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► **To cite this version:**

Ludovic Ferrand. Applying Ockham's chainsaw in modeling speech production. Behavioral and Brain Sciences, 1999, 22 (1), pp.42-43. 10.1017/S0140525X99261778 . hal-03878935

HAL Id: hal-03878935

<https://hal.science/hal-03878935>

Submitted on 28 Mar 2024

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APPLYING OCKHAM'S CHAINSAW IN MODELING SPEECH PRODUCTION

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“Things should be made as simple as possible, but not simpler.”

Albert Einstein

Abstract : The theory of lexical access in speech production reported by Levelt, Roelofs, and Meyer is exciting, well-described and well-organized, but because it relies mainly on the principle of simplicity (Ockham's razor), I argue that it might not be true. In particular, I suggest that over-applying this principle is wrong.

Levelt, Roelofs, and Meyer (LRM thereafter) have done a good job in summarizing their exciting work. They provide us with an authoritative and nicely presented review of their speech production model and related experimental studies. However, I feel that it is also the case that LRM's assumptions about their speech production model rest on a number of theoretical preconceptions that are not necessarily valid. My main criticism concerns their reliance on the principle of Ockham's razor. I believe that over-applying this principle, as they do, is wrong.

LRM apply the principle of Ockham's razor in modeling lexical access in speech production: this principle states that "Plurality should not be posited without necessity"

(William of Ockham, ca. 1285-1349). In other words, this principle states that one should not make more assumptions than the minimum needed. This principle, also called the principle of parsimony or simplicity, underlies almost all scientific modeling and theory building. LRM adopted the strong version of this principle saying that their model - and that models in general - have to be as simple as possible.

Over-applying this principle is unrealistic because it says that simpler models are more likely to be correct than complex ones. The problem of this over-application may lie in over-simplification. Why a theory of lexical access in speech production should be simple? Nowadays, this principle seems to be used within a context of a belief that perfection is simplicity itself. However, I believe that any real problem is complex and will force a complex model.

Part of the problem is also to know what counts as necessary. To modularists (such as LRM), interactionists multiply pluralities unnecessarily (feedback connections, inhibitory mechanisms, parallel activation, cascade processing). To interactionists, positing interactivity (e.g., Dell et al., 1997; Humphreys, Riddoch, & Price, 1997) and inhibition (e.g., Stemberger, 1985) is necessary. In the end, Ockham's razor (as over-applied by LRM) says little more than that for modularists interactivity and inhibition is unnecessary but for interactionists that is not true.

LRM's working hypothesis is that a strictly serial, feedforward, semantically holistic, localist model, with morphological decomposition and no inhibition is considerably simpler to describe, comprehend, and test than a cascaded, interactive, semantically componential, distributed model, with inhibition and without morphological composition (see also Jacobs & Grainger, 1994, for a similar claim applied to visual word recognition). But since every model is, by definition, incomplete (and a fortiori, simple models such as the one defended by

LRM), it is hardly surprising that a set of complementary models, more complex, is generally needed to describe more adequately lexical access in speech production.

I will consider two features that are not considered to be needed in LRM's model, although experimental evidence favor the inclusion of such features in a (more complex) model of speech production. Consider first the "inhibitory" feature. LRM did not include any inhibition in their model, following the principle of simplicity. However, their model is unable to explain the semantic inhibition effects observed by Wheeldon and Monsell (1994) in picture naming. In particular, these authors reported unambiguous evidence that the lexicalization process during picture naming is inhibited when a word likely to be a competitor has been primed by a recent production. Naming a pictured object (e.g., SHARK) was retarded when a competing word (e.g., WHALE) had been recently elicited by a definition. Berg and Shade (1992; Schade & Berg, 1992; see also Dell & O'Seaghdha, 1994) have summarized other empirical evidence in favor of a model which includes both excitatory and inhibitory mechanisms. These data are hard to reconcile with the purely activation-based model of LRM.

Consider now the "interactivity" feature. A thorough examination of the cognitive neuropsychology literature reveals studies that produce evidence for the existence of interactive processes between lexical selection and phonological encoding (Dell et al., 1997; Laine & Martin, 1996; Martin et al., 1996). For instance, Laine and Martin (1996) studied an amomic patient who suffered from a partial functional disconnection between lexical-semantic and lexical-phonological levels. Systematic manipulation of semantic and phonological relatedness between the to-be-named targets indicated that this patient's word error patterns were sensitive to both types of lexical relatedness. LRM's discrete theory of lexical access is unable to explain the observed effects of semantic and phonological relatedness. However, these results are consistent with an interactive activation model.

In sum, there is a great deal to disagree with the present target article, and the moral of this story is that Ockham's razor should not be wielded blindly.

ACKNOWLEDGMENTS

I am grateful to Art Jacobs for his insightful comments.

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