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## تأثیرات غیرزبانی آموزش تغییر زبان

### چکیده

چه رابطه‌ای بین مکانیسم‌های کنترل زبان دو زبانه (BLC) و فرایندهای کنترل اجرایی (EC) در حوزه عمومی وجود دارد؟ آیا این دو حوزه در برخی از سازوکارها مشترک هستند؟ در اینجا، ما یک رویکرد جدید به این سوال داریم، و بررسی می‌کنیم که آیا آموزش کوتاه مدت تغییر زبان باعث بهبود عملکرد تغییر زبان غیرزبانی می‌شود. دو گروه دوزبانه در دو پروتکل مختلف اختصاص داده شدند. یک گروه در تغییر زبان آموزش دیده بودند (گروه آموزش وظیفه تغییر) گروه دیگری در مورد نامگذاری عکس زبان بلوک بندی شده و سپس آموزش دیده شدند (گروه آموزش تک بلوکی). هر دو گروه یک وظیفه سوئیچینگ غیرزبانی و زبانی را قبل (پیش از آموزش) و بعد از آموزش (پساآموزش) انجام دادند. هزینه‌های سوئیچ (تغییر) غیرزبانی و زبانی برای دوره آموزش نسبت به گروه آموزش تک بلوکی از قبل به بعد از آموزش به میزان بیشتری کاهش می‌یابد. در مقابل، هزینه‌های آمیخته کاهش مشابهی را برای هر دو گروه نشان داد. این نشان می‌دهد که آموزش کوتاه مدت تغییر زبان می‌تواند برای زیر مکانیسم‌های خاصی به حوزه غیرزبانی انتقال یابد.

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Original Articles

# Non-linguistic effects of language switching training

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## ABSTRACT

What is the relationship between bilingual language control (BLC) mechanisms and domain-general executive control (EC) processes? Do these two domains share some of their mechanisms? Here, we take a novel approach to this question, investigating whether short-term language switching training improves non-linguistic task switching performance. Two groups of bilinguals were assigned to two different protocols; one group was trained in language switching (switching-task training group) another group was trained in blocked language picture naming (single-block training group). Both groups performed a non-linguistic and linguistic switching task before (pre-training) and after training (post-training). Non-linguistic and linguistic switch costs decreased to a greater extent for the switching-task training than for the single-block training group from pre- to post-training. In contrast, mixing costs showed similar reductions for both groups. This suggests short-term language switching training can transfer to the non-linguistic domain for certain sub-mechanisms (i.e., switch cost). Thus, there is some overlap of the control mechanisms across domains.

## 1. Introduction

The extent to which bilingual language control (BLC) and domain-general executive control (EC) processes share some of their mechanisms is a debated issue (Abutalebi & Green, 2007; Declerck, Koch, & Philipp, 2015; Dijkstra & van Heuven, 2002; Grainger, Midgley, & Holcomb, 2010; Green, 1998). This question is relevant when trying to understand whether BLC mechanisms are an instantiation of domain-general EC processes. The experimental evidence used to inform this issue comes from several sources. One of the most common paradigms used in the question regarding cross-talk is the comparison (either behaviorally or through neuroimaging studies) of a bilingual's performance in linguistic and non-linguistic control tasks (Branzi, Calabria, Boscarino, & Costa, 2016; De Baene, Duyck, Brass, & Carreiras, 2015; Timmer, Calabria et al., 2018; Timmer, Grundy, & Bialystok, 2017a). Here, we take a novel approach and explore cross-talk between BLC and EC by assessing whether short-term training in BLC affects performance on tasks that involve EC but do not (or only minimally) involve linguistic processes (Abutalebi et al., 2008; Dijkstra & van Heuven, 2002; Green, 1998).

The evidence regarding cross-talk that comes from correlational studies is based on the idea that if the two domains share cognitive processes then individuals' performances in tasks that involve linguistic

and non-linguistic control should correlate to some extent. To put it simply, if BLC is subsumed to EC processes, those individuals that are good at the latter should be good at the former too. This hypothesis has been tested mostly by looking at switching tasks (linguistic switching vs. non-linguistic switching tasks). Given that we also used these tasks in the present study, the following review will be focused on these types of studies. Most of the correlational studies do not reveal a correlation between switching costs across the linguistic- and non-linguistic tasks (Branzi et al., 2016; Calabria, Branzi, Marne, Hernández, & Costa, 2015; Calabria, Hernández, Branzi, & Costa, 2011; Cattaneo et al., 2015; Declerck, Grainger, Koch, & Philipp, 2017; Prior & Gollan, 2013). However, some studies revealed a correlation for the switch cost across domains (Declerck et al., 2017; Timmer, Calabria et al., 2018) or for the mixing cost across domains (Cattaneo et al., 2015; Prior & Gollan, 2013).

Moreover, other studies have looked at whether performance in task switching varied depending on the frequency of language switching in real life. The results of these studies suggest that more frequent language switching in daily life improves non-linguistic task switching performance (Hartanto & Yang, 2016; Pot, Keijzer, & de Bot, 2018; Prior & Gollan, 2011; Soveri, Rodríguez-Fornells, & Laine, 2011; Yang, Hartanto, & Yang, 2016). For example, Hartanto and Yang (2016) showed diminished switch costs in a non-linguistic task for those