Switch-costs in bilingual comprehension: what is their source and are they influenced by language dominance?

Research has shown that bilinguals incur a processing delay, or switch-cost, when producing or comprehending language switches. The source of this delay has been a topic of debate in the code-switching literature. The lexical activation account and BIA/BIA+ models (Dijkstra & van Heuven, 2002; Bultena, Dijkstra & van Hell, 2015) propose that switch costs originate in lexical access, while the inhibitory control (IC) model (Green, 1998) attributes them to a lexicon-external mechanism. The IC model is widely accepted for production switch-costs, but more controversial for the input-driven bottom-up process of comprehension. This study, building on Wang (2015), explores two questions: (1) what is the source of switch-costs in comprehension, and (2) can language dominance modulate switch-costs?

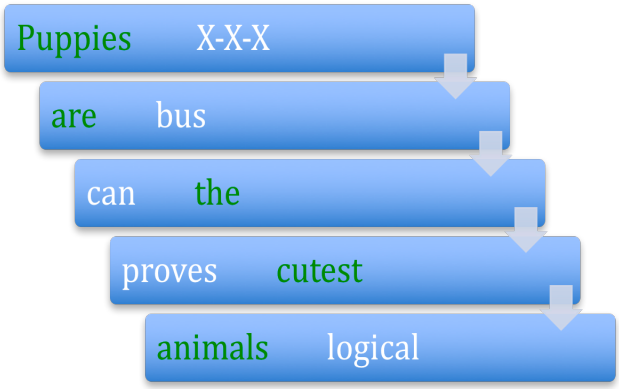
95 Dutch-English bilingual participants, split into a balanced bilingual group (n=56, mean age (MA)=24) and a Dutch dominant group (n=39, MA=22), completed a visual sentence maze task, in which they constructed 64 sentences word by word, selecting viable subsequent words from two options until the sentence was complete (see (1)). Sentences could either be in Dutch or English only, or contain an intra-sentential one-word switch to the other language (see (2)). Reaction times (RTs) to the pre-switch word, switched word, and post-switch word were recorded. Switch-costs were measured by comparing RTs in the non-switch version of a sentence, to those in the version containing a switch (so e.g. in (2) compare RTs on the 2nd, 3rd, and 4th word of the Dutch matrix sentences, and the same for the English matrix sentences).

The RTs were analysed using linear mixed effects models. For the balanced bilinguals, significant delays on the switched word were found both for English to Dutch (t=3.86, p=.0001), and Dutch to English (t=9.98, p< .0001), although the switch cost from Dutch into English was significantly larger (t=-4.55, p<.0001) (see (3) for raw RTs). The Dutch dominant bilinguals also showed a large 114ms switch cost for Dutch to English (t = 9.99, p<.0001), but showed no switch cost for English to Dutch (t=1.24, p=.215) (see (4)). The post-switch word RTs exhibit a similar sized switch-cost in both directions for both groups.

First, the finding of switch costs on the post-switch word indicates the presence of non-lexical inhibitory effects. Since switch-costs are measured by comparing non-switch to switch sentences, the post-switch word is crucially exactly the same word, in the same language. If switch-costs were simply caused by differing resting state activation levels of L1 and L2, then there should be no switch-cost on the post-switch word. This means that the lexical activation account cannot be *solely* responsible for switch-costs. There must also be a non-lexical mechanism at play. It is arguable that both the BIA/BIA+ models and the IC model can explain the present results. More research is needed to tease apart the difference between these models in the comprehension of same-script visual intra-sentential language switches.

Second, these results suggest that language dominance can modulate switch-costs, and lexical access in L1 is easier than in L2. It seems, furthermore, that for imbalanced bilinguals the facilitation effect of L1 over L2 access can be thus great that it cancels out switch-costs imposed by a lexicon-external mechanism.

(1) Example of English matrix non-switch trial



(2) Four versions of a sentence stimulus

Dutch matrix non-switch	English matrix non-switch	Dutch matrix switch	English matrix switch
De	The	De	The
vrouw	woman	vrouw	woman
verrekte	injured	injured	verrekte
spieren	muscles	spieren	muscles
in	in	in	in
haar	her	haar	her
nek	neck	nek	neck

(3) Balanced bilingual group raw RTs (ms)

		Before switch	Switch	After switch
Dutch matrix	Non-switch	834	887	802
	Switch	839	997	834
	RT difference	5	110***	32***
English matrix	Non-switch	839	917	822
	Switch	824	964	864
	RT difference	-15	47***	42***

(4) Dutch dominant group raw RTs (ms)

		Before switch	Switch	After switch
Dutch matrix	Non-switch	828	887	805
	Switch	815	1001	847
	RT difference	-13	114***	42***
English matrix	Non-switch	827	925	832
	Switch	836	949	889
	RT difference	9	24	57***

*$p<0.05$ * ; $p<0.01$ **, $p<0.001$ ****

References

Bultena, S., Dijkstra, T., & Van Hell, J. G. (2015). Language switch costs in sentence comprehension depend on language dominance: Evidence from self-paced reading. *Bilingualism: Language and Cognition*, *18*(03), 453–469. **Dijkstra, T., & Van Heuven, W. J.** (2002). The architecture of the bilingual word recognition system: From identification to decision. *Bilingualism: Language and Cognition*, *5*(03), 175-197. **Green, D. W.** (1998). Mental control of the bilingual lexico-semantic system. *Bilingualism: Language and Cognition*, *1*. **Wang, X.** (2015). Language Control in Bilingual Language Comprehension: evidence from the maze task. *Frontiers in Psychology*.