Bilingualism: Language and Cognition 19 (2), 2016, 256–258 © Cambridge University Press 2015 doi:10.1017/S136672891500036X

What bimodal and unimodal bilinguals can tell us about bilingual language processing.

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In their review, Emmorey, Giezen and Gollan (Emmorey, Giezen & Gollan) contrast bimodal bilinguals (individuals who are fluent in a signed and a spoken language) and unimodal bilinguals (individuals fluent in two spoken languages) to highlight the implications of bimodal bilingualism for language processing, the cognitive effects of bilingualism, and the neural organization of languages. For this purpose, the authors focus on the evidence for language mixing in bimodal bilinguals (so-called 'code-blends') by hearing children of deaf parents and explore how language co-activation and control differentially impacts the processing of languages compared to unimodal bilinguals. The sustained controlling of two languages from differing modalities in bimodal bilinguals, according to the authors, may lead to modality-specific cognitive advantages in contrast to unimodal bilinguals.

Language mixing in the form of code-switching in unimodal bilinguals has been found to be an effortful process during language production, made possible by language inhibition (Green, 1998). Meuter and Allport (1999) reported asymmetric language switch costs, with faster switches from L1 to L2 and slower switches from L2 back to L1. This asymmetry was assumed to stem from the stronger previous inhibition of L1 in order to produce L2, inhibition that needed to be lifted again when switching from the L2 to the L1. In a more recent cued picture naming study, Verhoef, Roelofs and Chwilla (2009) showed that if participants are given time to prepare for the switch, L2 inhibition may not be necessary for L1 production (but see Fink & Goldrick, 2014). Emmorey, Borinstein, Thompson and Gollan (2008) suggest that bimodal bilinguals prefer simultaneous code-blends over code-switching. Interestingly, when American Sign Language (ASL) is the matrix language, the dominant spoken language English is strongly inhibited, which evidently disallows single word utterances to accompany ASL signs. In contrast, when the spoken language English is the matrix language, continuous code-blends occur freely, as speech has been "completely released from inhibition" (p. 6). Furthermore, bimodal bilingual code-blends also exhibit the co-occurrence of signs and speech that are not translation equivalents; indeed such cases of dual non-overlapping lexical selection provide valuable data to better understand the architecture of the bilingual lexicon. Do unimodal bilinguals also simultaneously activate and possibly select lexical items that are not translation equivalents? If this is indeed the case, then it may also play a role in such phenomena as slower L1 lexical retrieval in unimodal bilinguals compared to monolinguals.

For unimodal bilinguals, it has been found that they are slower to name pictures than monolinguals both in the non-dominant and, critically, also in the dominant language. This has been explained, amongst others, by positing bi-directional competition between same modality languages (see, e.g., Ivanova & Costa, 2008 for adults, and Poarch & Van Hell, 2012a, for children). In contrast, when hearing bimodal bilinguals retrieve lexical items during picture naming in the non-dominant ASL, they are slower than deaf bilinguals, but when they name pictures in the dominant language English, they retrieve the lexical entries with similar speed and as accurately as deaf bilinguals. Hence, lexical access to the dominant language does not seem to suffer from the presence of another non-dominant language in a different modality, in this case ASL. Such a finding indicates unidirectional competition of the languages in bimodal bilinguals.

Lexical competition in bimodal bilinguals has also been observed indirectly through the occurrence of tip-of-the-tongue states (TOTs). More TOTs were found to be unresolved when signs accompanied the retrieval of the spoken word, indicating competition between lexical alternatives across modalities. As in unimodal bilinguals, the presentation of translation primes increased the occurrence of TOTs – driven by a partial but unsuccessful retrieval of the target word instead of a full retrieval failure. An interesting speculation on TOT resolution offered by Emmorey et al. (Emmorey et al) is that the manner of generating translating equivalents – either internally or externally – may influence the pattern of access to the target word. While internal self-generation of translations may interfere, externally provided translations may facilitate ultimate access.

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Evidence for cross-language competition and the subsequent need for inhibitory control in unimodal bilingual adults and children have so far been traced back to the co-activation of phonological systems. However, the absence of such a perceptual overlap in bimodal bilinguals while still observing cross-language competition (see Giezen, Blumenfeld, Shook, Marian & Emmorey, 2015) suggests that lexical connections and shared semantic representations contribute to a greater extent in inducing these cross-language phenomena – possibly even in unimodal bilinguals. Teasing apart what contributes to what extent in cross-language activation should be an interesting avenue of future research as is what contributes to the recruitment of cognitive control processes.

The authors furthermore discuss the implications of bimodal bilingualism for the architecture of the bilingual lexicon using the Revised Hierarchical Model as a model for bilingual word acquisition (RHM; Kroll & Stewart, 1994). The RHM, originally aimed at explaining translation production processes in L2 learners and bilinguals, has in the past also been used to test the activation and strength of lexical and conceptual links during language comprehension. Recent findings indicate that the task itself (i.e., production vs. comprehension) and the manner of word learning may play a distinct role in which links are activated to a greater or lesser extent during word acquisition (see, e.g., Poarch, Van Hell & Kroll, 2014). Children learning a second language of a different modality and early bimodal bilingual children could yield valuable information as to whether or not they exhibit the same pattern of language processing, cross-language activation, and cognitive control as adults (Poarch & Van Hell, 2012b; Van Hell & Poarch, 2014).

Finally, Emmorey, Petrich and Gollan (2012) presented evidence suggesting the integration of lexical information from both languages either at the form level or the semantic level. Furthermore, as there is evidence that bimodal bilinguals show little or no competition between languages during the comprehension of code-blends, there is no necessity for cognitive control regions in the brain to become engaged that deal with language competition. Such regions, however, are regularly recruited in unimodal bilinguals (Abutalebi & Green, 2007). Why? Since code-switches can be detrimental to communication in monolingual settings, inhibitory control is necessary during target language production in order to avoid non-target language intrusion and ensure successful communication. Emmorey et al. (Emmorey et al) liken non-target language inhibition and subsequent releasing of this inhibition to turning a language OFF and ON. Such a comparison implies that once the OFF switch has been flipped, the ensuing cognitive load would be nullified. However, active inhibition of a non-target language may require the sustained allocation of cognitive resources resulting in phenomena such as the above-mentioned slower lexical retrieval even in bilinguals' dominant L1 (when compared to monolingual speakers' retrieval). A simple ON/OFF switch, I fear, may not do sufficient justice to the cognitive and languages control mechanism required in bilinguals, even if, as the authors point out, there are differences in the recruitment of cognitive control between unimodal and bimodal bilinguals.

Nevertheless, comparing bimodal and unimodal bilinguals' recruitment of similar or distinct brain regions during language production and comprehension could indeed provide further insights intro the neural organization of languages in the bilingual brain and the neural plasticity accompanied with acquiring a second language or regularly using two (or more) languages.

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