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Code-switching and language control

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Bilingual speakers can use one of their languages in a given interactional context or switch between them when addressing different speakers during the same conversation. Depending on community usage bilingual speakers may insert single lexical forms from one language into the morphosyntactic frame of another or alternate between languages at clause boundaries. They may also engage in dense code switching with rapid changes of language within a clause during a conversational turn (Green & Li, 2014). These varieties of language use configure the same speech production mechanism and so a theory of code-switching must be part of a theory that accounts for the range of bilingual speech. Does the proposal described in Goldrick, Putnam and Schwartz (2016) meet these criteria?

In essence, they propose that the mapping of a communicative intention into speech output can be captured by weighting grammatical constraints. Activation values are the medium of such weighting. Our control process model of code-switching adopts the same broad approach but differs in critical respects (Green & Li, 2014). Appropriate weighting, in their computationally explicit proposal, can give rise to doubling constructions that are the focus of their exposition. We endorse their caution that "... understanding the cognitive and ultimately neural processes that compute these input-output mappings is key to developing a complete theory of language processing" [p. 18]. In other words, the goal should be to develop a neurocomputational account. Their proposal may capture input-output mappings and so achieve weak equivalence but it does not provide the causal machinery necessary to achieve strong equivalence. In particular, it lacks an explicit account of the mechanisms of language control required to account for the varieties of bilingual language use. Such mechanisms are required for monolingual speakers too who can elect to speak with greater or lesser focus on grammatical correctness and spend more or less time searching for the *mot juste*.

Goldrick et al. make no explicit reference to how languages are controlled. Instead output is determined by activation with the language system itself. Yet, as they note, parallel activation of languages leads to activation to the level of word form even when only one language is the intended target of production. Utterances are also planned in advance of overt production but clearly cannot be articulated in one go yielding a problem of serial order. We need mechanisms to resolve these problems.

It is vital to distinguish between activation within the language network and selection for entry into the speech plan. Selection enables the variety of language use in bilingual speakers. We distinguish two broad classes of language control: competitive control and cooperative control (Green & Abutalebi, 2013; Green & Li, 2014). Competitive control captures circumstances where there is a single target language and non-target representations are blocked from entry into the speech plan. That is, despite being activated, the mental representations of constructions and word forms are not selected. Once in the speech plan, incremental speech production can be achieved via a competitive choice mechanism (see Green & Li, 2014 for details). Cooperative control captures circumstances involving different forms of code-switching where constructions from more than one language can be part of the speech plan. We distinguish different forms of such control: coupled control and open control. Under coupled control, control is briefly passed from one language to another within an utterance. Coupled control retains the notion, in line with Goldrick et al., that there is a target language and it provides the basis for insertion and alternation. Following Muysken (2000), who treats doubling as a form of emphasis, we suggested that doubling also reflects coupled control. Without this rhetorical demand, control would remain with the target language. But there is another possibility. Doubling may be an outcome of open control (see Chan, 2015). Open control mediates dense code-switching. Under such control there is no target language and output reflects momentary fitness in the speech plan consistent, in the case of doubling, with the joint, and equal, activation of two different word orders. Which type of cooperative control best accounts for doubling

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in everyday conversation depends on knowledge of the speaker's communicative intentions. An experimental test might be possible. Coupled control predicts an increase in the incidence of doubling under cognitive load because the currently active double could unintentionally enter the speech plan.

Our control process account contrasts with one where control is, in essence, implicit in the weightings of the grammatical forms. Under our account, different types of speech output are mediated by distinct attentional states. The Goldrick et al. proposal makes no such prediction. For the control process account, competitive control requires a narrow attentional state where words and constructions from the non-target language are blocked from production. By contrast, dense code-switching, and perhaps doubling as an instance of such control, involves a broad attentional state in which the resources from both languages are recruited to convey speaker's meaning. Such a state also allows speakers to generate witty code-switches – a feature of code-switches for some speakers (Li, 2013). This control process account is committed to the claim that the mind/brain can be in simultaneously distinct attentional states during speech production. A speaker can be intensely focussed on the meaning they wish to convey (a narrow attentional state) but use linguistic means (open control) that require a broad attentional state. Psycholinguistic, neurophysiological and neuroimaging methods are needed to test such a prediction.

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