

The bilingual advantage: Conflict monitoring, cognitive control, and garden-path recovery

Susan Teubner-Rhodes¹, Alan Mishler¹, Ryan Corbett¹, Llorenç Barrachina², Monica Sanz-Torrent², John Trueswell³, and Jared Novick¹

¹University of Maryland, College Park, ²University of Barcelona, ³University of Pennsylvania

Contact: steubner@umd.edu

Mounting research findings demonstrate that balanced bilinguals enjoy certain cognitive advantages relative to monolinguals. On tasks requiring cognitive control (CC) – the ability to regulate behavior and resolve interference among competing representations – bilinguals frequently outperform monolinguals selectively on trials inducing conflict [1]. In these studies, monolinguals exhibit significantly slower reaction times on trials requiring selection between incompatible responses relative to non-conflict trials (e.g., in flanker and Simon paradigms); bilinguals, in contrast, show reliably less of this interference. Other evidence reflects broader patterns: bilinguals are better at conflict *monitoring* during goal-directed tasks, performing faster generally under high, but not low, conflict-monitoring conditions [2]. Specifically, bilinguals are faster on both conflict *and* non-conflict trials, but only during tasks requiring frequent switching between trial types. Considering psycholinguistic research emphasizing that domain-general CC enables recovery from temporary misinterpretation [3], we show that bilinguals’ putative CC advantage impacts their syntactic-ambiguity resolution abilities: brief practice on an N-back memory task with high (but not low) conflict-monitoring demands differentially affects garden-path recovery in bilinguals versus monolinguals.

Balanced Spanish-Catalan bilinguals (N=59) and Spanish monolinguals (N=51) completed three tasks in this order: a (Spanish) self-paced, moving-window reading task involving sentences that were temporarily ambiguous between a preferred subject-first or dispreferred object-first cleft interpretation; a 20-minute high- or low-interference version of an N-back task (interference condition was randomly assigned); and a posttest form of the reading task. In the reading task, comprehension probes measured lingering effects of misanalysis in object-first sentences [based on 4; see example].

Examples:

- Object-first Cleft Sentence (probe in parentheses): Este es el cajero que cuestionaba al gerente sobre el inventario. (El cajero cuestionaba al gerente.)

English: This is the cashier who the manager questioned about the inventory. (The cashier questioned the manager.)

- Subject-first Cleft Sentence (probe in parentheses): Este es el cajero que cuestionaba al gerente sobre el inventario. (El gerente cuestionaba al cajero.)

English: This is the cashier who questioned the manager about the inventory. (The manager questioned the cashier.)

During N-back, subjects viewed single words sequentially and indicated whether an item appeared 3 trials previously. Both high and low interference versions contained target words, which had appeared 3 items previously, and non-target words, which had not appeared before. Only the high-interference version contained “lures”—words that appeared 2, 4, or 5 items before, compelling subjects to override a familiarity bias to correctly indicate that the item was not a 3-back target. Thus, only lure trials evoke conflict that may be comparable to

the process of selecting among competing syntactic representations while reading temporarily ambiguous sentences [see 3].

On N-back, bilinguals were significantly more accurate than monolinguals in the high-interference ($p < .01$), but not the low-interference version ($p > .37$). However, in the high-interference version, language-group did not interact with trial type, suggesting that the benefit is not restricted to stimuli engaging conflict resolution (lures), but rather reflects a general conflict-monitoring advantage in high conflict-monitoring conditions, consistent with [2].

In the reading task, participants spent longer in disambiguating regions of, and were less accurate on, object-first versus subject-first items (p 's $< .01$)—the expected garden-path effect; but there was no interaction with group. Bilinguals were more accurate than monolinguals generally across all item types (object-first, subject-first, and filler probes; $p < .05$), demonstrating that bilinguals' comprehension advantage was not specific to garden-path recovery.

Interestingly however, bilinguals' accuracy improvement throughout the N-back task on lure trials, but not the other trial types, selectively predicted their improvement from pre- to posttest on object-first comprehension probes ($r = .39$, $p < .05$), which forced syntactic reanalysis and CC. Monolinguals showed no such pattern ($r = .15$, $p = .45$), suggesting only bilinguals transfer the benefit of brief interference-resolution practice to the ability to revise parsing misanalyses.

Together these results suggest that balanced bilingualism bestows a general cognitive benefit in high, but not low, conflict-monitoring situations – namely, when there is repeated switching between conflict (lures) and non-conflict (target, non-target) trials – non-specific to conflict trials independently. Regarding sentence-parsing, only bilinguals' short-term practice with interference resolution confers an improved ability to revise early misinterpretations. We discuss findings in terms of bilinguals' advantage in conflict-monitoring, which enables them to detect situations requiring frequent CC and flexibly increase domain-general conflict-resolution mechanisms that are shared with syntactic ambiguity resolution processes.

References

1. Bialystok, E., Craik, F. I. M., Klein, R., & Viswanathan, M. (2004). Bilingualism, aging, and cognitive control: Evidence from the Simon task. *Psychology and Aging, 19*, 290-303.
2. Costa, A., Hernández, M., Costa-Faidella, J., Sebastián-Gallés, N. (2009). On the bilingual advantage in conflict processing: Now you see it, now you don't. *Cognition, 113*, 135-149.
3. Novick, J. M., Trueswell, J. C., & Thompson-Schill, S. L. (2005). Cognitive control and parsing: Reexamining the role of Broca's area in sentence comprehension. *Cognitive, Affective, and Behavioral Neuroscience, 5*, 263-281.
4. Del Río, D., Maestú, F., López-Higes, R., Moratti, S., Gutiérrez, R., Maestú, C., & del-Pozo, F. (2011). Conflict and cognitive control during sentence comprehension: Recruitment of a frontal network during the processing of Spanish object-first sentences. *Neuropsychologia, 49*, 382-391.