Listeners assimilate foreign speech sounds to their own phonemic categories whenever possible. But what happens for bilinguals when their two languages are closely related? French monolinguals (MF) and Portuguese-French bilinguals (BPF) were tested in identification and AXB discrimination tasks. MFs' last responses were non-random, except for the longest prevoicing, whereas BPFs showed two peaks around the phonetic criterion. According to acoustic patterns and task demands, listeners rely either on a phonemic processing strategy or on a goodness of fit strategy which allows MF to build an allophonic space and BPF to keep separate their two languages.

While there is evidence that linguistic experience affects the ability to process phonemic categories as early as the last quarter of the first year [7], there is some disagreement about whether the perceptual analysis of bilinguals have to perform is thoroughly determined by phonological constraints or not. When the two languages are closely related, they are not differentiated at the phonological level [2]. But under certain conditions, the effect of phonological constraints can be weakened, and listeners can rely on phonetic cues to keep separate their perceptual representations [5].

Allophonic variants from the point of view of phonemic labelling can be perceived as different. It has been hypothesized that discrepancies between native and non-native sounds receiving an identical label are processed with reference to the acoustic distance between any exemplar and the category center [4]. The acoustic configuration usually produced by native speakers of the two languages. The present experiments study how listeners process perceptual dissimilarities in two cross-language situations: perception of a Portuguese /da/-/ta/ VOT continuum by French monolinguals (MF) and by Portuguese-French bilinguals (BPF). VOT is generally considered as the most salient cue for voicing when opposing voiced and unvoiced categories if not prevoiced and voiced ones [5]. As for the stop consonant subset, French and Portuguese are closely related. Both languages present a prevoiced-voiced contrast, opposing a long (French) or a very long (Portuguese) voicing to a null or a short lagging VOT. According to the assimilation hypothesis [3], allophonic processing for foreign, but neighbouring sounds such as those we study here, is phonemic. MF will assimilate all the prevoiced stimuli to the /da/ category. By contrast, if category goodness plays a role, it could limit allophonic space to certain stimuli.

But what happens for bilinguals when their two languages are closely related? Are their two languages differentiated at the level of perceptual representations, allowing them to detect phonetic differences related to their two languages within a single phonemic category [5]? In this case, they should exhibit a good discrimination accuracy for two distinct areas, corresponding either to the /da/-/ta/ boundary or to a contrast between the French and Portuguese /da/ phonetic categories. On the contrary, if they assimilate the members of the voicing contrast in one of the two languages to those of the other language, due to a partial acoustic overlap, their discrimination should be random, except in the /da/-/ta/ boundary area, common to both languages.

1. EXPERIMENT 1
This experiment was designed first to determine the phonemic /da/-/ta/ boundary values, second to study whether a shift, marking interlanguage interferences [2,3], appeared between MF and BPF responses or not.

1.1. Method
Subjects. The subjects were 5 MF and 5 BPF students with normal hearing. BPF first language was Portuguese. All bilinguals had been living in France since at least 15 years and acquired French before the age of 5.

Stimuli. A /da/ syllable, produced by a Portuguese monolingual female, was selected (syllable duration: 276 ms, VOT: -96 ms). The test stimuli were digitized at a 16 Khz sampling frequency and VOT reduced by 12 ms steps (from -96 ms to -36 ms) or 6 ms steps (frame by frame) along the /da/-/ta/ VOT continuum.

Procedure. Subjects listened individually over earphones, in a quiet room, at a comfortable listening level, to 10 blocks of 36 trials, randomized within blocks. The ISI was 3 s and the IBI was 20 s. Listeners' responses were forced choice 'Da' or 'Ta'. All instructions were given in French.

1.2. Results and discussion
The average labeling functions for the two groups are plotted in Figure 1. The /da/-/ta/ boundary fell at -9.2 ms of prevoicing for MF and at -16.6 ms for BPF. An ANOVA on boundary values showed that this difference between groups was significant (F(1,8)=10.4, p<.02). The steep curves suggest that a leading VOT is a strong perceptual cue for BPF as well as for MF.

These results differ from those of previous studies on prevoicing [2,5]. Moreover, there is a clear shift between MF and BPF identification functions. Whatever the case, identification data support the hypothesis of an assimilation of allophonic phonemic variants.

2. EXPERIMENT 2
Even though Experiment 1 suggested an assimilatory process, forced choice labeling could have interfered with perception of differences between stimuli. If allophonic variants have been perceptually assimilated, both MF and BPF should have a good discrimination accuracy just for the stimuli spanning their respective phonemic boundary. Should MF data be non-random on the right side of the VOT continuum and BPF around the medium VOT values, it would undermine assimilation hypothesis and suggest a multi-level processing.

2.1. Method
Subjects. 10 MF and 10 BPF were tested.

Stimuli and procedure. The same 12 stimuli as in Experiment 1 were used in an AXB discrimination task. A training block of 32 trials preceded 5 blocks of 36 trials, randomized within blocks. ISI was 500 ms, I(T 1 4 s and IBI 23 s. Subjects had to respond, as quickly and accurately as possible, whether the X stimulus was the same as the first or the third stimulus, by pressing one of two buttons.

2.2. Results
Mean values of correct responses for the two groups are plotted on Fig. 2. Each data point corresponds to 200 responses per group. The discrimination function for MF exhibited a maximum on the rightward end of the continuum, suggesting an effect of the phonemic /da/-/ta/ boundary. But correct responses are clearly above chance from pair 5 onwards (binomial test, p<.001). Results for BPF were less clear-cut, as their discrimination function showed just a
A slight peak around a 20ms prevoicing value.

An ANOVA on the correct responses showed an effect of stimulus pair just for MF (F(8,72) = 6.9, p < .0001). BPF responses were significantly more correct for the four stimulus pairs presenting at least one short prevoicing (pairs 6 to 9) than for the other ones (F(7,9) = 8.55, p < .01). Between-group difference was significant for the rightward end of the continuum (F(1,18) = 6.95, p < .01). What suggests first a link between discrimination accuracy and phonemic boundary: Discrimination is all the more correct as stimuli pairs span the phonemic boundary. Second, the difference between MF and BPF for the pair enclosing the null VOT value for MF (F(8,72) = 6.9, p<.0001). PF boundary: Discrimination is all the more correct for the other ones than for the three pairs 6 to 9. Thus, bilinguals' fast responses were above chance for the contrast between a very long and a medium prevoicing. Third, listeners of both groups have detected phonetic differences between phonemes receiving the same phonemic label, when corresponding either to values usually produced (MF) or to the contrast between values that respectively characterize bilinguals' two languages. The "goodness of fit" of one of the stimuli in the pair may have facilitated accuracy, even if it has been used as a referential point in consideration of the French or of the French and Portuguese languages.

Another striking result is that, in an AXB test, BPFs' slow responses were never above chance even though their discrimination accuracy is not significantly poorer than MFs'. In a task having high memory requirements listeners may rely not only on the most salient cue, but also on all the potential cues. Assuming that in this case perceptual analysis takes more time to be processed, its issue depends mainly on the compatibility of cues. Should multiple cues be perceived as lacking coherence, their analysis could not result in a strong discrimination accuracy. It is what happens to bilinguals who hearing equally well both languages, are plausibly sensitive to the discrepancy between temporal and spectral cues e.g. shorter and shorter French-like prevoicing vs. Portuguese fortis values.

Our data thus provide some support to the hypothesis that listeners can use multiple cues and task demands, they rely on a phonemic processing strategy specifically in the phonemic boundary area. However, they may take into account the category goodness, when further from this boundary, in order to differentiate syllables receiving the same label. They can build an allophonic space, and bilinguals can keep separate their two languages. Thus bilinguals and monolinguals appear as perceiving speech according to the same processes, but with different perceptual sensitivities due to linguistic experience.

REFERENCES