

How to detect the presence / absence of morphological activity in language production

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Sahin (2009) have shown on the grounds of electrophysiological data that language production involves neural activity corresponding to distinct cognitive operations that are serially ordered in time. This is revealed by three experimental conditions: Read merely requires the subject to repeat a stimulus word. Only lexical access is required for this task, since the word is not inserted into any grammatical context: the word must be retrieved from long term memory in order to be pronounced.

In the null inflect condition, a carrier sentence such as *ils sont* __ "they are __" followed by the (visually presented) stimulus *électrique* enforces the participant to grammatically process the stimulus word. This operation, however, leaves no phonetic trace: in the target *électriques*, the -s marking plural in spelling is not pronounced ([elektrik]). On top of a lexical access, this condition thus operates grammatical tagging (here plural). This is referred to as concatenation because a number of grammatical features need to be associated to a lexical item.

In the overt inflect condition things are as before except that the body of the stimulus (*électri*[k]) is now modified: the carrier sentence *on parle de* __ "they talk about __" requires the participant to produce the noun associated *électricité* "electricity", pronounced *électri*[s]-ité where the [k] present in the adjective appears as [s] ([k] alternates with [s]).

Following the results of Sahin et al., lexical access (Read) occurs at ~200ms, concatenation (Null Inflect) at ~320ms and phonology (k-s alternation in Overt Inflect) at ~450ms. This bears out the prediction that is made by the generative architecture of grammar since Chomsky (1965: 15ff), known as the inverted T model: in language production there are three macro operations (each encompassing a host of more detailed processing) that occur in this serial order.

The experimental evidence that we report replicates Sahin et al. in behavioural modality, and using stimuli sets from French (the original experiment used English stimuli). That is, in the Read condition, our participants were visually presented with the instruction "répétez __" ("repeat __"), followed by a fixation cross and the presentation of the stimulus word. Then a second fixation cross was displayed for 1500ms during which the participant was instructed to pronounce the word aloud. The same protocol was displayed in the Null Inflect and Overt Inflect conditions, except that the relevant carrier sentence appeared instead of the instruction.

Our results (figure 1) confirm Sahin et al.'s findings on a behavioural basis: the more cognitive operations are involved (Read < Null Inflect < Overt Inflect), the greater the response time. This result allows us to determine, for any given production, whether or not morphological activity was carried out by the mind/brain: yes for items located in the blue and red plot area in figure 1 (Null and Overt Inflect), no for items occurring in the green plot area. The same goes for the detection of phonological activity: yes (blue), no (red and green).

A more detailed word-by-word analysis shows that it is not the case that all items from a given stimulus set behave alike: bayesian analysis shows that the most probable location of *électricité* is in the green area (hence lexical storage of the whole item: no concatenation, no phonology), a word like *historicité* is most probably located in the red area (lexical access and concatenation, but no phonology).

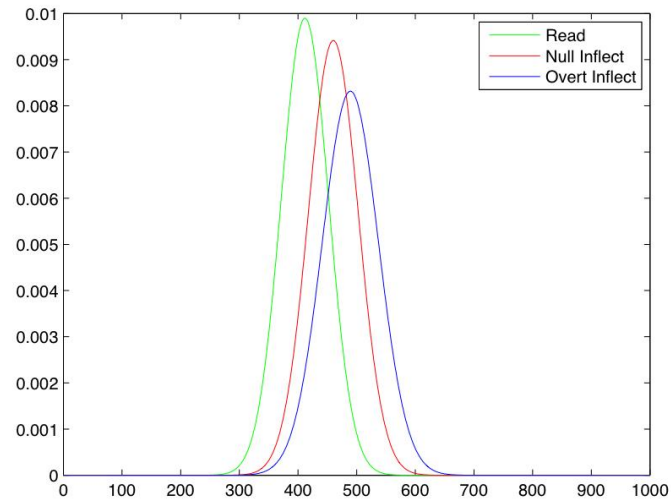


Figure 1. Estimated gaussian distributions of RT for the Read, Null inflect and Overt inflect conditions.

References:

Chomsky, Noam. 1965. *Aspects of the Theory of Syntax*. Cambridge, Mass.: MIT Press.

Sahin, Ned T., Steven Pinker, Sidney S. Cash, Donald Schomer & Eric Halgren. 2009. Sequential Processing of Lexical, Grammatical, and Phonological Information Within Broca's Area. *Science* 326. 445-449.