

Limits on bilingualism

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SPEECH, in any language, is continuous; speakers provide few reliable cues to the boundaries of words, phrases, or other meaningful units. To understand speech, listeners must divide the continuous speech stream into portions that correspond to such units. This segmentation process is so basic to human language comprehension that psycholinguists long assumed that all speakers would do it in the same way. In previous research^{1,2}, however, we reported that segmentation routines can be language-specific: speakers of French process spoken words syllable by syllable, but speakers of English do not. French has relatively clear syllable boundaries and syllable-based timing patterns, whereas English has relatively unclear syllable boundaries and stress-based timing; thus syllabic segmentation would work more efficiently in the comprehension of French than in the comprehension of English. Our present study suggests that at this level of language processing, there are limits to bilingualism: a bilingual speaker has one and only one basic language.

As in our earlier experiments, subjects listen to lists of unrelated words and press a response key as soon as they hear a word beginning with a specified word-initial sequence of sounds,

which is either a consonant-vowel (CV, for example, *ba-*) or a consonant-vowel-consonant (CVC, for example, *bal-*). French speakers listening to French responded faster when the target sequence was exactly the initial syllable of a word than when it was more or less of the word than the initial syllable. For instance, their responses to *ba-* were faster in *balance* (first syllable *ba*) than in *balcon* (first syllable *bal*), but *bal-* responses were faster in *balcon* than in *balance* (Fig. 1a).

English listeners performing the same task on English words such as *balance* and *balcony*, however, did not respond differently to CV and CVC targets in either word type (Fig. 1b). When English listeners heard the French words, they still showed no sign of syllable-based responding (Fig. 1d); but French listeners' responses to the English words were as syllable-based as their responses to the French words had been (Fig. 1c).

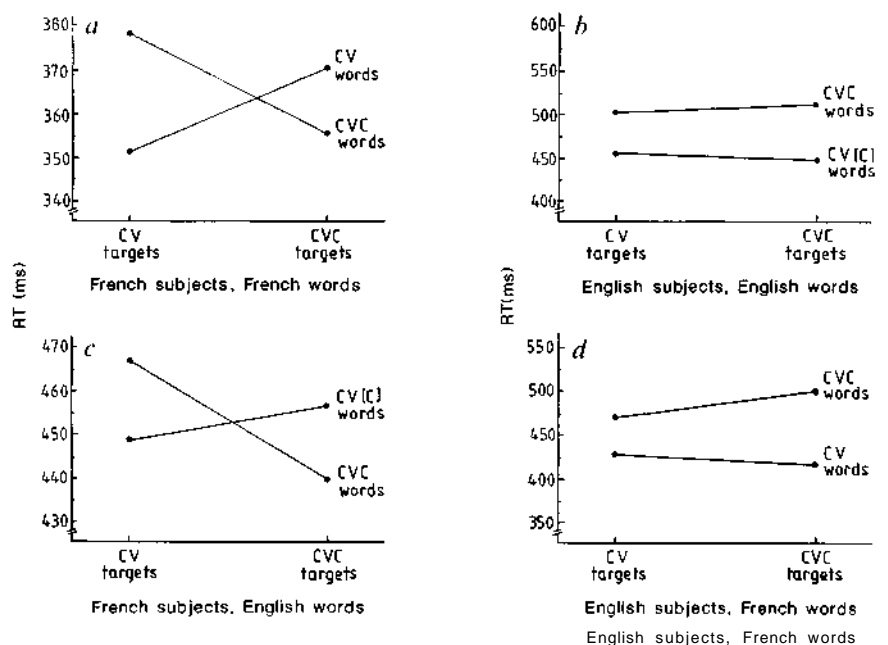
We concluded that speakers use syllabic segmentation only if their native language encourages it. Those who first acquired French, in which syllabic segmentation is efficient, can use syllabification even when they are listening to other languages. Those who first acquired English, in which syllabic segmentation is inefficient, cannot syllabify even when they are listening to a language, like French, which encourages syllabification.

In the present study we asked: can speakers who command two languages perfectly also vary their segmentation routines? We tested speakers who acquired two languages, French and English, in early childhood, still spoke both languages regularly, and were accepted by other native speakers of each language as native speakers; furthermore, 75% of our speakers had one native French-speaking and one native English-speaking parent.

We tested 13 such subjects in England and 14 in France. The subjects were required to express a preference for one of their languages. Although they all averred that they spoke each language with equal ease, they were made to provide an answer to the question: 'if you had to lose one of your languages to save your life, which would you keep?' This answer we termed their 'dominant' language. Each subject performed both the French and the English experiment from our previous studies with monolinguals.

When the group of 27 subjects was considered as a whole, the results with each set of materials did not resemble the performance of the monolingual groups in our previous studies. When our subjects were divided by choice of dominant language, however (15 English, 12 French), their results showed a pattern which can be related to our previous findings. English-dominant subjects performed like English monolinguals with both the

FIG. 1 Mean target-detection response time (RT) as a function of size of target sequence (CV, for example, *ba-*, versus CVC, for example, *bal-*) and size of initial syllable of stimulus word (CV versus CVC for French; CV[C] versus CVC for English), for four combinations (a-d) of subjects' native language and stimulus presentation language.



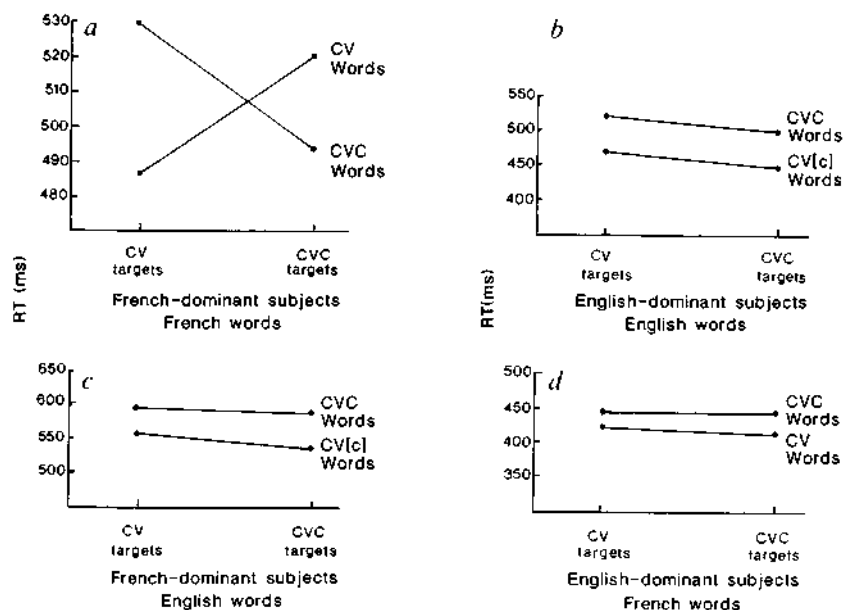


FIG. 2 Mean target-detection response time (RT) as a function of size of target sequence (CV, for example, *ba-*, versus CVC, for example, *bal-*) and size of initial syllable of stimulus word (CV versus CVC for French; CV[C] versus CVC for English), for four combinations (a-d) of subjects' dominant language and stimulus presentation language.

English and the French materials (Figs. 2b and 2d). French-dominant subjects behaved like French monolinguals with the French materials (Fig. 2a) and like English monolinguals with the English materials (Fig. 2c).

These results suggest several conclusions of considerable theoretical import. First, the fact that the group as a whole did not perform like either monolingual group is evidence that even speakers who by any pragmatic definition command two languages perfectly do not necessarily function as two monolinguals in one person. Instead, for any speaker, one and only one language is basic. Bilinguals who were English-dominant did not use syllabic segmentation when listening to either of their native languages; the only bilinguals who used syllabic segmentation were those who were French-dominant. Language dominance fully determined the speech segmentation routines that our subjects could apply.

It is notable, however, that the French-dominant bilinguals did not use syllabic segmentation when they were listening to English. As we have argued, syllabic segmentation is inefficient for processing English, but French monolinguals, as our previous studies showed, have no option but to use it. French-dominant French-English bilinguals, however, seem to be able to abandon syllabic segmentation when it would be inefficient. This prompts our second main conclusion: that syllabic segmentation is a special ('marked') language processing routine which speakers develop and apply only if their (dominant) native language encourages it. The majority of languages, including English, do not encourage it; their speakers develop only 'unmarked' non-syllabic routines (which may work adequately on any language). A speaker who segments syllabically can, it seems, with sufficient exposure to cases in which this is inefficient, also develop the unmarked process. Speakers who begin with unmarked routines, however, can apparently not develop syllabic segmentation, no matter how extensive their exposure to cases in which it would be more efficient. Therefore the English-dominant bilinguals necessarily performed like English monolinguals with both languages, whereas the only bilinguals who showed evidence of both syllabic and non-syllabic segmentation were those who were French-dominant. Thus, a speaker can simultaneously command a marked and an unmarked segmentation routine only when the language which encourages use of the marked routine dominates the language which encourages use of the unmarked routine. This finding has obvious bearing on contemporary parameter-setting theories of language acquisition³.

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1. Cutler, A., Mehler, J., Norris, D. & Segui, J. *Nature* **304**, 159-160 (1983).
2. Cutler, A., Mehler, J., Norris, D. & Segui, J. *J. Memory Language* **25**, 385-400 (1986).
3. Chomsky, N. *Knowledge of Language: Its Nature, Origin and Use* (Praeger, New York, 1986).

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Primary structure and functional expression of the cardiac dihydropyridine-sensitive calcium channel

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IN cardiac muscle, where Ca^{2+} influx across the sarcolemma is essential for contraction, the dihydropyridine (DHP)-sensitive L-type calcium channel¹ represents the major entry pathway of extracellular Ca^{2+} . We have previously elucidated the primary structure of the rabbit skeletal muscle DHP receptor by cloning and sequencing the complementary DNA². An expression plasmid carrying this cDNA, microinjected into cultured skeletal muscle cells from mice with muscular dysgenesis, has been shown to restore both excitation-contraction coupling and slow calcium current missing from these cells, so that a dual role for the DHP receptor in skeletal muscle transverse tubules is suggested³. We report here the complete amino-acid sequence of the rabbit cardiac DHP receptor, deduced from the cDNA sequence. We also show that messenger RNA derived from the cardiac DHP receptor cDNA is sufficient to direct the formation of a functional DHP-sensitive calcium channel in *Xenopus* oocytes. Furthermore, higher calcium-channel activity is observed when mRNA specific for the polypeptide of relative molecular mass ~140,000 (α_2 -subunit)⁴⁻⁶ associated with the skeletal muscle DHP receptor is co-injected.

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