

## MENTAL LEXICON ACCESS: INITIAL PHONOLOGICAL & MORPHEMIC SYLLABLE IN AUDITORY RECOGNITION

P.-Y. Connan\*, M.-N. Metz-Lutz\*\*, F. Wioland\*, G. Brock\*

\*Institut de Phonétique, ERS 125 CNRS

Université des Sciences Humaines de Strasbourg - FRANCE

\*\*Clinique Neurologique, INSERM U398

Hôpitaux Universitaires de Strasbourg - FRANCE

### ABSTRACT

This study deals with an auditory lexical decision task that should enable a better understanding of auditory word recognition. Interactive processes of perception and comprehension of spoken language are examined. A major question addressed here, is to find out if auditory word recognition is facilitated when a word or a non-word prime or target share the same initial sequence, whose status, whether phonological or morphemic, may change access conditions to the mental lexicon.

Results show a lack of a phonological priming effect and the specific status of the initial morphemic syllable as a factor that facilitates lexical decision. The data are discussed in relation to lexical recognition models such as the Cohort Theory. They differ from results usually obtained in the domain.

### INTRODUCTION

Spoken word recognition is an extremely complex phenomenon. It is plausible to assume the existence of a mental lexicon, whose components are accessible through different mental processes. This complexity is due, on one hand, to the numerous steps and functions (access, selection and integration, as described in many recognition models) that constitute the spoken language processing; on the other hand, to multiple relationships that exist within the different units of mental representations: phonological, morphological, syntactic and semantic dimensions can interact at different levels and time in these processes.

A good amount of studies and interactive models — like the Cohort model [1] — have shown the priority of acoustic-phonetic analysis of the incoming speech signal (bottom-up information) and the importance of acoustic features of word onsets during the access phase [2]. Such a model suggests that this initial sensory input could activate the representation of the signal itself, as well as all other words with common properties.

Thus, if word onsets «do have special status in the lexical access of spoken words» [2], a major question concerns the nature of the onsets of verbal sequences: do morphemic structure (prefixed words for e.g.) undergo a different processing during word recognition processes, compared with words sharing a similar syllabic onset? In other terms, could morphemic relationships be represented explicitly in the mental lexicon.

Several studies have dealt with this morphemic structure but largely using visually presented material. It has been shown [3] that prefixed and non-prefixed words (but not pseudo-prefixed words whose mean decision times are longer) are processed equally rapidly, «indicating that a decompositional process (left to right) is efficient». Interesting results in both visual and auditory modalities [4] have been attested, to demonstrate that «prefixed words are recognized, after the prefix has been removed, via a representation of their stem». Moreover, certain authors [5] tried to distinguish morphemic relationships from semantic and formal ones. The question, now, is to know if significant effects are just «a conver-

gence of semantic, orthographic and phonological relationships». This study shows that morphemic priming is «a separate dimension along which two words can be related».

### METHOD

With an aim to evaluate the role and the importance of word onset during the mental lexical recognition process, a lexical Decision task was used. For the two experimental conditions, subjects were required to listen to different pairs of Words (W) and/or Non-words (Nw) and to judge whether or not the second stimulus (the target) was a word of the French lexicon. The duration between W or Nw prime and W or Nw target was approximatively 400 ms.

### Corpus

#### • Syllabic priming condition.

Prime-target pairs of this first priming condition consisted of 138 pairs of syllabic French Words and Non-words. Nw were created from real words by displacing one phoneme. For this first experimental condition, 8 different combinations were used (see Table 1), where the status (W or Nw) of the prime and target may change with the presence or not of a syllabic priming effect. For each combination, 15 different pairs of verbal sequences were presented.

#### • Morphemic priming condition.

For this second experiment also, 8 different combinations of Word and Non-word pairs (see Table 2), with a total of 96 bi or tri-syllabic pairs of verbal sti-

muli were used. Note that the morphemic structure, here, is the «prefixe».

### Subjects

A group of 30 normal subjects participated in the experiment. This group was composed of the same number of male and female subjects. All subjects were, monolingual, French speakers and young adults, from 18 to 30 years old, chosen among volunteer students at the University of Strasbourg. None of them had hearing loss or neurological impairment. The same group of subjects participated in the two experimental conditions.

### Procedure

A work-station for the lexical decision task was specially built to accumulate data with a 100% reliability. The stimuli were recorded on the first channel of a Tascam Tape and were presented through headphones. Subjects, a maximum of 3 at a time, were carried out the tests in a sound-proof anechoic room, and had to press, the most rapidly and the most exactly possible, two buttons (labelled «yes» & «no») on an individual board. On the second channel, a «target-impulse activated a millisecond counter, localized on a digital acquisition card of a micro-computer. This inaudible signal started exactly at the onset of the target. The counter was stopped when subjects pressed one of the buttons. Finally, target counting, Reaction Times calculation and file creation for later statistical analysis were executed by software.

Table 1. Combinations, examples & results for syllabic priming

Type	Combination	Resp.	Example	mean RTs (ms)
1	W-W syll.+	yes	galop - gamin	779,96
2	W-Nw syll.+	no	bouton - [buʒɛj]	936,72
3	W-W Ø	yes	sapin - propos	782,39
4	Nw-Nw Ø	no	[rakaj] - [quzɛ]	914,14
5	Nw-W Ø	yes	[gafo] - milieu	772,26
6	Nw-Nw syll.+	no	[mupɛ] - [mutwar]	928,98
7	Nw-W syll.+	yes	[fime] - figure	791,76
8	W-Nw Ø	no	salon - [prode]	898,94

## RESULTS

Mean error rates were calculated for each experiment, subject and types of combinations. For syllabic and morphemic priming conditions, a mean error rate of respectively 2,19% and 3,04% was found. No subject was eliminated due to a high error rate.

Separate statistical analyses of variance (one-way ANOVA) were conducted for all combination types in the two experimental conditions. We first compared mean RTs for "yes" and "no" responses and, as expected, significantly faster RTs for "yes" in both experiments were found ( $p < 0.05$ ).

In the first experiment, no significant effect ( $p = ns$ ) of syllabic priming (Type 1 vs. Type 2) was found. The same result was found in Exp. n°2 (Type 5 vs. Type 3) in which the W-W Syllabic (pseudo-morpheme, here) condition, vs. W-W neutral condition were duplicated.

In the morphemic priming condition, statistical analyses revealed that mean RTs were significantly faster for W-W priming pairs than for neutral W-W pairs ( $p < 0.05$ ). On the contrary, no significant effect was found comparing W-W morphemic priming pairs vs. W-W syllabic priming pairs, intra and inter experimental conditions ( $p = ns$ ).

Table 2. Combinations, examples & results for morphemic priming

Type	Combination	Resp.	Example	mean RTs (ms)
1	W-W morph.+	yes	déboucher - déranger	808,36
2	W-Nw Ø	no	convenu - [desøge]	934,03
3	W-W Ø	yes	travail - prévenir	865,32
4	Nw-Nw Ø	no	[vedaj] - [sivø]	918,94
5	W-W syll.+	yes	infantile - incapable	827,80
6	W-Nw syll.+	no	emporter - [ätarke]	994,96
7	Nw-W Ø	yes	[efape] - déranger	830,50
8	Nw-Nw syll.+	no	[äsivø] - [ärimit]	1036,59

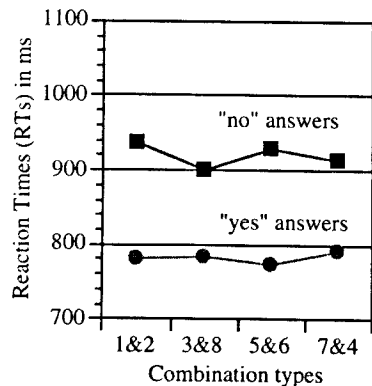


Figure 1. Results for syllabic priming

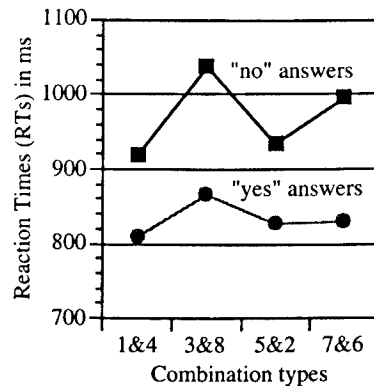


Figure 2. Results for morphemic priming

## DISCUSSION AND CONCLUSION

Results obtained in the syllabic priming condition (i.e. a lack of phonological effect) confirm earlier findings [6]. A few other studies also invalidate, to a certain extent, one of the hypothesis of the Cohort model: the special status, in word recognition, of word onsets during the primary activation process of candidates that are phonologically similar. However, although our findings, as has been reported elsewhere [7] strongly suggest «no evidence of facilitation in response to targets preceded by primes that shared word-initial phonological information with the target», evidence for inhibition could not be demonstrated: mean RTs obtained for W-W pairs without any priming effect, were not significantly longer than W-W syllabic prime pairs. We are inclined to favour the hypothesis of a desactivation process more than an inhibiting one. Lack of RT increase show that the final decision is not influenced by the prime i.e. activation level has become neutral again.

Results for the second experiment, demonstrate a facilitation of lexical decision when prime-words and target-words share the same morphemic onset (Type 1 vs. Type 3). This result seems to indicate that identification of a prefixe — and not simply of a phonological similarity — produces a different activation (facilitation) of the cohort candidates. But, on the contrary, when W-W pairs with a same morphemic or pseudo-morphemic (similar to syllabic priming) onset are compared, there is no significant effect. Taft & Forster hypothesized that RTs must be longer for pseudo-affixed words due to a complexe pre-lexical morphological analysis: our recent results do not confirm such a finding. Other studies, cited in the literature [8], also advocated that a prefixed-word prime does not facilitate the identification of a second word with the same prefixe (e.g. préface/prénom) compared to the condition in which the same word is presented after a pseudo-

prefixed word sharing the same initial syllable (e.g., préfet/prénom).

Finally, the significant effect of morphemic priming found in Exp. n°2, could be interpreted in terms of a specific process within a word recognition model. This hypothesis is being explored using more data.

## REFERENCES

- [1] Marslen-Wilson W.D. (1987), "Functional parallelism in spoken word recognition", *Cognition* 25, 71-102.
- [2] Marslen-Wilson W.D., Zwitserlood P. (1989), "Accessing Spoken Words: The Importance of Word Onsets", *Journal of Experimental Psychology: Human Perception and Performances*, vol. 15, n°3, 576-585.
- [3] Bergman A.W., Hudson T.W., Eling P. (1988), "How Simple Complex Words Can Be: Morphological Processing and Word Representations", *The Quarterly Journal of Experimental Psychology*, 40A, (1), 41-72.
- [4] Taft M., Hambley G., Kinoshita S. (1986) "Visual and Auditory Recognition of Prefixed Words", *The Quarterly Journal of Experimental Psychology*, 38A, 351-366.
- [5] Napps S.E. (1989), "Morphemic relationships in the lexicon: Are they distinct from semantic and formal relationships", *Memory & Cognition*, 17 (6), 729-739.
- [6] Connan P.Y., Metz-Lutz M.N., Wioland F., Brock Gilbert (1994), "Rôle des informations lexicales dans la reconnaissance des mots. Etude chez les sujets sains", *TIPS*, 24, 1-20.
- [7] Slowiaczek L.M., Pisoni D.P. (1986) "Effects of phonological similarity on priming in auditory lexical decision", *Memory & Cognition*, 14 (3), 230-237.
- [8] Colé P. (1988), "Le traitement des mots dérivés: une analyse morphologique sélective", *L'année Psychologique*, 88, 405-418.