

# THE ROLE OF NATURAL SUPRASEGMENTAL LANGUAGE IDENTIFICATION CUES: A COMPARATIVE STUDY OF PERCEPTUAL ABILITIES OF FRENCH AND GREEK ADULT NATIVE SPEAKERS

Athanassia-Lida DIMOU

UNIVERSITY PARIS 7 – DENIS DIDEROT

Jean-Yves DOMMERGUES\*

UNIVERSITY PARIS 7 – DENIS DIDEROT  
(\* ALSO AT THE UNIVERSITY PARIS 8-SAINT-DENIS)

## Περίληψη

Στη συγκεκριμένη μελέτη διερευνάται η υπόθεση της αναγνώρισης φυσικών γλωσσικών ερεθισμάτων αποκλειστικά από τα προσωδιακά στοιχεία, μέσω της δημιουργίας ενός πειραματικού πρωτοκόλλου. Για το σκοπό αυτό εξετάστηκαν οι μελωδικές ιδιότητες δύο γλωσσών με διαφορετικά δομικά χαρακτηριστικά, τα Ελληνικά και τα Γαλλικά. Τα γλωσσικά ερεθίσματα του πειράματος αποτέλεσαν ακολουθίες φυσικού λόγου, οι οποίες δεν περιείχαν λεξιλογικές ή μορφοσυντακτικές πληροφορίες. Δύο ομάδες των τεσσάρων ατόμων με μητρική γλώσσα την Ελληνική και τη Γαλλική αντίστοιχα συμμετείχαν στο πείραμα ως ομιλητές. Κάθε ομάδα μιμήθηκε την προσωδία τριών διαφορετικών προτάσεων της μητρικής της γλώσσας, αντικαθιστώντας κάθε συλλαβή αυτών των προτάσεων με τη συλλαβή [la]. Κάτ' αυτό τον τρόπο δημιουργήθηκαν ακολουθίες χωρίς σημασιολογικό περιεχόμενο, από συνεχόμενα «la-la-la» οι οποίες έδωσαν στη συνέχεια τις τρεις ακόλουθες κατηγορίες ερεθισμάτων: i) ηχητικές ακολουθίες που περιέχουν την επιτόνιση και τον ρυθμό των πρωτότυπων προτάσεων, ii) ηχητικές ακολουθίες με επίπεδη επιτόνιση και τον ρυθμό των πρωτότυπων προτάσεων και iii) ηχητικές ακολουθίες μόνο με επίπεδη επιτόνιση των πρωτότυπων προτάσεων (τα ερεθίσματα της κατηγορίας αυτής προέκυψαν από τον μηχανικό διπλασιασμό ενός μοναδικού 'λα'). Για την αντικειμενικότητα του πειράματος, το συνολικό χρονικό μήκος κάθε ακολουθίας δεν υπερέβαινε τις δέκα συλλαβές και στις τρεις κατηγορίες ερεθισμάτων. Ως ακροατές συμμετείχαν στο πείραμα δέκα ενήλικες Έλληνες και δέκα ενήλικες Γάλλοι, με μητρική γλώσσα την Ελληνική και την Γαλλική αντίστοιχα. Κατά τη διάρκεια της ακρόασης, τους ζητήθηκε να αναγνωρίσουν και να σημειώσουν στο απαντητικό φυλλάδιο αν κάθε μία από τις προκειμένες ηχητικές ακολουθίες ανήκει ή όχι στη μητρική τους γλώσσα. Η συνολική διάρκεια του πειράματος ήταν 17 λεπτά ενώ το σύνολο των ηχητικών ακολουθιών που άκουγε κάθε συμμετέχων ανέρχεται στις 72. Αυτή η πειραματική μελέτη στηρίχθηκε σε φυσικά γλωσσικά ερεθίσματα, αλλά τα αποτελέσματά της επιβεβαιώνουν συναφή πορίσματα από πειράματα βασισμένα σε γλωσσικά ερεθίσματα από μηχανική αναπαραγωγή λόγου (Ramus and Mehler (1997)). Τα δύο βασικά συμπεράσματα που προέκυψαν, δεν θα πρέπει να γενικευθούν για άλλες γλώσσες πλην της Γαλλικής και της Ελληνικής: i) Η έμφυτη γνώση της μητρικής γλώσσας μπορεί να οδηγήσει στη σωστή αναγνώρισή της αποκλειστικά από προσωδιακά στοιχεία, ακόμα κι όταν δεν υπάρχουν λεξιλογικά τεμάχια στην εισερχόμενη πληροφορία. ii) Η σωστή αναγνώριση της μητρικής γλώσσας (Ελληνικά, Γαλλικά) από την προσωδία, υπογραμμίζει τον ρόλο της επιτόνισης στην επεξεργασία του λόγου.

## Λέξεις – Κλειδιά

αντίληψη, υπερτεμαχιακά στοιχεία, αναγνώριση μητρικής γλώσσας, γαλλικά, ελληνικά.

## 1. Introduction

The present research has two main aims: first measure the extent to which Greek and French native speakers can identify their own mother tongue from the prosodic characteristics of aurally presented non-lexical stimuli; second, set up a simple procedure that is sensitive enough to reveal such ability. The next section of the paper is precisely devoted to the latter aim.

## 2. The experimental Protocol

### 2.1 About the experimental procedure

It seemed pretty obvious to us that we should use natural stimuli as a basis for such a study. Several native speakers thus produced simple original sentences in their mother tongue, using a normal prosody: they were instructed to tell the beginning of a story to a young child. They were then told to faithfully mime these original sentences, strictly respecting their prosody and rhythm while replacing each of the original syllables with a "la". The resulting utterances thus were prosodically as natural as possible, although some "human approximation" was inevitable: in any case no artificial or machine procedure had interfered with this conversion process which finally provided stimuli that sounded quite natural from a prosodic point of view.

This procedure ensured that the perception experiment was based on naturally produced stimuli and led us to also take into account the small but actual segmental information contained in the CV syllable (the replacement "la"). As a matter of fact it appeared that the segmental realizations of the successive "la" (their onset as well as the vowel itself) varied according to their position in the utterance, thus somewhat contributing along with prosodic information to the identification of the underlying mother tongue.

### 2.2 The perception experiment

The original sentences are quite simple utterances in both languages (see appendix): they are from six to twelve words long. They were each transformed into meaningless utterances (made up of series of syllabic "la") using three different intonation patterns, thus leading to the following experimental conditions:

- A. Normal intonation

Utterances with a normal intonation were naturally obtained from our Greek and French speakers, who had been told to repeat the original sentences, that is to faithfully mime them, strictly respecting their prosody and rhythm while replacing each of the original syllables with a "la". The first ten "la" were then selected and gave birth to a type a) utterance of each original sentence. For instance, the second sentence (first ten syllables) in the French corpus : "Tu vois, il y a une souris qui mange du fro..." was transformed into "la1la2\_la3la4la5la6\_la7la8la9la10" with a rich and varied F0 contour.

- B. Recto tonal intonation

Utterances with a recto tonal intonation were naturally obtained from our native speakers, who had been told to repeat “la” syllables with an even intonation and tempo. The first ten “la” were then selected and gave birth to a type b) utterance which also contained some segmental information. A typical utterance had the following syllabic structure:

“la1\_la2\_la3\_la4\_la5\_la6\_la7\_la8\_la9\_la10” with a recto tonal F0 contour.

- C. Flat intonation

Utterances with a flat intonation were not totally naturally obtained. From each recto tonal utterance a random “la” was cut off, along with a 30 ms silence to its right, and duplicated ten times, thus creating a ten syllable long utterance with a flawlessly flat intonation and regular tempo. The first ten “la” thus gave birth to a type c) utterance. Such an utterance contained very little prosodic and segmental information:

“la3\_la3\_la3\_la3\_la3\_la3\_la3\_la3\_la3\_la3”.

The corresponding Greek and French utterances were randomized by type. Then these utterances were presented to the listeners in the following order; first c) type utterances were presented, then b) type utterances and finally a) type ones.

After hearing each utterance, all 10 native listeners of each language had to decide whether it belonged to –or was typical of- their own mother tongue; they gave their answers on an answer sheet by ticking one of two boxes: the one corresponding to their mother tongue (Greek or French) or the one indicating “other language”. A bip sound signaled the end of their answering period (1.75 sec). During the perception experiment, listeners had to decide on the identity of 24 utterances in each of the three experimental conditions.

To avoid any possible language identification based on mere voice identification (as would have been the case with a single speaker per language), four different native speakers produced the utterances in each language. For the same reason large amplitude differences between utterances, due to voice within or among speaker variability, were mechanically reduced and normalized in a way that influenced neither the informational weight nor the stimuli’s identity.

### 2.3 Why the syllable “la” was chosen

One reason why “la” was chosen, and not “ma” for instance, was purely pragmatic: in order to get as natural as possible utterances, we told the speakers they could choose between “la” and “ma” to replace actual syllables; as most of them decided they preferred syllable “la”, it was decided that “ma” would be discarded. A second reason why “la” was preferred has its source in a pilot study: the segmental information contained in “ma” seemed greater than that in “la”, be it in French or in Greek.

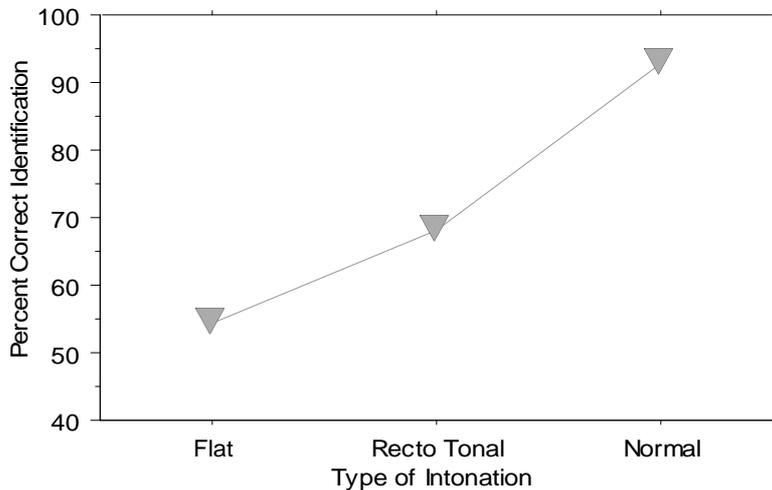
## 3. The Results

Statistical and acoustic analyses of the data were conducted. The acoustic analyses were twofold: a segmental analysis of the “la”, as well as a prosodic one (Ladefoged P., 1996).

### 3.1 Statistical analysis

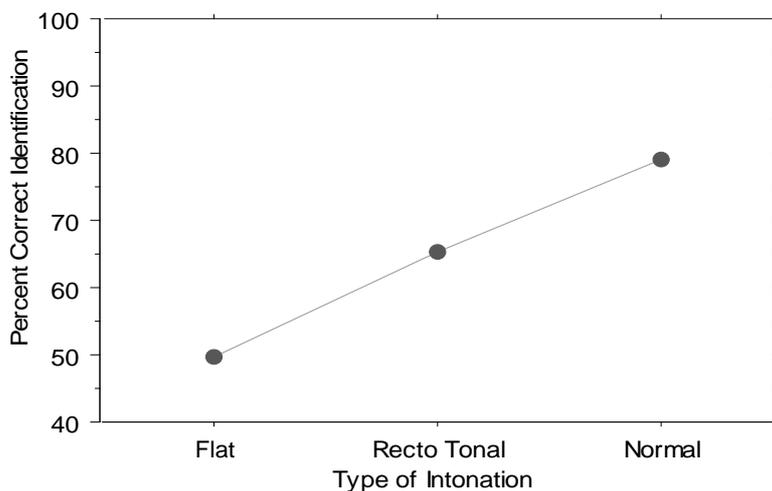
Parametric tests were conducted with Stat View 5.0. The correct identification percentage was computed for each language in each of the three experimental conditions, i.e. for the three types of stimuli. The following figures illustrate rates of correct identification of each mother tongue, for both groups of listeners, as a function of each of the three conditions: normal intonation, recto tonal intonation and flat intonation. For the two figures, a simple one-factor ANOVA was conducted, with the experimental condition (or type of stimulus) as the main factor (with three levels).

**Figure 1.** Percent correct identification for the three experimental types of stimuli in French (N=10 listeners).



Each of the three points of the graph is computed on 120 measures. For the French listeners, means are 55%, 68% and 93% respectively for normal intonation, recto tonal intonation and flat intonation. A one-factor ANOVA was thus conducted:  $F(2, 27) = 50.3$  ( $p < .01$ ). A post hoc test (PLSD Fisher) showed that all 2 by 2 differences were significant at the .01 level.

**Figure 2:** Percent correct identification for the three experimental types of stimuli in Greek (N=10 listeners).



Each of the three points of the graph is computed on 120 measures. For the Greek listeners, means are 50%, 65% and 79% respectively for normal intonation, recto tonal intonation and flat intonation. A one-factor ANOVA was thus conducted:  $F(2, 27) = 38.5$  ( $p < .01$ ). A post hoc test (PLSD Fisher) showed that all 2 by 2 differences were significant at the .01 level.

These analyses show that our initial hypothesis, that identification of a mother tongue is possible from suprasegmental cues, is valid.

### 3.2 Segmental analysis

The identification scores presented above are supposed to be a function of prosody type. But they might as well be due, at least in part, to the segmental information contained in CV “la”, which could bear specific vocalic Greek or French characteristics. An acoustic analysis of phone [a] was then undertaken (CALLIOPE, 1989). Ten “la” were randomly selected in the recto tonal production of each of the four speakers of both Greek and French and their individual F1 and F2 values were averaged and charted. Fig.3 is a visual representation of the comparison of the eight “la” formant characteristics in both languages.

**Figure 3:** Mean F1 and F2 values of [a] for each of the 4 Greek and 4 French speakers (each point is the average value of ten different “la” from the recto tonal condition)

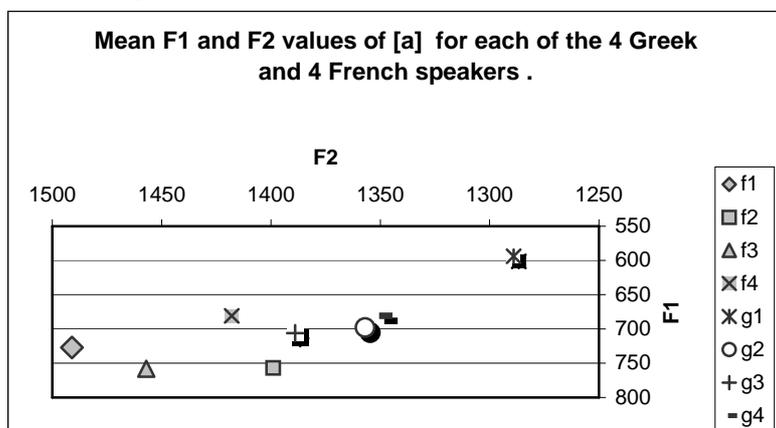


Figure 3 clearly indicates a strong F2 difference between a Greek [a] and its French equivalent: the French [a] is not as back as the corresponding Greek vowel in our data. Moreover there is no overlapping between French and Greek realization areas. A further F2 analysis of the semi vowel [ɪ] shows a similar tendency.

As is suggested above, these specific acoustic characteristics might well explain the identification results obtained in the recto tonal condition: native speakers of each language might use these F2 values to identify their mother tongue, particularly when they deal with a mixed presentation, as was the case in our experiment.

#### 3.2.1 An interaction of segmental and prosodic information.

Taken together, the above results suggest that listeners may have used both prosodic and segmental information to identify their mother tongue. Indeed the highest value in figures 1

and 2 corresponds to normal intonation that is to the intonation type that bears maximal prosodic and segmental information.

### 3.3 The role of prosodic information

The effect of mere prosodic information is best illustrated by the significant difference between identification scores of recto tonal utterances and normal ones (see Figures 1 and 2), with a larger score for the latter. This non random result clearly shows that prosody as such plays a crucial role in the identification process of both these syllable-stressed (Hirst & Di Cristo (eds), 1998) languages. More precisely, a comparison of Botinis (1989), and Martin (1982, 1987, 1999), who studied Greek and French prosody respectively, indicates that the prosodic features of Greek and French clearly differ from a strict phonetic point of view. Although three different sentences were presented, the listeners apparently had no difficulty extracting the significant prosodic information which best characterizes their own mother tongue (Altmann G.T.M (ed.), 1990). It is worth noting that succeeding in apparently so simple a task is pretty remarkable, if one takes into account the fact that no lexical information was available in the stimuli.

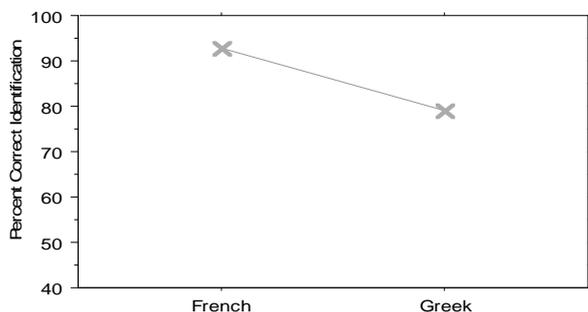
The role of such slight acoustic information was noted by a number of researchers, in various psycholinguistic domains. For instance Soares & Grosjean (1984) found, using a totally different task (phoneme triggered lexical decision task), that a listener was sensitive to subtle and quick acoustic changes in the signal; for instance in the code-switched “bac” sentence “I saw the bac” (ferry), although [b] was still quite English, the following vowel had recovered its full French characteristics; it was found that bilingual English-French listeners were quite quick noticing the language change.

In a similar way, our participants were quite sensitive to subtle prosodic changes and contrasts within the stimuli that were presented to them and could identify their own mother tongue, not only in a non random fashion but in a fairly reliable way.

#### 3.3.1 Some differences between Greek and French listeners.

As can be noticed in figures 1 and 2, the French listeners did better than the Greek participants on the identification task. Figure 4 illustrates this result. An independent t test shows that the difference in question ( $\Delta = 14\%$ ) is significant:  $t(18) = 4.26$  ( $p < .01$ ).

**Figure 4:** Mean correct identification values for the French and Greek groups of participants: utterances with normal intonation (N = 10 listeners in each group).



Each of the values in the graph is computed from 120 values. In the normal intonated condition the percent identification scores for French and Greek listeners rise up to 91% and 79% respectively.

This result was not predicted. One possible reason may explain the difference between the two groups. All participants had to complete a questionnaire (see appendix) that was intended to detect any social, cultural or linguistic intra or inter group heterogeneity. What we had in mind was to make up groups that would be as monolingual as possible. What struck us, of course, was the monolingual aspect of the French group but the somewhat “bilingual” aspect of the Greek group: after all, the experiment had been set up in Paris and most of the Greek students had at least some knowledge of French (although the ones selected were not supposed to stay in France beyond six months). As regards French participants, they had never or only very occasionally listened to Greek before.

This difference might thus be interpreted as follows. The French only had to have a single language system activated. Their task then seems fairly straightforward: they only had to look for familiar stimuli. The Greeks’ task was somewhat more complex: being in France, they were in a quasi bilingual language mode and had already started to become sensitive to some phonetic characteristics of French. As is noted above, they had to identify Greek, their most familiar language, and had to decide that the not so familiar language was not Greek: in other words, their task was more complicated than that of the French group and this might have led them to lower identification levels.

Ideally, to assess this hypothesis, a symmetrical experiment should and will be conducted in Greece with French and Greek participants. If the present interpretation is correct, a similar pattern should be obtained, with a smaller percent correct identification for the French participants.

#### **4. Conclusion**

The main objective of the research was to show the role of prosodic information in the identification of one’s native language. More specifically, it was found that:

- Utterances with no or very poor prosodic and segmental information leads to hardly any correct identification.
- The CV segment “la”, which systematically replaced the original syllables in the meaningful sentences, is differentially realized in Greek and in French; the subtle resulting acoustic and articulatory differences are detected and processed to identify the linguistic origin of the stimulus. This finding explains why utterances with some segmental information and hardly any prosodic information are partially identified.
- When intonation is normal, the specificity of prosodic contours in both languages is not only perceived but generally leads to correct identification of one’s native language.

The mere processing of both some segmental and prosodic (apart from lexical, syntactic and semantic) information was found to account for about 90% correct identification of the native language.

## **APPENDIX**

### **FRENCH ORIGINAL SENTENCES**

1. C'est l'histoire d'un chat qui court toujours apres les petites souris.
2. Tu vois il y a une souris qui mange du fromage.
3. La, tu vois, la petite souris a reussi a se sauver.

### **GREEK ORIGINAL SENTENCES**

1. Θα σας πώ την ιστορία μιάς γάτας που κυνηγούσε πάντα τα μικρά ποντίκια.
2. Για δές, το μικρό ποντίκι τρώει το τυρί.
3. Βλέπεις εδώ, το μικρό ποντίκι κατάφερε να σωθεί.

### **QUESTIONNAIRE FOR FRENCH PARTICIPANTS.**

Nom:

Prenom:

Date de naissance:

Adresse :

Nos. de tel: 1)

2)

Adresse electronique:

Votre niveau d'éducation:

Emploi:

Votre langue maternelle:

- 1) Quelles sont les autres langues que vous connaissez ? Quel est votre niveau dans chacune d'elles ?
- 2) Est-ce que vous avez entendu parler le grec ?
- 3) Est-ce que vous etes parti en Grece ?
- 4) Si vous entendez par exemple dans la rue des gens parler, est-ce que vous pensez que vous pouvez reconnaitre le grec des autres langues (p.ex. de l'espagnol, de l'italien, de l'arabe etc.) ?

### **QUESTIONNAIRE FOR GREEK PARTICIPANTS.**

Όνομα:

Επίθετο:

Ημερομηνία γέννησης:

Τηλέφωνα: 1)

2)

Ηλ. Διεύθυνση:

Επίπεδο Εκπαίδευσης:

Επαγγελματική Ενασχόληση:

- 1) Ποιά είναι η μητρική σας γλώσσα;
- 2) Ποιές άλλες γλώσσες γνωρίζετε; Ποιό είναι το επίπεδό σας;
- 3) Πώς μάθατε γαλλικά; Από τί ηλικία τα μιλάτε;

- 4) Πόσο χρόνο περνάτε καθημερινά μιλώντας γαλλικά;
- 5) Κατά την γνώμη σας, πόσο καλά μιλάτε την γαλλική γλώσσα;

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