# PHONOLOGICAL PRIMING EFFECTS IN LEXICAL COMPETITION

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## ABSTRACT

Cross-modal phonological priming between auditory pseudoword primes and visual word targets gave rise to two experiments. Targets were carrier trisyllabic words in which two shorter words were embedded. Interference effects were greater than facilitation, and the embedded words were never activated. It is suggested that decision bias effects could explain the weakness of phonological priming.

Lexical ambiguity inherent in carrier words in which are embedded shorter words may be resolved either according to a specific segmentation routine [1] or as a by-product of excitation and inhibition of overlapping lexical items [6]. In fact, lexical embedding is very frequent in English [4], and is probably still more important in French, a language which presents around 85% of polysyllabic words. Gating studies, as well as simulations, suggest that the amount of acoustic information is a main determinant of lexical access as far as an interactive activation process is assumed to command which lexical candidates are momentarily activated, and which of them gets the strongest activation [2]. In the TRACE model proposed by McClelland and Elman [6], the degree of matching information determines the issue of lexical activation at each processing cycle. Intermediate units such as phonetic features or phonemes are progressively activated or desactivated, irrespective of the lexical status of the input signal. Exhaustive alignment of the processing system on the input produces competition between multiple lexical hypotheses [2].

Phonological priming paradigm is well suited to test certain assumptions of this model. A residual activation of lexical hypothesis corresponding to the embedded words may facilitate their recognition. On the other hand, the longer carrier word offers the best conditions of phonological overlap between prime and target, and might present the highest activation. The fact that primes are pseudowords (except in the repetition condition), and that targets are words ought not to diminish priming effects since these effects are based on phonological overlap.

However, it is worth noting that phonological priming data do not afford clear-cut evidence [7]. In experiments bearing on monosyllabic words [3, 9] or on bisyllables [7], when both primes and targets were auditorily presented, interferences were often more important than facilitations. Still more often, there was no consistent priming effect [3, 7, 9]. We used a cross-modal priming technique, where subjects see a visual target immediately following an auditory prime, in order to pick up residual effects of the activation of successive segments in the auditory input. If priming is modality-independent and intervenes at the level of lexical entries, an auditory prime may affect a visual target as well as an auditory target [5]. As for lexical embedding, it offers a better opportunity to follow the time course of competition between lexical hypotheses than the non ambiguous items that usually constitute the test materials [8].

Several predictions were tested. The multiple representations of lexical hypotheses at different moments in time allows different types of segmentation to operate [2]. The amount of matching information will interact with the presence or the absence of an alignment between the onset of auditory primes and the representation of word targets. Activation of the initially embedded word, although transient, could be sufficient to trigger a lexical access attempt at the monosyllabic target, since it is initially aligned with the input. The longer carrier word will receive an increasingly overwhelming amount of activation, since it satisfies to the two requisits of matching and alignment.



However, the finally embedded bisyllabic word could become weakly activated, at least from the Isolation Point (according to Marslen-Wilson's definition of the Isolation Point [5]) onwards, because its match with part of the input and despite it is not aligned with the input. A sufficient amount of matching could thus compensate for the non alignment. In a second experiment, primes corresponding to the carrier words will contain a parsing cue in order to diminish the advantage of the long words and to enhance the chances of embedded words of being recognized [2]. Alternatively, the absence of phonological priming might be due to processing differences between auditory and visual modalities. It might thus support the assumption that post-access processes are implied both in the priming paradigm and in the lexical decision task.

Two cross-modal priming experiments were run, both with a lexical decision task. Experiment 1 aimed to compare the respective activation levels of each embedded word and of the carrier word when the input signal and the phonological representations of each target were progressively overlapping. In experiment 2, an interval of silence was introduced in the repetition condition to reinforce the lexical hypotheses corresponding to the embedded words.

## EXPERIMENT 1

### Method

**Subjects:** 18 native speakers of Parisian French participated.

**Materials**

Test stimuli were 15 low-frequency trisyllabic words, constructed so that both the syllable in initial position and the two following syllables were high- or middle-frequency meaningful words, e. g. "chapelure" = "chat" + "pelure". Syllabic structure of the monosyllable was CV, CVC or CCV (C: consonant, V: vowel). Fifteen sets of five trisyllabic items served as primes. A set of primes involved three pseudowords and two words: (1) a pseudoword beginning with a phoneme of the same broad phonetic category as the initial phoneme of the target ("sebojim"), (2) a pseudoword beginning with the same first syllable as target ("chabojim"), (3) a pseudoword beginning with the same sequence as target until target Isolation point ("chapeleun"), (4) the carrier word, (5) a word unrelated with the target (control condition). Targets were in turn one of the embedded words or the carrier words. In addition, 15 fillers were presented as primes with a pseudoword as target. All the items were stored and digitized at 10 kHz with 12 bit resolution.

**Procedure and design:**

Each of the 18 subjects participated to the five conditions, the order of presentation of the pairs being balanced within each subgroup of 3 subjects. No subject heared the same prime twice or saw the same target twice. The visual probe followed the auditory target immediately, and the speeded lexical decision was performed on the visual target. Response times (RTs) were measured from the offset of the auditory prime. The types of primes (5 modalities) and the format of targets (monosyllables, bisyllables, trisyllables) were between-subject factors.

**Results**

Error rates and RTs longer than 1,500 ms did not exceed 1.5%, and were discarded from the analysis. Mean RTs were faster for a monosyllabic target (501 ms, sd = 98 ms) than for either a bisyllabic (569 ms, sd = 130 ms) or a trisyllabic target (595 ms, sd = 137 ms). ANOVAs run on RTs showed that the main effect of target format was significant, overall and for each overlap condition, both by subjects and by items. More important, pairwise comparisons between test and control conditions for each overlap and each type of target showed that a significant effect of phonological priming never appeared, excepted in the repetition condition for a trisyllabic target (Fig. 1). Thus, a partial overlap either had no effect, when prime and target were sharing a phonetic category for their initial phoneme, or gave rise to weak interferences for the two embedded words, even when the one-syllable overlap corresponded to the initially embedded word and when the Isolation-point overlap gave enough acoustic information to access the finally embedded word. The next experiment aimed to help the subjects parse the carrier words into their components.

## EXPERIMENT 2

An interval of silence was introduced inside the carrier words in order to facilitate lexical access attempts to the embedded words. Its duration (from 18 ms to 34 ms) had been evaluated for each carrier word in a previous discrination experiment so that subjects could parse the signal in 50% of occurrences.

**Method**

18 native speakers of Parisian French participated. Except the introduction of an interval of silence in the trisyllabic primes for repetition trials, the apparatus and procedure were the same as those of the preceding experiment.

**Results**

1.3% erroneous data or RTs longer than 1,500 ms were discarded. Mean RT values were of the same order as previously, RTs to monosyllabic targets being significantly faster for each overlap condition than RTs to bisyllables and trisyllables. As shown in Fig. 2, comparing each overlap condition for each type of target to the control condition, the introduction of a silence strengthened the interference effects. Planned comparisons showed that these effects were significant for all types of word targets in the phonetic-category- and the one-syllable-overlap conditions, and for both embedded words in the repetition condition (for F1(1, 17), $p<.01$; for F2(1, 14), $p<.02$). The weak facilitation effect of the carrier-word target in the repetition condition did not reach significance. An interval of silence sufficient to be auditorily perceived did not trigger a lexical parsing of the carrier word into its constituents. This result pointed out that the interval of silence has not been processed as a potential boundary cue.

## GENERAL DISCUSSION

The present research aimed to evaluate the time course of lexical competition when a carrier word contains embedded words. Phonological priming was not efficient to trigger lexical access attempts: A facilitatory effect appeared in just the repetition condition for the longer word. Initial overlap had no effect in most previous studies [3, 7, 9]. Contrary to our expectations, processing of ambiguous words did not enhance the weight of residual activation, if any. Whatever, our data are not inconsistent with all the predictions derived from TRACE. The amount of inhibition for the initially embedded word decreased progressively as the overlap increased, except in the repetition condition. The importance of onset alignment has been assessed for all the overlaps. The processing system ignored parsing cues. However, even if interference effects may correspond to the issue of lexical competition, the difference between the two experiments suggest that interferences may be due to the discrepancy between pseudoword primes and word targets [7], increased by the presence of a silence. The presence, in the experimental set, of plurisyllabic suits segmented into their lexical components disturbed the search of a congruency between primes and targets. Subjects might have not processed the primes containing an interval of silence as two words, but as a long word containing a mismatch by misalignment. When they saw the word targets, they needed more time to respond "word", because they were waiting for a pseudoword. This point could explain the observed longer RTs in the repetition condition (Exp. 2). These results do not ascertain that critical matching points, such as a one-syllable overlap or an overlap between prime and target until the Isolation Point of the finally embedded word, play no role in lexical access. They suggest that a lexical decision task taps only into the phonological output representation, and not into the lexical hypothesis elaborated during prime processing. The weakness of phonological priming could thus be due to a decision bias.

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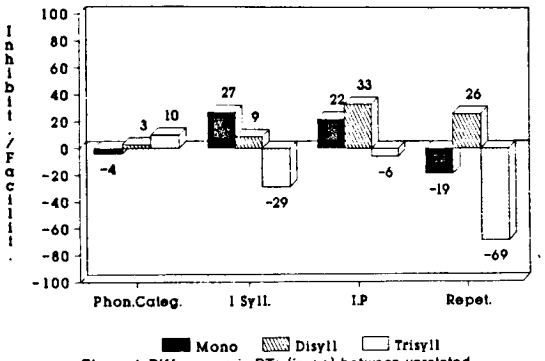


Figure 1: Differences in RTs (in ms) between unrelated and experimental conditions as a function of the amount of prime-target overlap for each type of target (Experiment 1)

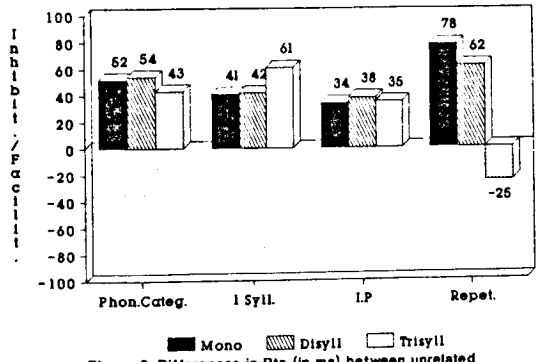


Figure 2: Differences in Rts (in ms) between unrelated and experimental conditions as a function of the amount of prime-target overlap for each type of target (Experiment 2)

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