Cognition 173 (2018) 115–132

Contents lists available at ScienceDirect

Cognition

journal homepage: www.elsevier.com/locate/cognit

Original Articles

Inhibition accumulates over time at multiple processing levels in bilingual language control

Daniel Kleinman[a,*], Tamar H. Gollan[b]

[a] Beckman Institute, University of Illinois at Urbana-Champaign, USA
[b] Department of Psychiatry, University of California, San Diego, USA

ARTICLE INFO

Keywords:
Bilingualism
Switching
Inhibition
Implicit learning

ABSTRACT

It is commonly assumed that bilinguals enable production in their nondominant language by inhibiting their dominant language temporarily, fully lifting inhibition to switch back. In a re-analysis of data from 416 Spanish-English bilinguals who repeatedly named a small set of pictures while switching languages in response to cues, we separated trials into different types that revealed three cumulative effects. Bilinguals named each picture (a) faster for every time they had previously named that same picture in the same language, an asymmetric repetition priming effect that was greater in their nondominant language, and (b) more slowly for every time they had previously named that same picture in the other language, an effect that was equivalent across languages and implies symmetric lateral inhibition between translation equivalents. Additionally, (c) bilinguals named pictures in the dominant language more slowly for every time they had previously named unrelated pictures in the nondominant language, exhibiting asymmetric language-wide global inhibition. These mechanisms dynamically alter the balances of activation between languages and between lemmas, providing evidence for an oft-assumed but seldom demonstrated key mechanism of bilingual control (competition between translations), resolving the mystery of why reversed language dominance sometimes emerges (the combined forces of asymmetrical effects emerge over time in mixed-language blocks), and also explaining other longer-lasting effects (block order). Key signatures of bilingual control can depend on seemingly trivial methodological details (e.g., the number of trials in a block) because inhibition is applied cumulatively at both local and global levels, persisting long after each individual act of selection.

1. Introduction

Although bilinguals can easily express most concepts in two languages, they rarely use the wrong language by mistake (Poulisse & Bongaerts, 1994). This is particularly impressive given that bilinguals often appear unable to entirely shut off activation of the language they don't want to speak; that is, they activate words in both languages even when planning to speak in just one language (e.g., Colomé, 2001; Costa, Caramazza, & Sebastián-Gallés, 2000; Hoshino & Kroll, 2008). How do bilinguals accomplish this feat of executive control? Though they do not seem to be equipped with an on/off switch (a dimmer might provide a better analogy), an emerging consensus identifies *inhibition* – operating at multiple processing levels – as a central mechanism enabling such feats, as well as related feats in psycholinguistics and cognitive psychology.

1.1. Global language control

In an influential paper, Green (1998) proposed that bilinguals use inhibition to facilitate selection of the target language while speaking. Green assumed that bilinguals have two language nodes and that each word representation (lemma) is connected to one of these nodes, tagging it for language membership. According to his model, when a non-target language becomes active, inhibition is applied in proportion to its activation level. This inhibition is global in scope; i.e., it is applied directly to a language node, and subsequently spreads to lemmas in that language. The inhibition persists until the inhibited language needs to be selected for production, at which point it is lifted – an action that is costly (in terms of time) in proportion to the quantity of inhibition that was previously applied.

This proposal neatly accounts for several phenomena that are often observed in studies of bilingual language switching. In many such studies, bilinguals name a series of digits or pictures, each of which is accompanied by a cue indicating the language to be used. A nearly

* Corresponding author at: University of Illinois at Urbana-Champaign, 5221 Beckman Institute, 405 North Mathews Avenue, Urbana, IL 61801-2325, USA.
E-mail address: kleinman@gmail.com (D. Kleinman).

https://doi.org/10.1016/j.cognition.2018.01.009
Received 10 August 2017; Received in revised form 24 December 2017; Accepted 18 January 2018
0010-0277/ © 2018 Elsevier B.V. All rights reserved.

universal finding is that bilinguals take longer to begin speaking when they need to use a different language relative to what they used on the preceding trial, and these *switch costs* are often asymmetrical: Counterintuitively, they are greater in the dominant language (Meuter & Allport, 1999; for a review, see Bobb & Wodniecka, 2013). Under Green's (1998) account, switch costs index the time needed to release inhibition from the target language to prepare it for production. Because the dominant language is more accessible than the nondominant language, it receives more inhibition when it is the non-target language, and this extra inhibition in turn leads to asymmetric switch costs. Sometimes, bilinguals may apply so much inhibition that they end up responding faster in their nondominant language than in their dominant language. This pattern of *reversed dominance* has been observed sporadically in experimental studies of language switching by several different investigators (Christoffels, Firk, & Schiller, 2007; Costa & Santesteban, 2004; Costa, Santesteban, & Ivanova, 2006; Declerck, Thoma, Koch, & Philipp, 2015; Gollan & Ferreira, 2009; Gollan & Goldrick, 2016, 2017; Gollan, Kleinman, & Wierenga, 2014; Gollan, Schotter, Gomez, Murillo, & Rayner, 2014), though it remains largely a mystery as to what conditions lead reversed dominance to emerge.

An alternative view is that bilinguals instead rely on global activation of the nondominant language rather than globally inhibiting the dominant language, or even that they may employ both global inhibition and global activation at the same time (Branzi, Martin, Abutalebi, & Costa, 2014; Costa & Santesteban, 2004; for discussion of how such an account is difficult to rule out on the basis of data from most language switching studies, see Declerck & Philipp, 2015; Philipp, Gade, & Koch, 2007). According to this proposal, bilinguals who have just spoken in their nondominant language are especially slow to switch into their dominant language because the extra nondominant activation increases competition between languages (see Verhoef, Roelofs, & Chwilla, 2009 for a variant of this account; but see Fink & Goldrick, 2015). Similarly, reversed dominance effects can be observed if enough activation is applied to the nondominant language, though this possibility has been considered less often, perhaps because of inherent limitations on the extent to which a less dominant language can be activated (at least at some processing levels; see Gollan & Goldrick, 2017). As activation-based accounts are less mainstream than inhibition-based accounts, however, we will frame the experimental setup in terms of global inhibition and revisit the inhibition-versus-activation debate in Section 4.5.1.

1.2. Local language control

In addition to altering the balance of global activation between language nodes, Green (1998) suggested that bilinguals use inhibition to exert local language control at the lemma level. Many models of word production assume that lemmas compete with each other for selection (cf. Levelt, Roelofs, & Meyer, 1999). As a mechanism for resolving this competition in the bilingual lexicon, Green claimed that translation-equivalent lemmas (e.g., *dog* and *perro*) directly inhibit each other when both lemmas are active. This resembles similar claims in research on monolingual language production that words which regularly compete for selection might be linked to each other via lateral inhibitory connections. On this view, when speakers attempt to select a single word for production, promising lexical candidates (e.g., other semantically related words) also become activated and inhibit each other in proportion to their own activation levels until a winner emerges. Lateral inhibition is relatively common in models of language comprehension (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001; Dijkstra & van Heuven, 2002; Grainger & Jacobs, 1996; McClelland & Elman, 1986) but has less commonly been proposed as a feature of the language production system (Berg & Schade, 1992; Cutting & Ferreira, 1999; Howard, Nickels, Coltheart, & Cole-Virtue, 2006), and researchers have turned to lateral inhibition to explain their results relatively infrequently in the domain of bilingual production (Declerck & Philipp, 2017; Khateb, Shamshoum, & Prior, 2017; Runnqvist, Strijkers, Alario, & Costa, 2012).

A major challenge for the possibility of mutually inhibitory connections between translation equivalents is the absence of strong evidence for competition between them in studies of bilingual language production. In fact, there is striking evidence instead for *facilitation* between translation equivalents (i.e., that translations mutually activate each other). For example, when bilinguals must name a picture while attempting to ignore a simultaneously presented distractor word, naming times are reliably faster when the distractor is a translation equivalent of the picture name than when it is an unrelated word (Costa, Miozzo, & Caramazza, 1999; for a recent replication in three pairs of languages, see Dylman & Barry, 2018; for a review, see Hall, 2011). Similarly, bilinguals are less likely to fall into a tip-of-the-tongue state if they know the word in both languages than if they know it in just one language (in which case the translation equivalent couldn't possibly compete for selection; Gollan & Acenas, 2004; see also Gollan, Montoya, Fennema-Notestine, & Morris, 2005). Such results, and also cross-language priming effects in studies of bilingual word recognition, have even led some researchers to suggest that translation equivalents are directly linked via facilitative – not inhibitory – connections (Dylman & Barry, 2018; Gollan, Forster, & Frost, 1997; Keatley, Spinks, & de Gelder, 1994; Kroll & Stewart, 1994). By contrast, evidence for the opposite (i.e., lateral inhibition) has been decidedly lacking in the literature to date.

1.3. Measuring how language control unfolds over time

In the present study, we take a different approach to the study of lateral inhibition and bilingual language control more generally by examining how the activation of both language-wide and word-specific representations change over time within mixed-language naming blocks. This approach hinges on a key observation about the timescale of inhibition: "previous episodes of suppression may [continue to] exert their effects, since it takes time for the effects of prior inhibition to be overcome" (Green, 1998, p. 72). In keeping with this claim, bilingual performance in a dominant-language block is often worse following a nondominant-language block, suggesting that the effects of inhibition are not immediately overcome (Guo, Liu, Misra, & Kroll, 2011; Misra, Guo, Bobb, & Kroll, 2012; Van Assche, Duyck, & Gollan, 2013; see also Declerck & Grainger, 2017).

This pattern shows that inhibition can persist across blocks; however, it does not address how that inhibition is established. One possibility is that some quantity of inhibition is applied to the dominant language at the start of the nondominant-only block, and each instance of nondominant retrieval simply refreshes that inhibition, keeping it at the same level throughout (and, for a limited time, after) the block. Another possibility is that residual inhibition of the dominant language accumulates over time even within a block, gaining force with each instance of nondominant retrieval – though inhibition may eventually plateau when more distantly applied inhibition expires or when the dominant language is maximally inhibited.

However, a recent study offers evidence against the idea that competition between languages diminishes over the course of a single-language block. Mercier, Pivneva, and Titone (2015) used a visual world task to measure the activation of both the target and non-target languages during comprehension. Bilinguals fluent in English and French were instructed on each trial to click on one of four objects presented on-screen. On some trials, a distractor picture had a French name (*fille*) belonging to the same cohort as the target picture's English name (*field*; this task was always conducted in English). Bilinguals looked less often at the target when this French competitor was present, and this effect grew as the experiment progressed. However, this pattern was observed only among bilinguals who had not performed a picture naming task in French immediately beforehand, suggesting that the bilinguals who did speak French subsequently applied global

دریافت فوری ← متن کامل مقاله

ISIArticles
مرجع مقالات تخصصی ایران

✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
✓ امکان دانلود نسخه ترجمه شده مقالات
✓ پذیرش سفارش ترجمه تخصصی
✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
✓ دانلود فوری مقاله پس از پرداخت آنلاین
✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات