



# The Neurocognition of language production: introduction to the special topic

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The boom of neuroscientific techniques has opened new ways to study the neural and cognitive processes sustaining human behavior. Combining the traditional behavioral measures with neurophysiological measures does not only provide information about the neurobiological basis of language processing, but also helps to test crucial theoretical hypotheses about the cognitive processes that allow individuals to use language. Hence, it is not surprising that many researchers started to study language processes such as comprehension and visual word recognition with these techniques, leading to an impressive amount of novel observations and significant advances. However, one aspect of language processing has been somewhat neglected during this development, namely the active behavior of speech production. Beyond the several reasons behind this absence of studies exploring the neural basis of language production, namely the theoretical and above all methodological complexity inherent to this psychomotor skill, this state of affairs is changing rapidly.

This is especially so thanks to technical advances and demonstrations that brain activity associated to cognitive processes can be reliably recorded in overt naming tasks with neuroimaging (e.g., Damasio et al., 1996), magnetoencephalographical (e.g., Salmelin et al., 1994; Levelt et al., 1998), and electrophysiological techniques (e.g., Eulitz et al., 2000; Christoffels et al., 2007; Strijkers et al., 2010). The goal of this Special Topic is to provide the reader with a general notion of how these techniques can be used to study the cognition of language production from a plural perspective. The Special Topic comprises both review articles providing current overviews of overt naming studies employing neurophysiological techniques and of methodological aspects of such studies, and original research articles addressing questions of various sub-domains related to speech production and further demonstrating how neurophysiological techniques can be applied to address complex cognitive questions.

Ganushchak et al. (2011) provide a concise review of language production studies employing ERPs. This review is specifically centered on the methodological issues of recording EEG in naming tasks and provides insights to the most relevant components that have been found so far, their possible significance and how well they relate to other ERP deflections observed in the literature. Indefrey (2011) review focuses on both the temporal and spatial correlates of picture naming and links this information to a well-known psychological model, hereby providing a critical update of an influential spatio-temporal meta-analysis on speech production (Indefrey and Levelt, 2004). Llorens et al. (2011) contribute with a critical review on yet another, less frequent but very powerful, technique for studying language production, namely intra-cranial recordings. The authors focus on the advantages and disadvantages of using this technique and, based on the available evidence, they

provide a characterization of the neural events occurring in the language network during speech. Finally, Purcell et al. (2011) offer the first quantitative meta-analysis of neuroimaging studies that have examined the neuronal substrates involved in the central and peripheral processes of written word production.

With respect to the original research articles, the Special Topic includes contributions concerning a wide range of speech production theory, illustrating the strong potential of neurophysiological investigations to address relevant cognitive questions for many areas in the field. Wu and Thierry (2011) explored phonological differences in first versus second language production by combining ERPs with a bilingual speech production task, providing novel temporal insights about the progression of language control in bilingual speech production. Also relying on an overt naming paradigm and ERPs, Strijkers et al. (2011) demonstrate how this research strategy can shed light on the role of higher-order intentional and goal-directed processing in accessing the lower-level lexical network during object naming. Price et al. (2011) investigated the interaction between speech production and comprehension through fMRI with the goal of identifying brain activation related to the internal model of speech production after vocalization. Finally, two fMRI studies concerning sentence production form part of the Special Topic. The first one (Shapiro et al., 2012) explored the nature of morphological inflections in sentence production and, in particular, whether neuronal specificity for grammatical operations could be identified. The second one (Tremblay and Small, 2011) examined the hemodynamic correlates involved in the selection of motor responses during sentence production and addressed the question of whether or not motor response selection is different for the production of sentences compared to isolated words.

We believe that the combination of review articles providing critical overviews of the available techniques and the results obtained from them so far with original research articles employing these techniques to study the cognition of language production perfectly satisfies the goals we set out to achieve with the current Special Topic: (1) Offer current and comprehensive insights of the neurophysiological advances in the field both for novices and experts; (2) Remove any lingering skepticisms toward the use of temporally and spatially sensitive measures to study language production; (3) Illustrate with various techniques and for various areas how spatio-temporal knowledge on language production can be exploited to target cognitive questions from a novel point of view. And although the “neurocognition” of language production is still in its infancy, with many open questions and unexplored territories, this is also what makes this such a vivid and exciting field, which will certainly grow exponentially in the years to come.

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