicitly stated in the literature, the underlying assumptions of the inhibition account is that proactive (or reactive) inhibitory control persist and does not adapt quickly to novel contexts, since inhibitory control involuntarily persists into a context where it is not optimal to implement said inhibitory control. No research into these underlying assumptions has been conducted with the blocked language order effect. Though, some supporting evidence that proactive inhibitory control might not adapt very quickly comes from the reversed language dominance literature. Christoffels et al. (2016) showed that the reversed language dominance effect (i.e., “L1 slowing”), which usually occurs in mixed-language blocks and not in single-language blocks, can also occur in single-language blocks if previously a mixed-language block was performed. These authors even found that the effect in single-language blocks was still there ten minutes later. Additionally, Liu, Timmer and colleagues (2019) presented language-congruent or language-incongruent “socio-cultural faces” and found that the reversed language dominance effect was not influenced by this manipulation, whereas asymmetrical switch costs (an effect often linked to reactive inhibitory control) were. Hence, proactive inhibitory control might not be very adaptive.

Yet, other studies that investigated proactive inhibitory control have reported findings suggesting that this process is to some extent adaptive. As we have mentioned in the section on the reversed language dominance effect, Kleinman and Gollan (2018) observed an increase of the reversed language dominance effect as participants progressed through a mixed-language

block. This seems to indicate that based on current language information, proactive inhibitory control can be flexibly adjusted to some degree.

Alternative accounts of the blocked language order effect. Wodniecka, Szewczyk et al. (2020) recently proposed that alternatives to the inhibitory account of the blocked language order effect cannot be excluded based on the current evidence. They suggested that an account based on activation, for example, could also explain the blocked language order pattern: the activation of the language in the previous block persists into the current block, which would result in the language from the previous block being highly activated when performing in the current block. In turn, words from the language in the previous block would be more considerable competitors (cf. Philipp et al., 2007), and thus make production in the language of the current block much harder than when no single language block in another language had preceded the current single language block. Given the recency of this account, future research will have to indicate whether persisting proactive language activation is the main process underlying the blocked language order effect.

Summary. The blocked language order effect is a highly interesting empirical effect for which an inhibitory control account would seem to provide a coherent explanatory framework. Yet, as we have seen, currently it may not be specific enough to allow predictions that help to discount non-inhibitory alternative accounts. Hence, further research will have to show how exactly the blocked language order effect can help specify theoretical accounts of inhibitory bilingual control.

Inhibitory Phenomena in Bilingual Language Comprehension

So far, we have solely discussed language production studies. Yet, comprehension-based language control has also been discussed in terms of inhibitory control. For instance, the

developmental version of the bilingual interactive activation model (Grainger et al., 2010; for the original bilingual interactive activation model, see Grainger & Dijkstra, 1992; see also Dijkstra et al., 2019; Dijkstra & van Heuven, 2002) proposed that when whole-word representations are activated, they in turn activate their corresponding language node (i.e., mental representation of a language). In turn, this language node inhibits all whole-word representations from the other language(s).

In this section, we briefly cover the four empirical effects that were discussed above in the context of bilingual language production, but now we focus on bilingual language comprehension. These empirical effects generally result from similar paradigms as their language production counterparts. A typical language switching paradigm used to investigate bilingual inhibitory control during comprehension also relies on mixed-language blocks. The main difference is that bilingual participants are usually presented with one single written word at a time, from one of two languages, that needs to be classified, for instance based on their semantic category (e.g., Macizo et al., 2012; Struys et al., 2019) or lexical status (e.g., Ong et al., 2019; von Studnitz & Green, 1997). However, other, more natural tasks have also been used, such as silent reading (e.g., Ahn et al., 2020; Dussias, 2003). Please note that no reference is made to the N2 ERP component in this section, as the N2 is typically not modulated during bilingual language comprehension by the effects discussed in this review (e.g., Jackson et al., 2004).

Asymmetrical switch costs in bilingual language comprehension

Regarding switch costs and their asymmetry across languages, bilingual language comprehension studies generally show symmetrical switch costs (Aparicio & Lavour, 2014; Declerck et al., 2019; Hirsch et al., 2015; Jylkkä, Lehtonen, Kuusakoski et al., 2018; Macizo et

al., 2012; Ong et al., 2019; Orfanidou & Sumner, 2005; Struys et al., 2019; Thomas & Allport, 2000; von Studnitz & Green, 2002). Yet, some comprehension studies observed larger switch costs for L1 than for L2 (Jackson et al., 2004; Mosca & de Bot, 2017; see also Declerck & Grainger, 2017; Olson, 2017; Philipp & Huestegge, 2015). Still others found the opposite pattern, with larger switch costs for L2 than for L1 (Byers-Heinlein et al., 2017; see also Liu, Timmer et al., 2020; Philipp & Huestegge, 2015; Struck & Jiang, 2021; von Studnitz & Green, 1997). So, apart from a handful of studies, the majority of bilingual language comprehension studies did not find larger switch costs for L1 than for L2.

In recent years, some studies have set out to examine why it is potentially even less likely to observe asymmetric switch costs during comprehension tasks relative to language production tasks. One explanation for the typical absence of asymmetrical switch costs during bilingual language comprehension is based on a methodological difference with production studies. In comprehension-based language switching studies, the stimuli (i.e., written or auditory words) are inherently linked to one of the languages, so that they represent “univalent” stimuli. In most production studies, on the other hand, the stimuli (i.e., pictures and digits) are equally related to both languages and thus are “bivalent” stimuli. Since the activation of the non-target language might be increased by bivalent stimuli, it might lead to larger reactive inhibitory control (cf. conflict monitoring) and thus to larger asymmetrical switch costs during bilingual language production than comprehension. However, univalent stimuli in a language production task can still lead to asymmetrical switch costs, such as during reading aloud of written words (e.g., Macizo et al., 2012; Reynolds et al., 2016). Thus, it is improbable that the use of univalent stimuli in comprehension-based language switching studies is the main reason why asymmetrical switch costs are usually absent during comprehension-based language switching.

Another relevant factor for the absence of asymmetrical switch costs during comprehension might be the absolute size of switch costs in comprehension-based language switching. If overall switch costs are small, then it is less likely to observe asymmetrical switch costs in the first place. No, or at least very small, comprehension-based language-switch costs is an often-observed pattern (for a discussion on this topic, see Declerck et al., 2019). Hence, it might be that the relative small size of comprehension-based switch costs might be one factor influencing the (lack of) asymmetrical switch costs in comprehension.

N-2 language repetition costs in bilingual language comprehension

Only one study has examined n-2 language repetition costs in comprehension so far (Declerck & Philipp, 2018). This study showed that n-2 language repetition costs can be observed during comprehension. Though, across two experiments this was only the case for the least dominant language among the three languages (thus even reversing the pattern expected if the dominant language requires the strongest inhibition). Based on these results, it was assumed that inhibition can be implemented during bilingual language comprehension but that it might not be necessary. Further evidence might change this picture though, given that there is only one comprehension-based n-2 language repetition costs study available so far.

Reversed language dominance effect in bilingual language comprehension

The reversed language dominance effect seems entirely absent in the bilingual language comprehension literature (e.g., Aparicio & Lavour, 2014; Hirsch et al., 2015; Ong et al., 2019; Struys et al., 2019). This was even the case when L2 was practiced prior to performing in mixed-language block (Declerck & Grainger, 2017), making it more likely that L2 should outperform L1 in the subsequent mixed-language block. The absence of a reversed language dominance

effect in the comprehension literature could be taken to suggest that no proactive L1 inhibition is implemented during bilingual language comprehension.

Blocked language order effect in bilingual language comprehension

Further evidence that no proactive inhibition is implemented during bilingual language comprehension comes from the blocked language order effect. The blocked language order effect seems to be restricted to bilingual language production (e.g., Branzi et al., 2014; Van Assche et al., 2013; Wodniecka, Szewczyk et al., 2020), since it has not been observed during bilingual language comprehension (Declerck et al., 2019). More specifically, Declerck and colleagues found no blocked language order effect by combining three data sets, which totaled 120 bilinguals. Additionally, an experiment with 58 French-English bilinguals, which used different tasks (i.e., animacy and size task) and different word sets in the first and second single language block, also showed no blocked language order effect during comprehension. However, the final word on this issue might not have been raised, as only one study has investigated the blocked language order effect in a pure comprehension setup.

Summary

Some limited evidence has been observed for the empirical effects of inhibitory control during bilingual language comprehension. While some effects are not studied extensively, the effects typically indexing inhibitory control do not seem to very replicable in bilingual language comprehension studies. This is especially the case for the effects indexing proactive inhibitory control. Hence, it would be worthwhile for future research to focus on the conditions under which inhibition is implemented in bilingual language comprehension. We would also recommend further exploring other, less utilized effects that have been related to inhibition during bilingual language comprehension than those discussed here (e.g., bilingual flanker effect,

cf. Declerck, Eben, et al., 2019; interlexical homographs, cf. Macizo et al., 2010; see also Branzi et al., 2020), as they could be more sensitive to bilingual inhibitory control during bilingual language comprehension. Moreover, relying on different effects from a variety of paradigms would prevent any models of language control to be narrow models of highly specific effects (e.g., asymmetrical switch costs) or specific paradigms (e.g., cued language switching). Though, all things considered, at this stage it appears as if the language comprehension literature does not allow us to derive strong theoretical conclusions regarding inhibitory bilingual control.

Requirements of a bilingual inhibitory control marker

This review shows that a theoretical framework in terms of inhibitory control has impressive integrative power and can account for a variety of empirical phenomena in a largely coherent way in the bilingual language production literature. However, we also suggested three areas where more empirical, and possibly additional theoretical, work is necessary. More specifically, we discussed three critical issues for any effect to be considered a marker of inhibitory control: the replicability of effects related to bilingual inhibitory control, the empirical evidence for the underlying assumptions of each inhibitory account of these effects, and the plausibility of alternative, non-inhibition based accounts of each effect.

First, since bilingual models of language processing assume that inhibitory control is implemented in most situations (e.g., Declerck, Koch et al., 2015; Grainger et al., 2010; Green, 1998), a marker of inhibitory control should be replicable across studies (e.g., Nosek et al., 2022). Unfortunately, the empirical phenomena discussed here do not always seem very replicable across the literature. Yet, it might very well be that language control relies on several processes (see below for further discussion) and that inhibitory control is only implemented in certain contexts or under certain conditions. For instance, it might be that inhibition of the non-

target language is mainly implemented during high levels of cross-language interference (e.g., Green & Abutalebi, 2013) or less so in more ecologically valid contexts (e.g., Blanco-Elorrieta & Pyllkänen, 2018). This view on bilingual inhibitory control thus assumes that inhibition is less pervasive and could thus possibly account for effects that are not always observed but still represent a viable marker of bilingual inhibitory control. The implementation of a less pervasive inhibitory control process in bilingual language processing models could be achieved by relying on inhibitory control at a later stage of language processing. Taking the ICM as an example, this model assumes that inhibitory control is first implemented between task schemas and later on at the lemma level. It could be that inhibitory control is only used at the lemma level, and that another language control process is at work between task schemas. Consequently, the fragile replicability of effects related with inhibitory control could then be accounted for by assuming that if most cross-language interference is resolved prior to the lemma level, very little inhibition would be necessary.

Regardless of whether inhibitory control is pervasive, we suggest basing theoretical accounts more strongly on studies with a larger sample size. This should be easier in the future, as there is currently a push for larger sample sizes (cf. Brysbaert, 2021; however, for a discussion on the risks and limitations of increasing sample size in bilingual research, see Navarro-Torres et al., 2021). A complementary approach to gain a more comprehensive picture of the size and replicability of the empirical effects related to bilingual inhibitory control, and their modulating factors, would be to rely on meta-analytic knowledge in order to filter out the empirical variability of individual studies. We note that there seem to be few meta-analyses of the four major empirical effects that were the focus of the present review (cf. Gade et al., 2021). This apparent scarcity of meta-analyses in the bilingual language control literature contrasts with the

growing number of meta-analyses in other areas of bilingualism research (e.g., the bilingual advantage; Donnelly et al., 2019; Gunnerud et al., 2020; Lehtonen et al., 2018; Lowe et al., 2021; Ware et al., 2020), and also the increase in large-scale studies (e.g., Dick et al., 2019; Nichols et al., 2020). As our systematic review of the four major inhibitory phenomena has shown, however, we lack empirical clarity to some degree in this research area, so that additional meta-analyses and more large-scale studies would be very beneficial for future progress in the field of bilingual language control. Additional meta-analyses, even for those effects examined in Gade et al. (2021) (cf. asymmetrical switch costs and reversed language dominance), are especially imperative, since different outcomes might occur depending on, for instance, inclusion/exclusion criteria and the statistical technique used in the meta-analysis (e.g., Lakens et al., 2016).

Second, we suggested that any credible marker of inhibitory control should also have support for the underlying assumptions of its inhibitory account. As we have shown throughout this review, effects related to bilingual inhibitory control tend to rely on one or several assumptions. For instance, the inhibitory account of n-2 language repetition costs assumes that inhibitory control dissipates over time. Unfortunately, this assumption and most of the other underlying assumptions (asymmetrical switch costs: persisting and proportional inhibitory control; n-2 language repetition costs: persisting and dissipating inhibitory control; reversed language dominance: similar language activation levels result in optimal performance in mixed-language blocks; blocked language order effect: proactive inhibitory control persists and does not quickly adapt to novel linguistic contexts) have not been thoroughly examined. Hence, it is difficult to gauge whether the effects discussed in this review can actually be used to justify strong theoretical conclusions about the implementation of inhibitory control during bilingual language production and comprehension.

The upside of more research into this line of research would be two-fold. On the one hand, evidence in line with the underlying assumptions would provide a stronger case for the corresponding effect to actually be taken as an empirical index of inhibition, and thus in turn, that bilingual language processing relies on inhibition. On the other hand, further research into the underlying assumptions would also provide us with a better understanding of the nature of bilingual inhibitory control. For instance, while it might be assumed that reactive inhibition is proportional to the amount of non-target language activation or that proactive language control is not very adaptive, empirically substantiated evidence along these lines would provide us with more insight into language control.

A third and final critical issue is whether an alternative account of an effect provides a better explanation. Even though inhibitory control appears to represent the dominant view in the bilingual language control literature, many effects can be explained without inhibition. Most notably is the activation account, which proposes that additional activation to the target language can result in fluent bilingual language processing. Other control processes have also been discussed in the literature, such as speech monitoring (Broos et al., 2016). It is important to point out that empirical effects tend to be the result of an accumulation of processes, as probably no effects are process-pure. Thus, several processes could be represented in an effect. Consequently, several explanations could, to some degree, explain results with a specific effect. But for an effect to be a convincing measure of bilingual inhibitory control, the inhibitory account of an effect should provide a better overall explanation across different contexts.

On a more theoretical note, even if there is ample evidence for inhibition, it is possible that language control does not just rely on inhibition. It is instructive to see that in the non-linguistic cognitive control literature on task switching, several processes are assumed to

underlie cognitive control, with inhibition being just one of them among persisting activation and proactive activation (sometimes called “reconfiguration”; see Koch et al., 2018, for a recent review). For instance, one prominent account of switch costs when switching between non-linguistic tasks (e.g., shape vs. color of a simple geometric object, or parity judgment vs. consonant/vowel judgment for digit-letter pairs) assumes that switch costs rely on both persisting inhibition and activation (Allport et al., 1994), along the lines of a combination of the ideas proposed in Meuter and Allport (1999) and Philipp et al. (2007). Hence, the interplay of inhibition and activation figures much more prominently in the non-linguistic control literature than in the language control literature. While we recognize that some prior studies have shown that there is no one-to-one mapping between bilingual language control and non-linguistic control (e.g., Calabria et al., 2012, 2015; Jylkkä, Lehtonen, Lindholm et al., 2018; Stasenko et al., 2017; Vaughn et al., 2021), we believe that the analogy of these two domains could be developed further at the theoretical level (for a recent discussion, see Graham & Lavric, 2021). For bilingualism research, this would imply that inhibitory control is only one of several control processes. Due to the inherent difficulties of disentangling the processes of inhibition and other control processes, computational modeling might provide an attractive solution to examine the relative contribution of these distinct processes during bilingual language processing (see, Lowry et al., 2021).

Summary and conclusion

This article provided a thorough and systematic review of research on four prominent empirical phenomena that have been used as indexes of inhibitory control during bilingual language processing. The review focused on asymmetrical switch costs, n-2 language repetition costs, the reversed language dominance effect, and the blocked language order effect. The first

two effects can be considered to be related to reactive inhibitory control, whereas the latter two are more related to proactive inhibitory control.

When covering these four effects, we assessed whether the empirical evidence is in line with the notion of inhibitory control. We suggested that the evidence for inhibitory control during bilingual language processing is troubled by some open gaps in our knowledge that need to be filled before accepting inhibition as the primary process underlying language control. More specifically, most of the effects discussed in this review article are open to potential alternative explanations that do not rely on inhibition. Yet, only little research has gone into such alternatives, whereas it would be pertinent to explore these accounts if the field wants to keep utilizing these effects as markers of inhibition. Another issue with these effects is that their inhibition accounts all rely on underexplored underlying mechanisms. Similar to the alternative explanations, research into these underlying assumptions is required to increase the potential merit in these effects as markers of inhibitory control. Finally, we discussed the replicability of each of the effects. Narrative reviews (e.g., Bobb & Wodniecka, 2013; Declerck & Philipp, 2015a) have suggested that some of the effects might not be replicable across studies. A recent meta-analysis of Gade et al. (2021) has assessed the evidence more formally, suggesting that the asymmetry of switch costs and the reversed language dominance effect may not be replicable effects. Moreover, as our review has shown, the conditions required for the absence or occurrence of the effects discussed here are still mostly unclear. Hence, the current state of the literature regarding the replicability of the effects linked to inhibitory language control still calls for clarification.

Together, the current review article focused on inhibition in bilingual language control and suggests that more research is needed before we can assume that language control is mostly

based on inhibitory control. Though, it seems more likely that language control partly relies on inhibition, as assumed in the non-linguistic control literature, with specific conditions (e.g., very high cross-language interference) leading to the implementation of these processes to ensure fluent language processing by bilinguals. Such a theoretical focus on the dynamic interplay of complementary language control processes in parallel to inhibitory control would broaden the theoretical landscape. Hence, we would like to end this review with a plea for more theoretical confluence across research domains and experimental paradigms.

References

- Abutalebi, J., & Green, D. (2007). Bilingual language production: The neurocognition of language representation and control. *Journal of Neurolinguistics*, *20*, 242-275.
- Ahn, D., Abbott, M. J., Rayner, K., Ferreira, V. S., & Gollan, T. H. (2020). Minimal overlap in language control across production and comprehension: Evidence from read-aloud versus eye-tracking tasks. *Journal of Neurolinguistics*, *54*, 100885.
- Allport, A., Styles, E. A., & Hsieh, S. (1994). Shifting intentional set: Exploring the dynamic control of tasks. In C. Umiltà & M. Moscovitch (Eds.), *Conscious and nonconscious information processing: Attention and performance XV* (pp. 421–452). Cambridge, MA: MIT Press.
- Aparicio, X., & Lavour, J. M. (2014). Recognising words in three languages: effects of language dominance and language switching. *International Journal of Multilingualism*, *11*, 164-181.
- Babcock, L., & Vallesi, A. (2015). Language control is not a one-size-fits-all languages process: evidence from simultaneous interpretation students and the n-2 repetition cost. *Frontiers in Psychology*, *6*, 1622.
- Bialystok, E., Craik, F. I., Klein, R., & Viswanathan, M. (2004). Bilingualism, aging, and cognitive control: evidence from the Simon task. *Psychology and Aging*, *19*, 290-303.
- Blanco-Elorrieta, E., & Caramazza, A. (2021). A common selection mechanism at each linguistic level in bilingual and monolingual language production. *Cognition*, 104625.
- Blanco-Elorrieta, E., Emmorey, K., & Pylkkänen, L. (2018). Language switching decomposed through MEG and evidence from bimodal bilinguals. *Proceedings of the National Academy of Sciences*, *115*, 9708-9713.

- Blanco-Elorrieta, E., & Pylkkänen, L. (2017). Bilingual language switching in the laboratory versus in the wild: The spatiotemporal dynamics of adaptive language control. *Journal of Neuroscience*, *37*, 9022-9036.
- Blanco-Elorrieta, E., & Pylkkänen, L. (2018). Ecological validity in bilingualism research and the bilingual advantage. *Trends in Cognitive Sciences*, *22*, 1117-1126.
- Bobb, S. C., & Wodniecka, Z. (2013). Language switching in picture naming: What asymmetric switch costs (do not) tell us about inhibition in bilingual speech planning. *Journal of Cognitive Psychology*, *25*, 568–585.
- Bonfieni, M., Branigan, H. P., Pickering, M. J., & Sorace, A. (2019). Language experience modulates bilingual language control: The effect of proficiency, age of acquisition, and exposure on language switching. *Acta Psychologica*, *193*, 160-170.
- Botvinick, M. M., Braver, T. S., Barch, D. M., Carter, C. S., & Cohen, J. D. (2001). Conflict monitoring and cognitive control. *Psychological Review*, *108*, 624-652.
- Branzi, F. M., Calabria, M., Boscarino, M. L., & Costa, A. (2016). On the overlap between bilingual language control and domain-general executive control. *Acta Psychologica*, *166*, 21-30.
- Branzi, F. M., Martin, C. D., Abutalebi, J., & Costa, A. (2014). The after-effects of bilingual language production. *Neuropsychologia*, *52*, 102-116.
- Branzi, F. M., Martin, C. D., Carreiras, M., & Paz-Alonso, P. M. (2020). Functional connectivity reveals dissociable ventrolateral prefrontal mechanisms for the control of multilingual word retrieval. *Human Brain Mapping*, *41*, 80-94.
- Broos, W. P., Duyck, W., & Hartsuiker, R. J. (2016). Verbal self-monitoring in the second language. *Language Learning*, *66*, 132-154.

Brysbaert, M. (2021). Power considerations in bilingualism research: Time to step up our game.

Bilingualism: Language and Cognition. Online first publication.

Bultena, S., Dijkstra, T., & van Hell, J. G. (2015). Switch cost modulations in bilingual

sentence processing: evidence from shadowing. *Language, Cognition and Neuroscience*, *30*, 586-605.

Byers-Heinlein, K., Morin-Lessard, E., & Lew-Williams, C. (2017). Bilingual infants control

their languages as they listen. *Proceedings of the National Academy of Sciences*, *114*, 9032-9037.

Calabria, M., Branzi, F. M., Marne, P., Hernández, M., & Costa, A. (2015). Age-related effects

over bilingual language control and executive control. *Bilingualism: Language and Cognition*, *18*, 65-78.

Calabria, M., Costa, A., Green, D. W., & Abutalebi, J. (2018). Neural basis of bilingual language

control. *Annals of the New York Academy of Sciences*, *1426*, 221-235.

Calabria, M., Baus, C., & Costa, A. (2019). Cross-talk between language and executive control.

In J.W. Schwieter (Ed.) *The handbook of the neuroscience of multilingualism* (pp. 447-466). Hoboken: Wiley-Blackwell.

Calabria, M., Hernández, M., Branzi, F. M., & Costa, A. (2012). Qualitative differences between

bilingual language control and executive control: Evidence from task-switching.

Frontiers in Psychology, *2*, 399.

Cespón, J., Hommel, B., Korsch, M., & Galashan, D. (2020). The neurocognitive underpinnings

of the Simon effect: An integrative review of current research. *Cognitive, Affective, & Behavioral Neuroscience*, *20*, 1133-1172.

Christoffels, I. K., Firk, C., & Schiller, N. O. (2007). Bilingual language control: An event-

- related brain potential study. *Brain Research*, 1147, 192–208.
- Christoffels, I., Ganushchak, L., & La Heij, W. (2016). When L1 suffers: Sustained, global slowing and the reversed language effect in mixed language context. In J. W. Schwieter (Ed.), *Cognitive Control and Consequences of Multilingualism* (pp. 171-192). Amsterdam: John Benjamins Publishing Company.
- Costa, A., Caramazza, A., & Sebastián-Gallés, N. (2000). The cognate facilitation effect: Implications for models of lexical access. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 26, 1283–1296.
- Costa, A., Miozzo, M., & Caramazza, A. (1999). Lexical selection in bilinguals: Do words in the bilingual's two lexicons compete for selection? *Journal of Memory and Language*, 41, 365–397.
- Costa, A., & Santesteban, M. (2004). Lexical access in bilingual speech production: Evidence from language switching in highly proficient bilinguals and L2 learners. *Journal of Memory and Language*, 50, 491–511.
- Costa, A., Santesteban, M., & Ivanova, I. (2006). How do highly proficient bilinguals control their lexicalization process? Inhibitory and language-specific selection mechanisms are both functional. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 32, 1057–1074.
- Crinion, J., Turner, R., Grogan, A., Hanakawa, T., Noppeney, U., Devlin, J. T., Aso, T., Urayama, S., Fukuyama, H., Stockton, K., Usui, K., Green, D. W., & Price, C. J. (2006). Language control in the bilingual brain. *Science*, 312, 1537-1540.
- de Bruin, A. (2019). Not all bilinguals are the same: A call for more detailed assessments and

- descriptions of bilingual experiences. *Behavioral Sciences*, 9, 33.
- de Bruin, A., Roelofs, A., Dijkstra, T., & FitzPatrick, I. (2014). Domain-general inhibition areas of the brain are involved in language switching: fMRI evidence from trilingual speakers. *NeuroImage*, 90, 348-359.
- de Bruin, A., Samuel, A. G., & Duñabeitia, J. A. (2018). Voluntary language switching: When and why do bilinguals switch between their languages? *Journal of Memory and Language*, 103, 28-43.
- de Bruin, A., Samuel, A. G., & Duñabeitia, J. A. (2020). Examining bilingual language switching across the lifespan in cued and voluntary switching contexts. *Journal of Experimental Psychology: Human Perception and Performance*, 46, 759–788.
- Declerck, M. (2020). What about proactive language control? *Psychonomic Bulletin & Review*, 27, 24-35.
- Declerck, M., Eben, C., & Grainger, J. (2019). A different perspective on domain-general language control using the flanker task. *Acta Psychologica*, 198, 102884.
- Declerck, M., & Grainger, J. (2017). Inducing asymmetrical switch costs in bilingual language comprehension by language practice. *Acta Psychologica*, 178, 100-106.
- Declerck, M., Grainger, J., Koch, I., & Philipp, A. M. (2017). Is language control just a form of executive control? Evidence for overlapping processes in language switching and task switching. *Journal of Memory and Language*, 95, 138-145.
- Declerck, M., Ivanova, I., Grainger, J., & Duñabeitia, J. A. (2020). Are similar control processes implemented during single and dual language production? Evidence from switching between speech registers and languages. *Bilingualism: Language and Cognition*, 23, 694-701.

- Declerck, M., Kleinman, D., & Gollan, T. H. (2020). Which bilinguals reverse language dominance and why? *Cognition*, *204*, 104384.
- Declerck, M., Koch, I., Duñabeitia, J. A., Grainger, J., & Stephan, D. N. (2019). What absent switch costs and mixing costs during bilingual language comprehension can tell us about language control. *Journal of Experimental Psychology: Human Perception and Performance*, *45*, 771-789.
- Declerck, M., Koch, I., & Philipp, A. M. (2012). Digits vs. pictures: The influence of stimulus type on language switching. *Bilingualism: Language and Cognition*, *15*, 896-904.
- Declerck, M., Koch, I., & Philipp, A. M. (2015). The minimum requirements of language control: Evidence from sequential predictability effects in language switching. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *41*, 377–394.
- Declerck, M., Meade, G., Midgley, K. J., Holcomb, P. J., Roelofs, A., & Emmorey, K. (2021a). On the connection between language control and executive control—An ERP study. *Neurobiology of Language*. Online first publication.
- Declerck, M., Meade, G., Midgley, K. J., Holcomb, P. J., Roelofs, A., & Emmorey, K. (2021b). Language control in bimodal bilinguals: Evidence from ERPs. *Neuropsychologia*, *161*, 108019.
- Declerck, M., & Philipp, A. M. (2015a). A review of control processes and their locus in Language switching. *Psychonomic Bulletin & Review*, *22*, 1630-1645.
- Declerck, M., & Philipp, A. M. (2015b). The unusual suspect: Influence of phonological overlap on language control. *Bilingualism: Language and Cognition*, *18*, 726-736.
- Declerck, M., & Philipp, A. M. (2018). Is inhibition implemented during bilingual production

- and comprehension? n-2 language repetition costs unchained. *Language, Cognition and Neuroscience*, 33, 608-617.
- Declerck, M., Schuch, S., & Philipp, A. M. (2021). Conflict adaptation during multilingual language production as evidenced by the n-3 effect. *Bilingualism: Language and Cognition*, 24, 211-214.
- Declerck, M., Stephan, D. N., Koch, I., & Philipp, A. M. (2015). The other modality: Auditory stimuli in language switching. *Journal of Cognitive Psychology*, 27, 685-691.
- Declerck, M., Thoma, A., Koch, I., & Philipp, A. M. (2015). Highly proficient bilinguals implement inhibition - Evidence from N-2 repetition costs when switching between three languages. *Journal of Experimental Psychology: Learning, Memory & Cognition*, 41, 1911-1916.
- Degani, T., Kreiner, H., Ataria, H., & Khateeb, F. (2020). The impact of brief exposure to the second language on native language production: Global or item specific? *Applied Psycholinguistics*, 41, 153-183.
- Dias, P., Villameriel, S., Giezen, M. R., Costello, B., & Carreiras, M. (2017). Language switching across modalities: Evidence from bimodal bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 43, 1828-1834.
- Dick, A. S., Garcia, N. L., Pruden, S. M., Thompson, W. K., Hawes, S. W., Sutherland, M. T., Riedel, M. C., Laird, A. R., & Gonzalez, R. (2019). No evidence for a bilingual executive function advantage in the ABCD study. *Nature Human Behaviour*, 3, 692-701.
- Dijkstra, T., Wahl, A., Buytenhuijs, F., Van Halem, N., Al-Jibouri, Z., De Korte, M., & Rekké, S. (2019). Multilink: a computational model for bilingual word recognition and word translation. *Bilingualism: Language and Cognition*, 22, 657-679.

- Dijkstra, T., & Van Heuven, W. J. (2002). The architecture of the bilingual word recognition system: From identification to decision. *Bilingualism: Language and Cognition*, 5, 175-197.
- Dolk, T., Hommel, B., Colzato, L. S., Schütz-Bosbach, S., Prinz, W., & Liepelt, R. (2014). The joint Simon effect: a review and theoretical integration. *Frontiers in Psychology*, 5, 974.
- Donkers, F. C., & van Boxtel, G. J. (2004). The N2 in go/no-go tasks reflects conflict monitoring not response inhibition. *Brain and Cognition*, 56, 165-176.
- Donnelly, S., Brooks, P. J., & Homer, B. D. (2019). Is there a bilingual advantage on interference-control tasks? A multiverse meta-analysis of global reaction time and interference cost. *Psychonomic Bulletin & Review*, 26, 1122-1147.
- Dussias, P. E. (2003). Syntactic ambiguity resolution in second language learners: Some effects of bilinguality on L1 and L2 processing strategies. *Studies in Second Language Acquisition*, 25, 529-557.
- Emmorey, K., Li, C., Petrich, J., & Gollan, T. H. (2020). Turning languages on and off: Switching into and out of code-blends reveals the nature of bilingual language control. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 46, 443-454.
- Falkenstein, M., Hoormann, J., & Hohnsbein, J. (1999). ERP components in Go/Nogo tasks and their relation to inhibition. *Acta Psychologica*, 101, 267-291.
- Festman, J. & Mosca, M. (2016). Influence of preparation time on language control. In R. J. Harris (Ed.) In J. W. Schwieter (Ed.), *Cognitive Control and Consequences of Multilingualism* (pp. 145-171). Amsterdam: John Benjamins Publishing Company.
- Filippi, R., Karaminis, T., & Thomas, M. S. C. (2014). Bilingual language switching in

- production: Empirical and computational studies. *Bilingualism: Language and Cognition*, 17, 294-315.
- Fink, A., & Goldrick, M. (2015). Pervasive benefits of preparation in language switching. *Psychonomic Bulletin & Review*, 22, 808-814.
- Finkbeiner, M., Almeida, J., Janssen, N., & Caramazza, A. (2006). Lexical selection in bilingual speech production does not involve language suppression. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 32, 1075–1089.
- Frings, C., Hommel, B., Koch, I., Rothermund, K., Dignath, D., Giesen, C., Kiesel, A., Kunde, W., Mayr, S., Moeller, B., Möller, M., Pfister, R., & Philipp, A. M. (2020). Binding and Retrieval in Action Control (BRAC). *Trends in Cognitive Sciences*, 24, 375-387.
- Gade, M., Declerck, M., Philipp, A. M., Rey-Mermet, A., & Koch, I. (2021). On the existence of asymmetrical switch costs and reversed language dominance. *Journal of Cognition*, 4, 55.
- Gambi, C., & Hartsuiker, R. J. (2016). If you stay, it might be easier: Switch costs from comprehension to production in a joint switching task. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 42, 608-626.
- Giezen, M. R., & Emmorey, K. (2016). Language co-activation and lexical selection in bimodal bilinguals: Evidence from picture–word interference. *Bilingualism: Language and Cognition*, 19, 264-276.
- Gollan, T. H., & Ferreira, V. S. (2009). Should I stay or should I switch? A cost-benefit analysis of voluntary language switching in young and aging bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 35, 640–665.

- Gollan, T. H., Kleinman, D., & Wierenga, C. E. (2014). What's easier: Doing what you want, or being told what to do? Cued versus voluntary language and task switching. *Journal of Experimental Psychology: General*, *143*, 2167-2195.
- Gollan, T. H., Weissberger, G. H., Runnqvist, E., Montoya, R. I., & Cera, C. M. (2012). Self-ratings of spoken language dominance: A multi-lingual naming test (MINT) and preliminary norms for young and aging Spanish-English bilinguals. *Bilingualism: Language and Cognition*, *15*, 594-615.
- Graham, B., & Lavric, A. (2021). Preparing to switch languages versus preparing to switch tasks: Which is more effective? *Journal of Experimental Psychology: General*. Online first publication.
- Grainger, J. & Dijkstra, T. (1992). On the representation and use of language information in bilinguals. In R.J. Harris (Ed.) *Cognitive processing in bilinguals* (pp. 207-220). Amsterdam: North Holland.
- Grainger, J. Midgley, K. J., & Holcomb, P. J. (2010). Re-thinking the bilingual interactive-activation model from a developmental perspective (BIA-d). In M. Kail and M. Hickman (Eds), *Language acquisition across linguistic and cognitive systems* (pp. 267-284). Philadelphia: John Benjamins.
- Grange, J. A., Kowalczyk, A. W., & O'Loughlin, R. (2017). The effect of episodic retrieval on inhibition in task switching. *Journal of Experimental Psychology: Human Perception and Performance*, *43*, 1568-1583.
- Green, D. W. (1986). Control, activation, and resource: A framework and a model for the control of speech in bilinguals. *Brain and Language*, *27*, 210-223.
- Green, D. W. (1998). Mental control of the bilingual lexico-semantic system. *Bilingualism:*

- Language and Cognition*, 1, 213–229.
- Green, D. W., & Abutalebi, J. (2013). Language control in bilinguals: The adaptive control hypothesis. *Journal of Cognitive Psychology*, 25, 515-530.
- Grosjean, F. (2010). *Bilingual: Life and reality*. Harvard University Press.
- Gross, M., & Kaushanskaya, M. (2015). Voluntary language switching in English–Spanish bilingual children. *Journal of Cognitive Psychology*, 27, 992-1013.
- Grunden, N., Piazza, G., García-Sánchez, C., & Calabria, M. (2020). Voluntary language switching in the context of bilingual aphasia. *Behavioral Sciences*, 10, 141.
- Gunnerud, H. L., ten Braak, D., Reikerås, E. K. L., Donolato, E., & Melby-Lervåg, M. (2020). Is bilingualism related to a cognitive advantage in children? A systematic review and meta-analysis. *Psychological Bulletin*, 146, 1059-1083.
- Guo, T., Liu, H., Misra, M., & Kroll, J. F. (2011). Local and global inhibition in bilingual word production: fMRI evidence from Chinese–English bilinguals. *NeuroImage*, 56, 2300-2309.
- Guo, T., Liu, F., Chen, B., & Li, S. (2013). Inhibition of non-target languages in multilingual word production: Evidence from Uighur-Chinese-English trilinguals. *Acta Psychologica*, 143, 277–283.
- Guo, T., Ma, F., & Liu, F. (2013). An ERP study of inhibition of non-target languages in trilingual word production. *Brain and Language*, 127, 12–20.
- Hahn, M., Degen, J., & Futrell, R. (2021). Modeling word and morpheme order in natural language as an efficient trade-off of memory and surprisal. *Psychological Review*. Online first publication.
- Heikoop, K. W., Declerck, M., Los, S. A., & Koch, I. (2016). Dissociating language-switch costs

- from cue-switch costs in bilingual language switching. *Bilingualism: Language and Cognition*, 19, 921-927.
- Hirsch, P., Declerck, M., & Koch, I. (2015). Exploring the functional locus of language switching: Evidence from a PRP paradigm. *Acta Psychologica*, 161, 1-6.
- Holcomb, P. J., & Mcpherson, W. B. (1994). Event-related brain potentials reflect semantic priming in an object decision task. *Brain and Cognition*, 24, 259-276.
- Hommel, B. (2011). The Simon effect as tool and heuristic. *Acta Psychologica*, 136, 189-202.
- Hommel, B., Müsseler, J., Aschersleben, G., & Prinz, W. (2001). The theory of event coding (TEC): A framework for perception and action planning. *Behavioral and Brain Sciences*, 24, 849-878.
- Ivanova, I., & Hernandez, D. C. (2021). Within-language lexical interference can be resolved in a similar way to between-language interference. *Cognition*, 214, 104760.
- Jackson, G. M., Swainson, R., Cunnington, R., & Jackson, S. R. (2001). ERP Correlates of executive control during repeated language-switching. *Bilingualism: Language and Cognition*, 4, 169–178.
- Jackson, G. M., Swainson, R., Mullin, A., Cunnington, R., & Jackson, S. R. (2004). ERP correlates of a receptive language-switching task. *The Quarterly Journal of Experimental Psychology*, 57, 223–240.
- Jevtović, M., Duñabeitia, J. A., & de Bruin, A. (2020). How do bilinguals switch between languages in different interactional contexts? A comparison between voluntary and mandatory language switching. *Bilingualism: Language and Cognition*, 23, 401-413.
- Jylkkä, J., Laine, M., & Lehtonen, M. (2021). Does language switching behavior rely on general executive functions?. *Bilingualism: Language and Cognition*. Online first publication.

Jylkkä, J., Lehtonen, M., Kuusakoski, A., Lindholm, F., Hut, S. C., & Laine, M. (2018). The role of general executive functions in receptive language switching and monitoring.

Bilingualism: Language and Cognition, 21, 839-855.

Jylkkä, J., Lehtonen, M., Lindholm, F., Kuusakoski, A., & Laine, M. (2018). The relationship between general executive functions and bilingual switching and monitoring in language production. *Bilingualism: Language and Cognition*, 21, 505-522.

Kang, C., Ma, F., & Guo, T. (2018). The plasticity of lexical selection mechanism in word production: ERP evidence from short-term language switching training in unbalanced Chinese-English bilinguals. *Bilingualism: Language and Cognition*, 21, 296-313.

Kang, C., Ma, F., Li, S., Kroll, J. F., & Guo, T. (2020). Domain-general inhibition ability predicts the intensity of inhibition on non-target language in bilingual word production: An ERP study. *Bilingualism: Language and Cognition*, 23, 1056-1069.

Kaufmann, E., Mittelberg, I., Koch, I., & Philipp, A. M. (2018). Modality effects in language switching: Evidence for a bimodal advantage. *Bilingualism: Language and Cognition*, 21, 243-250.

Kaufmann, E., & Philipp, A. M. (2017). Language-switch costs and dual-response costs in bimodal bilingual language production. *Bilingualism: Language and Cognition*, 20, 418-434.

Khateb, A., Shamshoum, R., & Prior, A. (2017). Modulation of language switching by cue timing: Implications for models of bilingual language control. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 43, 1239-1253.

- Kiesel, A., Wendt, M., Jost, K., Steinhauser, M., Falkenstein, M., Philipp, A. M., & Koch, I. (2010). Control and interference in task switching: A review. *Psychological Bulletin*, *136*, 849–874.
- Kirk, N., Declerck, M., Kemp, R., & Kempe, V. (2021). Language control in regional dialect speakers – “monolinguals” by name, bilinguals by nature? *Bilingualism: Language and Cognition*. Online first publication.
- Kleinman, D., & Gollan, T. H. (2016). Speaking two languages for the price of one: Bypassing language control mechanisms via accessibility-driven switches. *Psychological Science*, *27*, 700-714.
- Kleinman, D., & Gollan, T. H. (2018). Inhibition accumulates over time at multiple processing levels in bilingual language control. *Cognition*, *173*, 115-132.
- Koch, I., Gade M., Schuch S., & Philipp A. M. (2010). The role of inhibition in task switching: A review. *Psychonomic Bulletin & Review*, *17*, 1–14.
- Koch, I., Poljac, E., Müller, H., & Kiesel, A. (2018). Cognitive structure, flexibility, and plasticity in human multitasking—An integrative review of dual-task and task-switching research. *Psychological Bulletin*, *144*, 557-583.
- Kowalczyk, A. W., & Grange, J. A. (2020). The effect of episodic retrieval on inhibition in task switching: A diffusion model analysis. *Psychological Research*, *84*, 1065-1999.
- Kreiner, H., & Degani, T. (2015). Tip-of-the-tongue in a second language: The effects of brief first-language exposure and long-term use. *Cognition*, *137*, 106-114.
- Kroll, J. F., Bobb, S. C., Misra, M. M., & Guo, T. (2008). Language selection in bilingual speech: Evidence for inhibitory processes. *Acta Psychologica*, *128*, 416-430.

- La Heij, W. (2005). Selection processes in monolingual and bilingual lexical access. In J.F. Kroll & A.M.B. de Groot (Eds.), *Handbook of bilingualism: Psycholinguistic approaches* (pp. 289-307). Oxford: Oxford University Press.
- Lakens, D., Hilgard, J., & Staaks, J. (2016). On the reproducibility of meta-analyses: Six practical recommendations. *BMC Psychology*, 4, 24.
- Lavric, A., Clapp, A., East, A., Elchlepp, H., & Monsell, S. (2019). Is preparing for a language switch like preparing for a task switch? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 45, 1224-1233.
- Lehtonen, M., Soveri, A., Laine, A., Järvenpää, J., de Bruin, A., & Antfolk, J. (2018). Is bilingualism associated with enhanced executive functioning in adults? A meta-analytic review. *Psychological Bulletin*, 144, 394–425.
- Li, S., Botezatu, M. R., Zhang, M., & Guo, T. (2021). Different inhibitory control components predict different levels of language control in bilinguals. *Memory & Cognition*. Online first publication.
- Li, C., & Gollan, T. H. (2018). Cognates facilitate switches and then confusion: Contrasting effects of cascade versus feedback on language selection. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 44, 974-991.
- Linck, J. A., Schwieter, J. W., & Sunderman, G. (2012). Inhibitory control predicts language switching performance in trilingual speech production. *Bilingualism: Language and Cognition*, 15, 651–662.
- Linck, J. A., Schwieter, J. W., & Sunderman, G. (2020). The differential role of executive functions in the cognitive control of language switching. *Languages*, 5, 19.
- Liu, C., Jiao, L., Wang, Z., Wang, M., Wang, R., & Wu, Y. J. (2019). Symmetries of bilingual

- language switch costs in conflicting versus non-conflicting contexts. *Bilingualism: Language and Cognition*, 22, 624-636.
- Liu, H., Li, W., de Bruin, A., & He, Y. (2021). Should I focus on self-language actions or should I follow others? Cross-language interference effects in voluntary and cued language switching. *Acta Psychologica*, 216, 103308.
- Liu, H., Liang, L., Dunlap, S., Fan, N., & Chen, B. (2016). The effect of domain-general inhibition-related training on language switching: An ERP study. *Cognition*, 146, 264-276.
- Liu, H., Rossi, S., Zhou, H., & Chen, B. (2014). Electrophysiological evidence for domain-general inhibitory control during bilingual language switching. *PloS ONE*, 9, e110887.
- Liu, C., Timmer, K., Jiao, L., Yuan, Y., & Wang, R. (2019). The influence of contextual faces on bilingual language control. *Quarterly Journal of Experimental Psychology*, 72, 2313-2327.
- Liu, C., Timmer, K., Jiao, L., & Wang, R. (2020). Symmetries of comprehension-based language switch costs in conflicting versus non-conflicting contexts. *International Journal of Bilingualism*, 24, 588-598.
- Liu, H., Zhang, Y., Blanco-Elorrieta, E., He, Y., & Chen, B. (2020). The role of proactive control on subcomponents of language control: Evidence from trilinguals. *Cognition*, 194, 104055.
- Lowe, C. J., Cho, I., Goldsmith, S. F., & Morton, J. B. (2021). The Bilingual advantage in children's executive functioning is not related to language status: A meta-analytic review. *Psychological Science*, 32, 1115-1146.
- Lowry, M., Dubé, C., & Schotter, E. (2021). Evaluating theories of bilingual language control

- using computational models. *Journal of Memory and Language*, 117, 104-195.
- Lu, C. H., & Proctor, R. W. (1995). The influence of irrelevant location information on performance: A review of the Simon and spatial Stroop effects. *Psychonomic Bulletin & Review*, 2, 174-207.
- Ma, F., Li, S., & Guo, T. (2016). Reactive and proactive control in bilingual word production: An investigation of influential factors. *Journal of Memory and Language*, 86, 35-59.
- Macizo, P., Bajo, T., & Martín, M. C. (2010). Inhibitory processes in bilingual language comprehension: Evidence from Spanish–English interlexical homographs. *Journal of Memory and Language*, 63, 232-244.
- Macizo, P., Bajo, T., & Paolieri, D. (2012). Language switching and language competition. *Second Language Research*, 28, 131–149.
- Martin, C. D., Strijkers, K., Santesteban, M., Escera, C., Hartsuiker, R. J., & Costa, A. (2013). The impact of early bilingualism on controlling a language learned late: an ERP study. *Frontiers in Psychology*, 4, 815.
- Massa, E., Köpke, B., & El Yagoubi, R. (2020). Age-related effect on language control and executive control in bilingual and monolingual speakers: Behavioral and electrophysiological evidence. *Neuropsychologia*, 138, 107336.
- Meade, G., Midgley, K. J., Dijkstra, T., & Holcomb, P. J. (2018). Cross-language neighborhood effects in learners indicative of an integrated lexicon. *Journal of Cognitive Neuroscience*, 30, 70-85.
- Meara, P. M. (2006). *XLex: The Swansea vocabulary levels test*. Swansea: Lognostics.
- Meuter, R. F. I., & Allport, A. (1999). Bilingual language switching in naming: Asymmetrical

- costs of language selection. *Journal of Memory and Language*, 40, 25–40.
- Misra, M., Guo, T., Bobb, S. C., & Kroll, J. F. (2012). When bilinguals choose a single word to speak: Electrophysiological evidence for inhibition of the native language. *Journal of Memory and Language*, 67, 224-237.
- Mosca, M., & Clahsen, H. (2016). Examining language switching in bilinguals: The role of preparation time. *Bilingualism: Language and Cognition*, 19, 415-424.
- Mosca, M., & de Bot, K. (2017). Bilingual language switching: Production vs. recognition. *Frontiers in Psychology*, 8, 934.
- Mofrad, F. T., Jahn, A., & Schiller, N. O. (2020). Dual function of primary somatosensory cortex in cognitive control of language: Evidence from resting state fMRI. *Neuroscience*, 446, 59-68.
- Navarro-Torres, C. A., Beatty-Martínez, A. L., Kroll, J. F., & Green, D. W. (2021). Research on bilingualism as discovery science. *Brain and Language*, 222, 105014.
- Nichols, E. S., Wild, C. J., Stojanoski, B., Battista, M. E., & Owen, A. M. (2020). Bilingualism affords no general cognitive advantages: A population study of executive function in 11,000 People. *Psychological Science*, 31, 548-567.
- Nieuwenhuis, S., Yeung, N., Van Den Wildenberg, W., & Ridderinkhof, K. R. (2003). Electrophysiological correlates of anterior cingulate function in a go/no-go task: effects of response conflict and trial type frequency. *Cognitive, Affective, & Behavioral Neuroscience*, 3, 17-26.
- Nosek, B. A., Hardwicke, T. E., Moshontz, H., Allard, A., Corker, K. S., Dreber, A., Fidler, F.,

- Hilgard, J., Struhl, M. K., Nuijten, M. B., Rohrer, J. M., Romero, F., Scheel, A. M., Scherer, L. D., Schönbrodt, F. D., & Vazire, S. (2022). Replicability, robustness, and reproducibility in psychological science. *Annual Review of Psychology, 73*.
- Olson, D. J. (2016). The gradient effect of context on language switching and lexical access in bilingual production. *Applied Psycholinguistics, 37*, 725-756.
- Olson, D. J. (2017). Bilingual language switching costs in auditory comprehension. *Language, Cognition and Neuroscience, 32*, 494-513.
- Ong, G., McKague, M., Weekes, B., & Sewell, D. K. (2019). Diffusing the bilingual lexicon: Task-based and lexical components of language switch costs. *Cognitive Psychology, 114*, 101225.
- Orfanidou, E., & Sumner, P. (2005). Language switching and the effects of orthographic specificity and response repetition. *Memory & Cognition, 33*, 355–369.
- Paap, K. R., & Greenberg, Z. I. (2013). There is no coherent evidence for a bilingual advantage in executive processing. *Cognitive Psychology, 66*, 232-258.
- Paap, K. R., Myuz, H. A., Anders, R. T., Bockelman, M. F., Mikulinsky, R., & Sawi, O. M. (2017). No compelling evidence for a bilingual advantage in switching or that frequent language switching reduces switch cost. *Journal of Cognitive Psychology, 29*, 89-112.
- Peeters, D. (2020). Bilingual switching between languages and listeners: Insights from immersive virtual reality. *Cognition, 195*, 104107.
- Peeters, D., & Dijkstra, T. (2018). Sustained inhibition of the native language in bilingual language production: A virtual reality approach. *Bilingualism: Language and Cognition, 21*, 1035-1061.
- Peeters, D., Runnqvist, E., Bertrand, D., & Grainger, J. (2014). Asymmetrical switch costs in

- bilingual language production induced by reading words. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 40, 284-292.
- Philipp A. M., Gade M., & Koch I. (2007). Inhibitory processes in language switching: Evidence from switching language-defined response sets. *European Journal of Cognitive Psychology*, 19, 395–416.
- Philipp, A. M., & Huestegge, L. (2015). Language switching between sentences in reading: Exogenous and endogenous effects on eye movements and comprehension. *Bilingualism: Language and Cognition*, 18, 614-625.
- Philipp, A. M., & Koch, I. (2009). Inhibition in language switching: What is inhibited when switching between languages in naming tasks? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 35, 1187–1195.
- Poullisse, N., & Bongaerts, T. (1994). First language use in second language production. *Applied Linguistics*, 15, 36–57.
- Prior, A., & Gollan, T. H. (2011). Good language-switchers are good task-switchers: Evidence from Spanish-English and Mandarin-English bilinguals. *Journal of the International Neuropsychological Society*, 17, 682–691.
- Reynolds, M. G., Schlöffel, S., & Peressotti, F. (2016). Asymmetric switch costs in numeral naming and number word reading: Implications for models of bilingual language production. *Frontiers in Psychology*, 6, 2011.
- Roelofs, A. (1998). Lemma selection without inhibition of languages in bilingual speakers. *Bilingualism: Language and Cognition*, 1, 94-95.
- Schneider, D. W., & Anderson, J. R. (2010). Asymmetric switch costs as sequential difficulty effects. *Quarterly Journal of Experimental Psychology*, 63, 1873-1894.

- Schuch, S., Dignath, D., Steinhauser, M., & Janczyk, M. (2019). Monitoring and control in multitasking. *Psychonomic Bulletin & Review*, 26, 222-240.
- Schwietter, J. W., & Sunderman, G. (2008). Language switching in bilingual speech production: In search of the language-specific selection mechanism. *The Mental Lexicon*, 3, 214-238.
- Seo, R., & Prat, C. S. (2019). Proactive and reactive language control in the bilingual brain. *Brain Sciences*, 9, 161.
- Simon, J. R., & Rudell, A. P. (1967). Auditory SR compatibility: the effect of an irrelevant cue on information processing. *Journal of Applied Psychology*, 51, 300-304.
- Slevc, L. R., Davey, N. S., & Linck, J. A. (2016). A new look at “the hard problem” of bilingual lexical access: evidence for language-switch costs with univalent stimuli. *Journal of Cognitive Psychology*, 28, 385-395.
- Stasenko, A., Kleinman, D., & Gollan, T. H. (2021). Older bilinguals reverse language dominance less than younger bilinguals: Evidence for the inhibitory deficit hypothesis. *Psychology and Aging*. Online first publication.
- Stasenko, A., Matt, G. E., & Gollan, T. H. (2017). A relative bilingual advantage in switching with preparation: Nuanced explorations of the proposed association between bilingualism and task switching. *Journal of Experimental Psychology: General*, 146, 1527-1550.
- Struck, J., & Jiang, N. (2021). Language switch costs in a lexical decision task: Symmetry and cognitive correlates. *Second Language Research*, 0267658321998740.
- Struys, E., Woumans, E., Nour, S., Kepinska, O., & Van den Noort, M. (2019). A domain-general monitoring account of language switching in recognition tasks: Evidence for adaptive control. *Bilingualism: Language and Cognition*, 22, 606-623.
- Surrain, S., & Luk, G. (2019). Describing bilinguals: A systematic review of labels and

- descriptions used in the literature between 2005–2015. *Bilingualism: Language and Cognition*, 22, 401-415.
- Tarlowski, A., Wodniecka, Z., & Marzecová, A. (2012). Language switching in the production of phrases. *Journal of Psycholinguistic Research*, 42, 103–118.
- Thierry, G., & Wu, Y. J. (2007). Brain potentials reveal unconscious translation during foreign-language comprehension. *Proceedings of the National Academy of Sciences*, 104, 12530-12535.
- Thomas, M. S. C., & Allport, A. (2000). Language switching costs in bilingual visual word recognition. *Journal of Memory and Language*, 43, 44–66.
- Timmer, K., Calabria, M., Branzi, F. M., Baus, C., & Costa, A. (2018). On the reliability of switching costs across time and domains. *Frontiers in Psychology*, 9, 1032.
- Timmer, K., Christoffels, I. K., & Costa, A. (2019). On the flexibility of bilingual language control: The effect of language context. *Bilingualism: Language and Cognition*, 22, 555-568.
- Van Assche, E., Duyck, W., & Gollan, T. H. (2013). Whole-language and item-specific control in bilingual language production. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 39, 1781-1792.
- van Gompel, R. P., van Deemter, K., Gatt, A., Snoeren, R., & Krahmer, E. J. (2019). Conceptualization in reference production: Probabilistic modeling and experimental testing. *Psychological Review*, 126, 345-373.
- Von Studnitz, R. E., & Green, D. W. (1997). Lexical decision and language switching. *International Journal of Bilingualism*, 1, 3-24.
- Von Studnitz, R. E., & Green, D. W. (2002). The cost of switching language in a semantic

- categorization task. *Bilingualism: Language and Cognition*, 5, 241-251.
- Vandierendonck, A., Liefoghe, B., & Verbruggen, F. (2010). Task switching: Interplay of reconfiguration and interference control. *Psychological Bulletin*, 136, 601–626.
- Vaughn, K. A., Watlington, E. M., Linares Abrego, P., Tamber-Rosenau, B. J., & Hernandez, A. E. (2021). Prefrontal transcranial direct current stimulation (tDCS) has a domain-specific impact on bilingual language control. *Journal of Experimental Psychology: General*, 150, 996-1007.
- Verhoef, K. M. W., Roelofs, A., & Chwilla, D. J. (2009). Role of inhibition in language switching: Evidence from event-related brain potentials in overt picture naming. *Cognition*, 110, 84–99.
- Verhoef, K. M., Roelofs, A., & Chwilla, D. J. (2010). Electrophysiological evidence for endogenous control of attention in switching between languages in overt picture naming. *Journal of Cognitive Neuroscience*, 22, 1832-1843.
- Wang, Y., Kuhl, P. K., Chen, C., & Dong, Q. (2009). Sustained and transient language control in the bilingual brain. *NeuroImage*, 47, 414–422.
- Ware, A. T., Kirkovski, M., & Lum, J. A. (2020). Meta-analysis reveals a bilingual advantage that is dependent on task and age. *Frontiers in Psychology*, 11.
- West, W. C., & Holcomb, P. J. (2002). Event-related potentials during discourse-level semantic integration of complex pictures. *Cognitive Brain Research*, 13, 363-375.
- Wodniecka, Z., Casado, A., Kałamała, P., Marecka, M., Timmer, K., & Wolna, A. (2020). The

- dynamics of language experience and how it affects language and cognition. In K. D. Federmeier and H. Huang (Eds.), *Psychology of Learning and Motivation* (Vol. 72, pp. 235-281). Cambridge, MA: Elsevier Academic Press.
- Wodniecka, Z., Szewczyk, J., Kałamała, P., Mandera, P., & Durlík, J. (2020). When a second language hits a native language. What ERPs (do and do not) tell us about language retrieval difficulty in bilingual language production. *Neuropsychologia*, *141*, 107390.
- Wong, W. L., & Maurer, U. (2021). The effects of input and output modalities on language switching between Chinese and English. *Bilingualism: Language and Cognition*. Online first publication.
- Wu, R. & Struys, E. (2021). Domain-general monitoring control: An investigation in bilinguals who live in a minority/majority sociolinguistic setting. *Frontiers in Psychology*, *12*, 594648.
- Yeung, N., & Monsell, S. (2003). Switching between tasks of unequal familiarity: The role of stimulus-attribute and response-set selection. *Journal of Experimental Psychology: Human Perception and Performance*, *29*, 455-469.
- Zheng, X., Roelofs, A., & Lemhöfer, K. (2020). Language selection contributes to intrusion errors in speaking: Evidence from picture naming. *Bilingualism: Language and Cognition*, *23*, 788-800.
- Zheng, X., Roelofs, A., Erkan, H., & Lemhöfer, K. (2020). Dynamics of inhibitory control during bilingual speech production: An electrophysiological study. *Neuropsychologia*, *140*, 107387.
- Zhu, J. D., Seymour, R. A., Szakay, A., & Sowman, P. F. (2020). Neuro-dynamics of executive control in bilingual language switching: An MEG study. *Cognition*, *199*, 104247.

Zhu, J. D., & Sowman, P. F. (2020). Whole-language and item-specific inhibition in bilingual language switching: The role of domain-general inhibitory control. *Brain Sciences, 10*, 517.