

INTRODUCTION

Each language has its own more or less fixed inventory of phonemic units. Given this, each language differs as concerns the number of phonemes in its inventory. The study performed by Manuel & Krakow (1984) showed that the tolerance for variation in the production of a vowel is lesser in a language with a filled vocalic system. In addition, Maddieson & Wright (1991) observed very few variation in a low density system (three vowels).

As concerns perception, the majority of studies have dealt with the more global problem of perceptual assimilation, rather than with the specific issue of density. Flege and Munro (1994) argue in favor of a universal perceptual process, based upon a purely auditory component which is independent of any given phonological system.

In recent studies (Meunier et al., 2003 & 2004), we observed that American English listeners had great difficulty in a vowel identification task, while French and Spanish had not. It has been suggested that English listeners could not find the cues they need to take their decision: French and Spanish system are mainly characterized by F1 and F2 values while, in English system, stress and duration are also relevant.

In the present study, we compared the categorization ability of English and French listeners. We hypothesize that duration could change English listeners categorization. It means that for one phonological vowel a specific duration is expected. As a consequence, if the duration presented is not correct, subjects may decide it is not the right vowel. We expect that French listeners will not be sensitive to duration changes.

METHOD

Stimuli: Three continua of F1, F2 and F3 values have been synthesized (/i-/a/, /a-/u/, and /u-/i/). Each stimulus was presented with two durations: short (200ms) and long (400ms). For each continuum, 21 stimulus were created:

Continuum i-a

F1 = from 250 Hz to 1050 Hz ; gate=40 Hz
F2 = from 2800 Hz to 1400 Hz ; gate=70 Hz
F3 = from 3500 Hz to 2500 Hz ; gate=50 Hz

Continuum a-u

F1 = from 250 Hz to 1050 Hz ; gate=40 Hz
F2 = from 600 Hz to 1400 Hz ; gate=40 Hz
F3 = 2500 Hz for all stimuli

Continuum u-i

F1 = 250 Hz for all stimuli
F2 = from 2800 Hz to 600 Hz ; gate=110 Hz
F3 = from 3500 Hz to 2500 Hz ; gate=50 Hz

Task: Stimuli were presented to French and English subjects which had to make an identification task. For each continuum, subjects had to identify both vowels by responding "yes" or "no" as fast as possible. Reaction Times were measured. Stimuli presentations were blocked by vowel. Each vowel was presented 3 times.

Subjects number: EN, n=13; FR, n=7

Experiment was managed with PERCEVAL software (<http://www.lpl.univ-aix.fr/~lpldev/perceval/>)

Targets	i	a	u
French	« i comme dans lit »	« a comme dans lac »	« ou comme dans loup »
English	« ee as in feed »	« a as in farm »	« oo as in food »

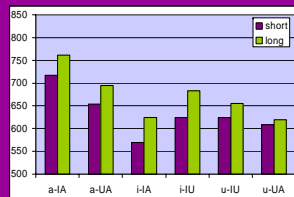


Figure 3: RT (ms) for short and long vowel identification. French subjects.

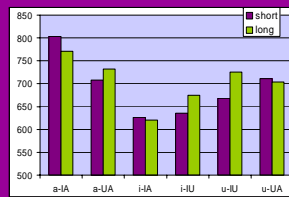


Figure 4: RT (ms) for short and long vowel identification. English subjects.

RESULTS

Reaction Times

•For both languages, RT increase at the boundary of the categories, and are longer for /a/. This reflect that /a/ seems to be a vowel with fuzzy boundaries for both languages. French subjects were systematically more rapid for short stimuli (fig. 3, the identification RT then is related to the size of the stimulus). This was not the case for English subjects, as long as duration may play a phonological role and should be more complex to process (fig. 4).

Responses

•As long as the English targets were long vowels ("feed", "farm", "food"), we expected that short vowels would be more rejected than the long ones.

•No duration effect was observed for /i/ nor /u/ identification whatever the continuum.

•For English subjects (but not for French ones) /a/ responses were different according as the vowel is short or long (fig 1 & 2).

•The experiment has pointed out that duration can change the boundary, hence the size of vowel categories, for English listeners.

PROBLEMS AND PERSPECTIVES

•Linear gates may not be appropriate for vowel perceptual experiments.

•Short durations (200ms) may be too long to be considered as short vowels for English subjects. This may explain why there is no duration affect for /i/ and /u/ identification.

NEW EXPERIMENTS...

Logit model:

Probability /a/ responses ~ step*dur
step : stimulus rank from /i/ or /u/ to /a/
dur : 2 levels factor (long vs short)

French subjects: dur and interaction step: dur insignificant : no level or slope difference between long and short stimuli

i-a	Dev. Resid.	Df Resid.	P(> Chil)
Step	631.24	30	0
Dur	0.03	29	0.87
Step:dur	0.96	28	0.33

u-a	Dev. Resid.	Df Resid.	P(> Chil)
Step	617	30	0
Dur	2.28	29	0.13
Step:dur	1.06	28	0.30

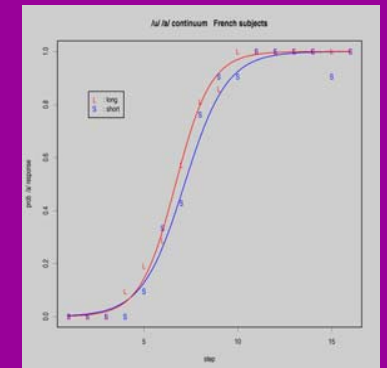
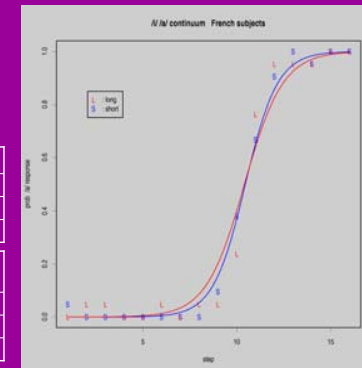


Figure 1: data points and fitted curves for the probability of /a/ response (red for long stimuli, blue for short stimuli). French subjects. i-a continuum (left) and u-a continuum (right).

English subjects: significant interaction step:dur : slope differs between long and short stimuli

i-a	Dev. Resid.	Df Resid.	P(> Chil)
Step	453.60	30	0
Dur	16.72	29	1.e-04
Step:dur	9.49	28	1.e-02

u-a	Dev. Resid.	Df Resid.	P(> Chil)
Step	611.21	24	0
Dur	39.89	23	1.e-09
Step:dur	16.25	22	1.e-04

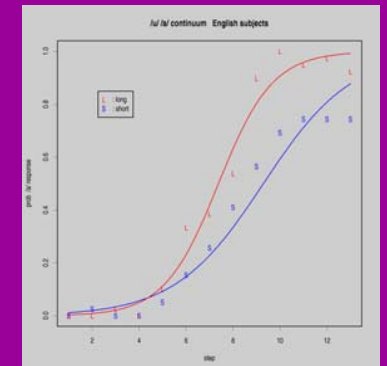
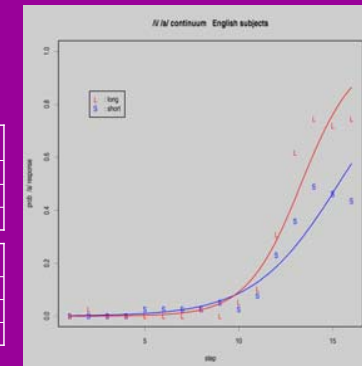


Figure 2: data points and fitted curves for the probability of /a/ response (red for long stimuli, blue for short stimuli). English subjects. i-a continuum (left) and u-a continuum (right).