Vowel variability and speech production context: a cross-linguistic study

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INTRODUCTION

• The great amount of variation in speech production is an heterogeneous phenomenon which can be explained by many different factors.
• One of them could be the way phonological systems are structured. Structural variations may be determined by the characteristics of each language phonological system (number of phonemes, organisation of features in the system, prosodic structure, syllabic structure, phonotactics, phoneme frequencies, etc).
• A second one could be the consequence of contextual information. These 'conjunctural' variations may be determined by the way the information flow is distributed in each linguistic domain (Blache & Meunier, 2004).
• The goal of the present study is to observe the respective effects of different factors.
  • A structural question: Is phonetic production of vowels affected by the density of the system?
    ➢ Hypothesis: a vowel system with high density should produce smaller categories (Manuel & Krakow, 1984) (increase of variation).
  • A conjunctural question: Is phonetic production of vowels affected by the amount of information in the message?
    ➢ Hypothesis: the more informative the message, the less prototypical vowels (increase of variation).
  • A physiological question: Is phonetic production of vowels affected by the characteristics of connected speech?
    ➢ Hypothesis: connected speech should produce hypo-articulation (reduction of the system).

LINGUISTIC MATERIAL

Two female speakers of three languages (English, French and Spanish) were recorded.

Isolated vowels and vowels within words.

For each vowel two lists were created, each having three-word groups that contained the vowel of interest. At the end of the list, the speakers had to pronounce the vowel present in the 3 words. Each speaker repeated 5 times the lists corresponding to her language.

Examples:

- English: “the, me, be... /ɪ/”
- French: “si, lit, rid... /ɛ/”
- Spanish: “si, mi, si... /i/”

Vowels within texts

Two female speakers read 2 short texts containing two exemplars of each vowel within monosyllabic words.

Example (Spanish text):

« La tierra de mis hijos no tiene fin. Hay que que Que si “me toca a ti” (por el control remoto), que si “tu toca a ti” (por el control remoto). Su madre! Yo les dije “Ya basta. No puede ser. Por favor un poquito de luz”. Hace apenas una hora de semanas por la noche y cuantos más te lo digas, más te lo toco...»

RESULTS

1st and 2nd formant have been manually measured.

Isolated vs. word vo. text vo.

French speakers

English (5 vowels)

French (10 vowels)

Spanish (5 vowels)

These three languages thus offer the opportunity to distinguish the effects of density, without a concomitant difference in the phonological nature of the vowels present in the two systems (French and Spanish), from the effect of differing inventories of vowels within comparably dense systems (French and English).

- Isolated: 10 tokens of each vowel by speaker
- Word: 30 tokens of each vowel by speaker
- Text: 8 tokens of each vowel by speaker

Figure 1: F1 and F2 values of vowels in the 3 languages splitted by conditions and by speakers

Vowel analysis:

• Isolated vowels: Spanish (SP) and French (FR) vowels are highly distinct (narrow production areas and a large empty space inside the system) while English (EN) ones are less.

• Vowels within words: distinctivity decreases for the three languages (reduction of empty spaces) but remains higher for SP. Increase of vowel production areas. A reduction of the system is already observable (fig. 2 & 3).

• Vowels within texts: high decrease of distinctivity for the three languages (no empty space left, apparition of overlap between categories). Strong reduction of the areas occupied by the systems (fig. 2 & 3).

CONCLUSION

Structural effects:

• No density effect: Spanish vowels are hyperarticulated and clearly distinct while English ones are less. The distinctivity of SP and FR systems can be attributed to the characteristics of the system of features. FR and SP are characterized by a primary feature system (F1/F2) while EN is characterized by a secondary feature system (additional features) (Vallée, 1994). This means that the overlap between the EN vowels /e/ and /I/ on a F1/F2 representation may remain distinctive for English listeners as long as duration holds the distinction.

• As a consequence, we suppose that structural factors may have an influence on vowel production. But this influence seems to be complex and requires the consideration of all structural characteristics.

Conjunctural effects and/or physiological effects:

• A conjunctural effect: reduction of the vowel system size is observed when context is added to vowel (word and particularly connected speech). It is quite difficult to distinguish conjunctural from physiological factors: is reduction a consequence of coarticulation or reduction of articulatory effort, or even, a consequence of contextual information which can allow less distinctiveness as long as this information (semantic, syntax, etc) is sufficient to understand a message (hypo-articulated speech and adaptability, Lindblom, 1990). We hypothesize that both factors work together: hypo-articulation is possible as long as information from other linguistic domains is sufficiently present; hyper-articulation is needed when information is completely absent (isolated vowels).

PERSPECTIVES: new observations of distinctivity changes regarding to contextual information (spontaneous speech) and language specificities (other languages)

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