1. SUMMARY OF THE PROPOSAL (the summary must be also filled in Spanish)

PROJECT TITLE: The role of tonal scaling and tonal alignment in distinguishing intonational categories in Catalan and Spanish.

PRINCIPAL INVESTIGATOR: Pilar Prieto (ICREA-UPF)

SUMMARY (brief and precise, outlining only the most relevant topics and the proposed objectives):
As is well-known, the standard Autosegmental-Metrical Theory of intonation has claimed that variations in **tonal alignment** are crucial in distinguishing intonational categories in languages such as English and Dutch (Pierrehumbert 1980, Pierrehumbert & Beckman 1988, and Ladd 2008, among others). Yet this model claims that **tonal scaling** (pitch range) variation does not encode phonological contrasts but rather only reflects the degree of involvement of the speaker with the speech act. In the last decade, a relatively small number of studies have investigated the role of pitch range in establishing categorical contrasts in English and in other languages, and they have yielded mixed results. The main goal of this project is to investigate whether variations in tonal scaling and alignment give rise to **categorical distinctions** in Catalan and Spanish intonation. The results should provide a wider crosslinguistic perspective on whether scaling and alignment differences can encode discrete categories as opposed to simply within-category phonetic variation. Our plan it to conduct a set of production and perception experiments (congruity task, identification and discrimination tasks, imitation task) that allow us to assess whether listeners make categorical linguistic use of alignment and scaling features in intonational languages (see Work Plan below). A further goal is to characterize the types of meanings that intonational contrasts convey in Catalan and Spanish and advance towards a formal theory of the **semantic** and pragmatic **interpretation of prosody**.

Another important goal of this project is to test the **convergence** and **degrees of appropriateness** of these various experimental methods to study intonational contrasts. By comparing the results of congruity tasks, imitation tasks and identification and discrimination tasks using the same stimuli we hope to be able to test the applicability of the categorical perception paradigm to the analysis of tonal contrasts in intonational languages. As a novelty, in collaboration with Carles Escera’s group (Universitat de Barcelona), we will also analyze the response to these intonational contrasts by the human brain as reflected by mismatch negativity (MMN). In the phonemic realm, MMN data show that the perception of phonemes is based on language-specific phonetic traces developed in the posterior part of the left-hemisphere auditory cortex, and that these traces serve as recognition models for the corresponding speech sounds in listening to speech (Näätanen 2001, Näätanen et al. 1997). We will assess whether the human brain processes intonational contrasts and phonemic contrasts in similar ways.
TITULO DEL PROYECTO:

La relevancia de la alineación y la altura tonales en la distinción de categorías entonativas en catalán y español

RESUMEN
(breve y preciso, exponiendo sólo los aspectos más relevantes y los objetivos propuestos):

La teoría Métrica y Autosegmental estándar de la entonación considera que las variaciones en alineación tonal son cruciales para distinguir las categorías entonativas en lenguas como el inglés o el holandés (Pierrehumbert 1980, Pierrehumbert y Beckman 1988, Ladd 2008, entre otros). Además, este modelo afirma que las variaciones relacionadas con la altura tonal no desencadenan contrastes fonológicos sino sólo grados variables de implicación por parte del hablante en relación al acto de habla. En la última década, algunos estudios han investigado el papel de la altura tonal a la hora de establecer contrastes tonales en inglés y en otras lenguas, y los resultados obtenidos no son convergentes. El objetivo principal de este proyecto es investigar si las variaciones debidas a la altura tonal y la alineación desencadenan distinciones categóricas en la entonación del catalán y el español. Los resultados deberían proporcionar una amplia perspectiva comparada ante la hipótesis de que diferencias en altura tonal y alineación puedan ser las causas de la existencia de categorías discretas opuestas a una simple variación fonética. Nuestro plan es llevar a cabo una serie de experimentos de producción y de percepción (tareas de adecuación, identificación y discriminación, o imitación) que nos permitan valorar si los oyentes hacen un uso lingüístico y categorial de los rasgos de altura tonal y alineación en las lenguas entonativas (véase el plan de trabajo más adelante). Un objetivo adicional es el de caracterizar los diferentes tipos de significados que los contrastes expresan en catalán y español, y avanzar en la propuesta de una teoría formal de la semántica y pragmática de la prosodia.

Otro objetivo importante de este proyecto es el de evaluar los niveles de adecuación de los métodos experimentales para estudiar los contrastes entonativos. Esperamos ser capaces de evaluar la aplicabilidad del paradigma de percepción categorial al análisis de los contrastes entonativos en lenguas entonativas mediante la comparación de los resultados de las tareas de congruencia, imitación y de percepción categorial. Como novedad, y en colaboración con el grupo de Carles Escera (Universitat de Barcelona), analizaremos la respuesta del cerebro humano a estos contrastes entonativos reflejada por los potenciales evocados (MMN). En el campo fonémico, los datos procedentes de los potenciales evocados demuestran que la percepción de los fonemas está basada en indicios fonéticos de cada lengua que se desarrollan en la parte posterior del córtex auditivo izquierdo, y que estos indicios sirven de modelos de reconocimiento del habla cuando se escucha una lengua determinada (Näätanen 2001, Näätanen et al. 1997). Evaluaremos si el cerebro humano procesa los contrastes entonativos de un modo similar a los contrastes fonológicos segmentales.
2. INTRODUCTION
(maximum 5 pages)

- The introduction should include: the aims of the project; the background and the state of the art of the scientific knowledge, including the essential references; the most relevant national and international groups working in the same or related topics.

State of the Art and Background of the Project

In the field of intonational phonology, the timing or alignment of fundamental frequency (F0) peaks or valleys with respect to segments has been shown to be consistently associated with intonational meaning distinctions in a number of languages (e.g., Kohler, 1987 for German; D’Imperio & House 1997, D’Imperio 2000 for Neapolitan Italian; Pierrehumbert & Steele 1989; Dilley 2005 in press for English). All in all, these articles provide robust evidence to claim that changes in F0 alignment of peaks and valleys are specially salient and cue phonological distinctions across languages. This evidence has been interpreted as direct support for AM theory, which is widely held to afford a number of advantages over other discrete tone theories, as tonal alignment differences in this model are encoded phonologically at the pitch accent level. For example, one of the main contrasts investigated is the English rising pitch accent interpreted as incredulity vs. uncertainty, which is represented by L+H* vs. L*+H (see the original claim in Pierrehumbert 1980 and experiments that indicated the discreteness of this contrast in Pierrehumbert & Steele 1989, Dilley 2008 and Redi 2003).

However, the role of pitch scaling in establishing categorical contrasts is controversial. The general approach to this topic by the Autosegmental-Metrical (AM) model is the original claim by Pierrehumbert (1980) that only two tones, L and H, are necessary to distinguish pitch accent and boundary tone categories in English, and the rest of the pitch range variation is attributed to phonetic variation and the paralinguistic expression of emphasis and speaker involvement (Pierrehumbert 1980, Beckman & Pierrehumbert 1986, and others). This central assumption of the model is what Ladd calls the Free Gradient Variability Hypothesis (Ladd 1994, 2008). In the last decade, a relatively small number of studies have investigated the role of pitch range in establishing categorical contrasts in English and in other languages, and they have met with mixed results. On the one hand, Ladd & Morton (1997) investigated the contrast between normal vs. emphatic rising pitch accents in English. They found evidence of an abrupt shift in identification from normal to emphatic as pitch range increases, but little evidence of an associated peak in discriminability between stimulus pairs. They interpreted the results as suggesting that the normal / emphatic distinction may be “categorically interpreted” but not categorically perceived. In Chen’s (2003) replication of the experiment which examines the distinction between normal high accent and emphatic high accent, she claims that the identification results together with the reaction time data reveal that the contrast is of a discrete nature. On the other hand, Hirschberg & Ward (1992) showed that variations in pitch range can change the interpretation of the incredulity pitch accent in English L*+H LH% into the uncertainty interpretation. Subjects interpreted the stimuli with larger pitch ranges as conveying incredulity and those with smaller pitch ranges as conveying incredulity. Calhoun (2003) found that themes and rhemes are marked by distinctive pitch accents and that the most reliable cue to the theme and rheme accents is pitch height.

Work for languages other than English has also revealed that differences in pitch range can convey intonational contrasts. In her examination of the distinction between yes-no questions and wh-questions in Majorcan Catalan using the categorical perception paradigm, Vanrell (2006, 2007) found that the main cue used by Catalan listeners to distinguish the two was the pitch height of the leading tone H in falling nuclear pitch accents H+L*. Similarly, Savino & Grice (2007, 2008) investigated the distinction between information-seeking questions and challenging-echo (antiexpectational) questions in Bari Italian. The results of the identification task showed that Bari Italian listeners rely on the pitch range
difference existing between the same rising pitch accent, namely L+H*, to distinguish between the two question interpretations. In general, these investigations strengthen the arguments that pitch height differences can be perceived in a categorical way and that they should be treated in phonological terms as an independent feature.

Currently, the issue of whether pitch range variation gives rise to distinctive linguistic categories across languages is unclear and researchers do not have a consensus view on this topic. In fact, the abovementioned evidence coming from different languages seems to be only partially compatible or totally incompatible with the AM interpretation (see Hirschberg & Ward 1992, Ladd & Morton 1999 and later Chen 2003, Calhoun 2003, for English, Vanrell 2006, 2007 for Catalan, Savino & Grice 2007, 2008 for Bari Italian). Yet in a recent experiment, Dilley (2005, 2007) constructed a continuum of pitch range differences, while controlling for F0 peak alignment across stimuli. Imitation data showed that speakers reproduced the continuous variation in the stimuli, suggesting that pitch range differences may be perceived as less categorical than F0 alignment differences. In a recent article (Prieto, Torres & Vanrell 2008) we investigated whether differences in F0 scaling at the boundary tone level can distinguish intonational categories in Catalan. The test case under investigation was the contrast found in Catalan between echo questions and categorical-obvious statements. In Catalan, the crucial difference between echo questions and categorical-obvious statements lies in the height of the sentence-final boundary tone: whereas echo questions are produced with a sentence-final high boundary tone, obvious statements are produced with a mid boundary tone. One of the claims of the autosegmental-metrical theory of intonation is that only two tones, L and H, are necessary to distinguish pitch accent and boundary tone categories in English. With the goal of testing whether differences in F0 scaling of the boundary tone trigger a perceptual change from one interpretation to the other, we carried out several perception experiments, the results of which provide converging evidence that Catalan listeners perceive the contrast between the tonal configurations LH% and LM% in a discrete fashion. It is clear that the original AM theoretical claim that pitch scaling differences are gradient, in contrast with alignment differences, is in need of careful evaluation.

Aims of the project

One of the main goals of this project is to continue the work on the description of the intonational phonology of Catalan and Spanish and to specifically investigate whether variations in F0 scaling and F0 alignment give rise to categorical distinctions in Catalan and Spanish intonation. The results should provide a wider crosslinguistic perspective on whether scaling and alignment differences can encode discrete categories as opposed to simply within-category phonetic variation. Our plan is to conduct a variety of perceptual experiments (congruity task, identification and discrimination tasks, imitation task) to analyze whether listeners make categorical linguistic use of alignment and scaling features in intonation (see Work Plan below).

Another important goal of this project is to contribute to this discussion and test the convergence and degrees of appropriateness of such experimental methods. A number of experimental methods have been used to study what is categorical or linguistic in intonation and what is paralinguistic and gradient (see a review in Gussenhoven 2004, 2006; see also Dilley in press), including imitation tasks (Pierrehumbert & Steele 1989; Dilley 2005, 2007; Dilley & Brown 2007), congruity tasks (Ratchke & Harrington 2006), prominence judgments (Gussenhoven & Rietveld 1988), and semantic judgments (Gussenhoven & Rietveld 2000; Calhoun 2006). Several studies have applied the complete categorical perception paradigm to the study of intonation contrasts, be they between boundary tones, e.g., L% vs H% contrasts that prototypically mark the difference between questions and statements (Remijisen & van Heuven 1999 for Dutch, Schneider & Linfert 2003 for German, Cummins, Doherty & Dilley 2006 for English, Falé & Hub Faria 2006 for European Portuguese) or pitch accents (Kohler 1987 for German, Ladd & Morton 1999 for English, Vanrell 2006, 2007 for Catalan, Dilley in press, Gili-Fivela in press). In
these articles, while identification curves show clear discrete effects, discrimination results are less clear cut and thus these articles leave several questions unanswered. Although claims are made of ‘categorical perception’ for a particular contrast, out of the abovementioned articles, only two show clear evidence of categorical perception, with a clear discrimination peak at the expected position (Kohler 1987, Vanrell 2006, 2007, Schneider & Linftert 2003). The discrimination functions observed differ between studies, and in the majority of cases no discrimination peaks appear in the crossover of categories revealed by the identification test (Falé & Hub Faria 2006, Cummins et al. 2006, Remijsen & van Heuven 1999). Some authors like Remijsen & van Heuven (1999) claim that the low discriminatory precision obtained in intonational results is also clear when CP is applied to vowel contrasts, taking the shape of a distributed plateau rather than that of a local peak. They claim that since acoustically, intonational units are similar to vowel phonemes in that they are encoded over relatively long time intervals, as such they may be equally perceived in a continuous rather than categorical manner. Yet other authors argue that the absence of a discrimination peak does not necessarily mean that contrasts are not categorical. As Chen (2003:97) puts it, “the CP paradigm may be unsuitable for investigating the categoricality of peak height contrast. The CP paradigm relies on the incapability of listeners to detect differences between two stimuli taken from the same category.”

By comparing the results of congruity tasks, imitations tasks and categorical perception tasks using the same stimuli, we hope to be able to test the applicability of this paradigm to the analysis of tonal contrasts. Specifically, we plan to implement several types of discrimination schemes that have been shown to work for vowel perception (Gerrits & Schouten 2004) in order to seek converging evidence regarding the viability of the categorical perception paradigm for the study of intonational categories. Finally, another important goal of this work is to be able to characterize the intonational phonology of Catalan and Spanish and the types of meanings that intonational contrasts convey in these two languages so that we can advance towards a formal theory of the semantic and pragmatic interpretation of prosody.

References
[these references are general and reference works cited in other sections in of this research project]


NÄÄTÄNEN, R. (2001). The perception of speech sounds by human brain as reflected by the mismatch negativity (MMN) and its magnetic equivalent (MMNm). *Psychophysiology* 38, 1-21.


3. OBJECTIVES
(maximum 2 pages)

3.1 Describe the reasons to present this proposal and the initial hypothesis which support its objectives (maximum 20 lines)

Work on the intonational phonology of several languages (see Background in Section 2) has started to investigate the role of tonal scaling and tonal alignment differences in the encoding of discrete categories in intonation, as opposed to simply within-category phonetic variation. Our main goal in this research project is to conduct a set of perceptual experiments (congruity tasks, identification and discrimination tasks, imitation tasks) to analyze whether Catalan, Spanish, and in some cases English listeners make categorical linguistic use of alignment and scaling features. Our initial hypotheses, based on the results of two recent experiments undertaken by our group (Vanrell (2006, 2007; Prieto, Torres-Tamarit & Vanrell 2008), are that both scaling and alignment F0 features contribute to the linguistic use of intonation. If this were the case, some postulates of the AM theory would need to be revised. We also hope that this project will contribute to test the convergence and degrees of appropriateness of such experimental methods. Finally, we would like to be able to characterize the intonational grammar of Catalan and Spanish speakers and to describe the types of meanings conveyed by prosody.

3.2. Indicate the background and previous results of your group or the results of other groups that support the initial hypothesis

We have two recent results in our group that contribute to our initial hypothesis that pitch scaling differences contribute to the distinction of intonational categories in some languages:

1. In her MA thesis, Vanrell (2006, 2007) examined the distinction between yes-no questions and wh-questions in Majorcan Catalan using the categorical perception paradigm. She found that the main cue used by Catalan listeners to distinguish the two was the pitch height of the leading tone H in falling nuclear pitch accents H+L*. This work suggests the need for the presence of a three-way distinction in height at the level of the leading tone.

2. In recent work, a team in our group (Prieto, Torres-Tamarit & Vanrell 2008) examined the difference between echo questions and categorical-obvious statements. The results from five experimental tasks provided converging evidence that Catalan listeners perceive the contrast between the tonal configurations that end in a high tone LH% and those that end in a mid tone LM% in a discrete fashion.

Other groups in other labs have also offered evidence that pitch scaling might be relevant for phonological contrasts in intonation (Hirschberg & Ward 1992, Ladd & Morton 1999 and later Chen 2003, and more recently Savino & Grice 2007, 2008 for Bari Italian).

3.3. Describe briefly the objectives of the project.

1. To investigate whether variations in F0 scaling and F0 alignment give rise to categorical distinctions in Catalan and Spanish intonation. The results should provide a wider crosslinguistic perspective on whether scaling and alignment differences can encode discrete categories as opposed to simply within-category phonetic variation.
2. To test the appropriateness of a set of perception tasks (imitation tasks, congruity tasks, prominence judgments, discrimination and identification tasks) for distinguishing between what is categorical or linguistic in intonation and what is paralinguistic and gradient.

3. To contribute to a full-fledged description of the intonational and metrical phonology of Catalan and Spanish. We plan to have three Intonation Atlases ready by the end of the project (see Working Plan below).

4. To characterize the types of meanings that intonational contrasts convey in Catalan and Spanish and advance towards a formal theory of the semantic and pragmatic interpretation of prosody.

3.4. For Coordinated projects only, the coordinator must indicate (maximum 2 pages):

- the global objectives of the coordinated project, the need for coordination, and the added value provided by this coordination
- the specific objectives of each subproject
- the interaction among the objectives, activities and subprojects
- the mechanisms of coordination for an effective execution of the project.
4. METHODOLOGY AND WORKING PLAN
(in the case of coordinated projects this title must include all the subprojects)

Detail and justify precisely the methodology and the working plan. Describe the working chronogram.

♦ The working plan should contain the tasks, milestones and deliverables. The projects carried out in the Hesperides or in the Antarctic Zone must include the operation plan.

♦ For each task, it must be indicated the Centre and the researchers involved in it.

♦ If personnel costs are requested, the tasks to be developed by the personnel to be hired must be detailed and justified. Remember that personnel costs are eligible only when personnel is contracted, **fellowships are not eligible** as personnel costs.

Background and recent results

In recent years, one of the main aims of the *Grup d’Estudis de Prosòdia* has been to investigate the intonational phonology of the Romance languages (specifically Catalan, Castilian Spanish, and Occitan) and the development of a prosodic transcription system for these languages. The group has undertaken **comparative intonational work** based on careful phonological descriptions. This comparative work is useful on several grounds. First, contrastive dialectological research may allow us to develop some postulates regarding previous diachronic stages of the intonation of the languages or varieties under investigation. Hualde (2003) points out that there is reason to believe that the reconstruction of Proto-Romance intonation is possible, provided the availability of detailed descriptions of as many languages and dialects as possible. Two projects aimed at mapping the geographical distribution of some of the features of the intonation of several Romance languages are currently being developed within our group. Three teams, led by Pilar Prieto, are currently preparing three interactive, **on-line dialectal atlases** covering the main regional varieties of **Catalan**, **Spanish** and **Occitan** with a focus on describing their intonational systems and mapping the geographical distribution of some of their characteristics. Two of them, the *Atles interactiu de l’entonació del català* (Prieto & Cabré 2008; [http://prosodia.uab.cat/atlesentonacio/](http://prosodia.uab.cat/atlesentonacio/)) and the *Atlàs interactiu de l’intonacion de l’occitan* (Prieto & Sichel 2008; [http://prosodia.uab.cat/atlasintonacion/](http://prosodia.uab.cat/atlasintonacion/)) are already on-line and users may interact with maps, analyze examples of different features gathered from different regional dialects, and even download audio and video files. The Spanish Atlas is currently under way and several interviews have already been recorded in locations like Madrid, Málaga, Ciudad de México, Buenos Aires, Quito, San Juan de Puerto Rico and Lima. For this project, we are collaborating with investigators abroad like Laura Colantoni (U of Toronto), Leopoldo Labastía (U de Comahue), Meghan Crowhurst (Ohio State U.), and Erin O’Rourke (U of Pennsylvania), Ana Estrella (U. de Quito), among many others, and we are going to have our first workshop on Spanish intonational transcription in Las Palmas, as part of the conference *Phonetics and Phonology in Iberia*.

As noted above, the goal of the present project is to test the **phonological validity** of the intonational units proposed in the abovementioned work and to test whether variations in **tonal alignment** and **tonal scaling** are able to convey **intonational contrasts**. For example, empirical work on Catalan from our group revealed that differences in pitch range might be conveying several intonational contrasts. This empirical observation is relevant because it is one of the claims of the autosegmental-metrical theory of intonation that only two tones, L and H, are necessary to distinguish pitch accent and boundary tone categories in English. Yet in recent years, crosslinguistic work on ToBI labelling systems have documented a mid tone in the boundary domain, transcribed as either !H% or M% (see Beckman & Ayers-Elam 1997 for English, Arvaniti & Baltazani 2005 for Greek, Grice et al. 2005 for German, Beckman et al. 2002 for Spanish, and Lee 2003 for Korean).

Work conducted within our group by Vanrell (2006, 2007) examined the distinction between yes-no questions and wh-questions in Majorcan Catalan using the categorical perception paradigm. She found that the main cue used by Catalan listeners to distinguish the two was the **pitch height** of the leading tone H in falling nuclear pitch accents H+L∗. In more recent work, a team in our group examined the difference between echo questions (e.g. (Has dit) la Bàrbara? ‘(Did you say) Bàrbara?’) and categorical-obvious statements (e.g. (Home), la Bàrbara!, ‘(Obviously), Bàrbara!’), as exemplified in the figures below (Prieto, Torres & Vanrell 2008). The crucial difference between echo questions and categorical-obvious statements lies in the **F0 scaling** of the sentence-final boundary tone: whereas echo questions are produced with a sentence-final high boundary tone, obvious statements are produced with a mid boundary tone. The results from five experimental tasks provided converging evidence that Catalan listeners perceive the contrast between the tonal configurations LH% and LM% in a discrete fashion.

(1) (a) categorical-obvious statement (b) yes-no echo question

![Diagram](image)

Methodology

As noted above, a number of experimental methods have been used to try to separate what is categorical or linguistic in intonation from what is paralinguistic and gradient (see a review in Gussenhoven 2004, 2006; see also Dilley 2008), including imitation tasks (Pierrehumbert & Steele 1989; Redi 2003; Dilley 2005, 2007; Dilley & Brown 2007), congruity tasks (Ratchke & Harrington 2006, in press), prominence judgments (Rietveld & Gussenhoven 1985; Gussenhoven & Rietveld-1988; Ladd, Verhoeven & Jacobs 1994), semantic judgments (Nash & Mulac 1980; Gussenhoven & Rietveld 2000; Calhoun 2006), or perceptual equivalence judgments (Odé 2005).

One method that comes from the study of consonantal contrasts and which has also been applied to intonational contrasts is the **categorical perception paradigm** (see Liberman, Harris, Hoffman, & Griffith, 1957). One of the crucial tests of categorical perception is that a discrimination peak appears at the same location where the shift in identification occurs along an acoustic continuum (Repp 1984). Several studies have applied the complete categorical perception paradigm to the study of intonation contrasts, whether involving boundary tones, e.g. L% vs H% contrasts that prototypically mark the difference between questions and statements (Remijisen & van Heuven 1999 for Dutch, Schneider & Linfert 2003 for German, Cummins, Doherty & Dilley 2006 for English, Falé & Hub Faria 2006 for European Portuguese) or pitch accents (Kohler 1987 for German, Ladd & Morton 1999 for English,
Vanrell 2006, 2007 for Catalan, Dilley 2008, Gili-Fivela in press). In these articles, while identification curves show clear discrete effects, discrimination results are less clear cut and thus these articles leave several questions unanswered.

Another method which has been especially successful in empirical studies of intonation is the imitation task, in which participants attempt to reproduce the continuous acoustic variation in stimuli (Pierrehumbert & Steele, 1989; Redi, 2003; Dilley, 2005, 2007, 2008; Dilley & Brown, 2007; Gili Fivela in press; see a review in Gussenhoven, 2004, 2006). The majority of articles investigated F0 alignment contrasts and show that speakers produced the target pitch accents, which clustered according to two distinct patterns. For example, in their seminal papers, Pierrehumbert & Steele (1989) and later Dilley (2008) investigated the potential effects of early peak vs. late peak in the contrast between L+H* and L*+H in English. The authors argued that if the subjects were able to reproduce the continuum in their imitation, peak alignment difference must be gradient. However, if subjects' imitations were to fall into two categories, peak alignment difference must be categorical. They found that by and large the distribution of peak alignments was bimodal in the imitation data and therefore concluded that the distinction between early peak alignment and late peak alignment was discrete. The discreteness of the peak alignment contrast supported by Pierrehumbert and Steele’s production data was borne out by the perception data (and also imitation data). The CP paradigm has been applied to both tonal languages (Francis et al. 2003, Francis & Ciocca 2003, Lee 2003) and intonational languages, for boundary tones (Remijsen & van Heuven 1999, Post 2000, Schneider & Linfert 2003; Cummins et al. 2006, Falé & Hub Faria 2006) as well as pitch accents, both for differences in peak alignment (Kohler 1987, D’Imperio & House 1997, Chen 2003, Niebuhr 2003, Niebuhr & Kohler 2004, Grice & Savino 2007, 2008, Dilley & Brown 2007, Dilley 2008, Gili Fivela 2008) and for differences in pitch height (Ladd & Morton 1997, Cummins et al. 2006, Vanrell 2006).

As mentioned above, the application of this paradigm has met with mixed success (see Gussenhoven, 2004 for a review). One possible reason for the conflicting results using categorical perception is that the Kohler (1987) study alone used a stimulus continuum based on F0 alignment differences, while the remaining studies used continua based on pitch range differences. It has been proposed that the extent to which categorical perception obtains depends on the acoustic difference investigated (Newport, 1982); it may be that F0 alignment differences more readily give rise to categorical perception than pitch range differences (Gussenhoven, 2004, 2006).

The ‘problems’ reported with the discrimination tasks (mainly in vowel studies) relate to the fact that it is an auditory task that can be answered in an auditory mode (Newman 1984, Repp 1984, Gussenhoven 1986, Niebuhr & Kohler 1984, Gerrits & Schouten 2004). Gerrits & Schouten (2004) claim that the type of discrimination task AX (which is the one typically used in intonation), generally activates an ‘auditory mode’ which leads to common psychoacoustic patterns (like substantial differences in performance between subjects). For this reason, they have designed a discrimination task that prevents direct comparison between successive stimuli and necessitates the use a phonetic labeling strategy for discrimination results that are highly categorical for vowels. In this two-interval task, stimuli are presented in duplets in two possible orders (BA or AB), and speakers have to determine the order in which they are presented (speakers need to be told what ‘order’ means relative to a particular label).

In order to assess the usefulness of such experimental methods and provide converging evidence about their validity, all the experiments planned in our project will include the following perceptual tasks:

- Two types of semantic congruity tasks that will investigate whether the two intonation contours being compared are largely appropriate in their semantic context.
- An identification task that will investigate whether participants are able to correctly identify different exemplars of the continuum. Reaction Time measures will also be recorded.
- Three types of discrimination tasks: AX, AX with increased ISI, and AXB discrimination tasks.
• **An imitation task**: that will investigate whether speakers are able to produce two groups of productions when imitating the different range of stimuli.

In some of the experiments, namely the ones involving pitch accents in sentence-initial position, we will use **gating tasks** (Face 2003).

Results from previous experiments have indicated that congruity tasks, imitation tasks, standard identification tasks and several types of discrimination tasks can be profitably used to investigate intonational categories.

As a novelty, in collaboration with Carles Escera’s group, we will also analyze the response to these intonational contrasts by the human brain as reflected by **mismatch negativity** (MMN). In the phonemic realm, MMN data show that the perception of phonemes is based on language-specific phonetic traces developed in the posterior part of the left-hemisphere auditory cortex, and that these traces serve as recognition models for the corresponding speech sounds in listening to speech (Näätanen 2001, Näätanen et al. 1997). We propose to assess whether the human brain processes intonational contrasts and phonemic contrasts in similar ways.

**Working Plan**

• For each task, we specify the Centre and the researchers involved in it (see also Chronogram).

• If personnel costs are requested, the tasks to be carried out by the personnel to be hired must be detailed and justified.

  A. **Empirical background and descriptive work.** During the execution of the research project, we will continue to collect data for the **three Intonation Atlases** (for Catalan, Occitan, and Spanish). We believe that the collection of dialectal data is necessary in order to be able to describe the intonational phonology of the three languages.

  • **Catalan Atlas**, *Atles interactiu de l'entonació del català* (Prieto & Cabré 2008; [http://prosodia.uab.cat/atlesentonacio/](http://prosodia.uab.cat/atlesentonacio/)) This Atlas is already available online and more geographical areas are currently being added to the project.


A **student contract** for 24 months (4 h/day) will allow us to get valuable assistance in data collection and the preparation of that data for the website. This contract will allow us to complete the two Atlases during the second year of the project.

  • **Spanish Atlas** (Peninsula and LatinAmerican Spanish). This Atlas is not yet available, since the web interface still has to be developed. Yet we have done recordings in Madrid, Málaga, Ciudad de México, Buenos Aires, Quito, San Juan de Puerto Rico and Lima. For the Spanish Atlas, we are leading a successful international collaboration effort that started with the last Sp_ToBI Workshop (we are currently organizing the next workshop in Las Palmas).

A **student contract** for 3 years (4 h/day) will allow us to get assistance in data collection and the preparation of that data for the website. If we can have this, we can have an online and very advanced version of this Atlas by the end of the project.
The empirical data contained in the three Atlases, which focus on prosodic analysis and variation, is of key importance and gives us the necessary background on the intonational phonology of these languages. In this way we will be able to discover new phonological contrasts that can be studied experimentally, as we explain in the section below.

B. Experimental work: In the following working plan, we outline the experimental work that will be undertaken in order to answer the main questions above. The first part of the experiments deal with contrasts in boundary tone combinations and the last part on pitch accent differences. To carry out these tasks successfully, we will need a laboratory technician working 5h a day that can help us with data collection and preparation, data treatment, and statistical data analyses.

Experiment 1: $L^+H^* L^H%$ vs. $L^+H^* L^M%$, echo questions vs. obvious statements (Spanish). One of the main goals for the study of Spanish intonation is to analyse the phonetic and phonological properties of the mid boundary tone ($M^\%$). In order to find out whether a final mid pitch is phonologically relevant in Spanish, a variety of production and perception experiments will be designed. This experiment is intended to replicate the results for Catalan found in Prieto, Torres-Tamarit & Vanrell (2008). The experiments are expected to be carried out by Eva Estebas-Vilaplana at the UNED. In particular, the presence of the mid tone and its contrastive status will be analysed in two contexts. We will analyse whether the difference between an echo question and an obvious statement in Spanish can be accounted for by differences in the scaling of the final boundary tone (high vs. mid). Like in Catalan, the only intonational difference between these two contours seems to depend on the scaling of the final tone, which is $H^\%$ for echo questions, as in ¿La niña? ($L^+H^*L^H%$), and $M^\%$ for obvious statements, as in La niña ($L^+H^*L^M%$). A production test will be carried out so as to analyse the actual realization of the two tones. Additionally, several perception tests will be carried out by varying the pitch of the final tone from $M$ to $H$ and viceversa. Listeners will be asked to decide which of the two meanings is associated with a number of stimuli which will vary in the scaling of the final tone.

Experiment 2: $L^+H^* L^%$ vs. $L^+H^* M^\%$, statements vs. hesitations (Catalan-Spanish). A second context in which the mid tone will be analysed is in falling contours. It has been observed that differences in the scaling of the final tone (low vs. mid) can account for a neutral statement intonation and an open statement intonation. An $L^\%$ boundary tone, as in La niña ($L^+H^*L^\%$), prompts a neutral declarative reading. An $M^\%$ boundary tone, on the other hand, triggers a hesitation interpretation. Similar to the previous study, the contrast between $L^\%$ and $M^\%$ in the aforementioned contexts will be tested by means of a production experiment and a perception experiment. These experiments are expected to be carried out for Catalan and Spanish by the group at the Universitat Pompeu Fabra and by Eva Estebas-Vilaplana at the UNED.
Experiment 3: L+H* L% vs. L+H* LM% Statements vs. disapproval statements (Catalan). A third context for the mid tone in which M% seems to play a role is the expression of disapproval. The following graphs illustrate the difference between a statement (L+H* L%) and a disapproval statement (L+H* LM%). The question here is how disapproval statements and obvious statements differ. It might be that we are facing a difference in scaling at the boundary tone level. The experiments are expected to be carried out for Catalan and Spanish by the group at the Universitat Pompeu Fabra.

![Graphs showing L+H* L% and L+H* LM%]

Experiment 4: L* HH% vs. L* LH%, informational questions vs. incredulity questions (Catalan-Spanish). Here the aim is to investigate whether the alignment contrast between L* HH% vs L* LH% conveys a phonological difference between neutral questions (L* HH%) and incredulity questions (L* LH%). L* HH% is manifested as a low tone during the accented syllable followed by a very sharp rising pitch movement at the end of the phrase, often attaining a very high frequency in the speaker’s range. It is attested at the end of rising yes-no questions. On the other hand, L* LH% is manifested phonetically as a dip and then a rise to a high F0 value, and is attested in anti-expectational and incredulity questions. We intend to test whether Spanish and Catalan listeners are able to perceive a phonological difference between the two by exploiting this alignment difference. The contribution of duration and scaling will be controlled in the experiment. The experiments are expected to be carried out for both Catalan and Spanish by the group at the Universitat Pompeu Fabra and by Eva Estebas-Vilaplana at the UNED.

![Graphs showing L* HH% and L* LH%]

Experiment 5: L* HH% vs. L+H* HH%, neutral vs. inviting questions (Catalan, English). In this case the languages under study are Catalan and English. The main goal of the proposed research is to investigate the form and function of two distinct types of final rises which are typically used with yes/no questions in the two languages. In English, they have been studied by Jones 1918, Palmer 1922, Bolinger 1961, O’Connor & Arnold 1963, Cruttenden 1997, and more recently by Ladd 1996, and Gussenhoven (2004), among others. However, there still remains an active debate in the literature as regards their form, function and uses. In fact, a recent study proposes that there are in fact three types of rises: two kinds of low rises, one much lower than the other, which both contrast with the high rise (Levis 2002). The existence of two distinct types of low rise should explain the often contradictory claims in the literature. The experiments are expected to be carried out for Catalan by the group at the Universitat Pompeu Fabra and by Lluïsa Astruc at the University of Cambridge.
Experiment 6: L+H* LL% vs L+H* HL%, simple request vs. insisting request (Catalan, Spanish). We plan to investigate whether the HL% boundary tone is important in the perception of emphatic requests or whether these nuances are cued by other pitch cues like duration and scaling. The experiments are expected to be carried out for Catalan and Spanish by the group at the Universitat Pompeu Fabra and by Eva Estebas-Vilaplana at the UNED.

Experiment 7: H+L* L% vs. H* L%, neutral vs. focalized meaning. (Catalan) This experiment will analyze the contrast between a neutral wh-question (left panel) and a focused wh-question (right panel). The main difference between the two is the alignment of the falling tune towards the end of the utterance: while wh-questions are characterized by a fall during the accented syllable (H+L*), focused wh-questions have a high tone H* in the nuclear syllable. Previous research on function of focus and intonation patterns in Majorcan Catalan wh-questions (Vanrell, 2008) shows that the use of different nuclear configurations (H+L* L% —falling pitch accent— and L+H* L% —rising pitch accent—) is related to a difference in the focus structure. To this end, congruity perception experiments are going to investigate the contextual appropriateness of the target sentence’s intonation patterns on a five-point scale. The results of a pilot study suggest that the presence/absence of focus in topic sentences of wh-questions might be to some extent iconically reflected in perception by the pitch height of the nuclear accent: the higher the pitch on the nuclear syllable, the greater the probability of having the sentence following the wh-word in focus. The experiments are expected to be carried out for Catalan by the group at the Universitat Pompeu Fabra.

Experiment 8: H+L* vs. ¡H+L*, confirmatory questions. (Catalan). Previous studies have shown that speakers can signal information- and confirmation-seeking questions intonationally. The main goal of this work is to determine how it is marked in Catalan. Following Escandell’s proposal (Escandell 1993) about transactional speech and the real knowledge/knowledge presupposition scale, we have
conducted a production experiment in Central and Balearic Catalan in which information- and confirmation-seeking questions were elicited. The results showed that Catalan speakers use two main cues in distinguishing information- from confirmation-seeking questions: the use of different boundary tones or the use of different pitch accents (Vanrell, Mascaró, Torres-Tamarit & Prieto 2008). In this project, we will undertake several perceptual studies that will allow us to determine a) whether the nuclear configurations found in production can be used successfully in different pragmatic contexts; b) whether Escandell’s scale is mirrored perceptually; and c) whether the nuclear configurations found in production can be distinguished categorically. The experiments are expected to be carried out for Catalan by the group at the Universitat Pompeu Fabra.

**Experiment 9: L+H* vs. L+>H*, neutral vs. focalized meaning (Catalan, Spanish).** Another contrast that we expect to examine in relation to Catalan and Spanish intonation is the phonological status of the prenuclear rising accents, namely, L*+H vs. L+>H*. Prieto and Face 2007 showed a three-way contrast between rising accents in Spanish: L*+H (low accented syllable followed by a rise), L+H* (high accented syllable preceded by an F0 valley) and L+>H* (high accented syllable with an F0 peak on the post-tonic syllable). The L*+H pitch accent is found in prenuclear position in questions with a nuance of surprise and the L+>H* accent is typical of neutral declaratives. In order two find out whether these two accents correspond to two distinctive categories or are different realizations of the same unit, we expect to carry out a perception test where listeners will only hear the first part of the sentence (that is, the prenuclear position) and will then have to identify the kind of utterance that is about to be produced (namely, statement or question). If they can recognise the type of sentence by only listening to the prenuclear accents, then we can postulate that these units correspond to two different phonological units. To analyze this pitch accent choice in prenuclear accents, we will use a gating paradigm in which listeners listen to progressively larger parts of the utterance and have to decide on the meaning of it. L+H* is phonetically realized as a rising pitch movement during the accented syllable. The rise starts at the onset of the accented syllable and ends at the end of that syllable. It is attested in nuclear position in broad and narrow focus, in anti-expectational questions, and in combination with a variety of boundary tones in calls, insistent requests, obvious statements, etc. On the other hand, L+>H* is also phonetically realized as a rising pitch movement. Typically, the L tone is aligned with the onset of the accented syllable, and the H tone is aligned with the postaccentual syllable. This is the predominant choice for prenuclear accents in broad focus statements. For more arguments in favour of the analysis of this pitch accent as L+>H*, see Prieto, D’Imperio & Gili-Fivela 2006. We will control for pitch scaling, as it has been reported to accompany strict alignment in focus cases. The experiments are expected to be carried out for Catalan and Spanish by the group at the Universitat Pompeu Fabra and by Eva Estebas-Vilaplana at the UNED.
Experiment 10: L+H* vs. L*+H, statement vs. interrogative cues. (Catalan, Spanish) L+H* is phonetically realized as a rising pitch movement during the accented syllable. The rise starts at the onset of the accented syllable and ends at the end of that syllable. It is attested in nuclear position in broad and narrow focus, in anti-expectational questions, and in combination with a variety of boundary tones in calls, insistent requests, obviousness statements, etc. On the other hand, this pitch accent is realized as a low tone on the accented syllable followed by a rise on the posttonic syllable. The peak is typically realized at the end of the posttonic syllable, and sometimes later. In our corpus, it is attested in prenuclear position in yes-no questions and requests. The experiments are expected to be carried out for Catalan and Spanish by the group at the Universitat Pompeu Fabra and by Eva Estebas-Vilaplana at the UNED.

Experiment 11: Baseline experiment with scaling: L+¡H* vs. L*+H, emphasis cues (Catalan, Spanish). We will investigate whether Catalan and Spanish listeners rely on the pitch range difference existing between the same rising pitch accent, namely L+H*, to distinguish between different degrees of emphasis. The experiments are expected to be carried out for Catalan and Spanish by the group at the Universitat Pompeu Fabra and by Eva Estebas-Vilaplana at the UNED.

Experiment 12: Politeness and intonation. (Catalan, Spanish). It has been proposed in the literature that prosody plays a role in the expression of politeness. We plan to explore the contribution of tonal scaling to the expression of paralinguistic meanings, and more specifically, to examine the relationship between pitch height and the degree of perceived politeness. Experimental studies have found that the use of a higher pitch range or use of higher peaks is typical of polite utterances (Álvarez & Blondet 2003; Maekawa 1999; Orozco 2006). Yet other studies (Culpeper 2005) have shown that higher pitch can also be associated with impoliteness. In a recent MA thesis presented in our group, Nadeu (2009) tested whether pitch height correlates positively or negatively with politeness. Two continua were created by gradually increasing and decreasing the final boundary tone of a rising and a falling yes–no question. 20 native speakers of Central Catalan took part in the experiment. They had to compare stimuli in pairs and also rate the degree of politeness that each stimulus conveyed in isolation. Results obtained in both tasks and for both continua point in the same direction: the degree of perceived politeness gradually decreases when the pitch height of the final boundary tone is increased. Our research on this will test
whether duration is playing a role in the perception of politeness, and also whether audiovisual cues can act as a disambiguating factor.

Our group has also a research line on the interaction between prosodic structure and phonological and morphological structure (Teresa Cabré and Maria Ohannesian). Their recent research has focused on how stress position and segmental and prosodic effects interact. The empirical data that is used is from previous literature, data from the Atlases, and interviews designed to obtain specific data. Within this project, these two researchers will undertake the analysis of the interaction between intonational prominence and morphological structure, and more specifically, the analysis of imperatives and vocative forms. Both imperatives and vocatives usually display minimal flexive affixation, and intonational prominence constitutes one of the true marks of imperative and vocative modality. Cabré & Ohannesian will undertake the study of these two cases within the morphology/prosody interface.

Finally, in relation to this, the group will continue doing work on the intonation variation that is shown by several dialects of Catalan and Spanish. For examples, Alguerese Catalan intonation is very interesting because of its linguistic isolation surrounded by different languages like Italian and Sardinian. This dialect of Catalan is spoken exclusively, in the north-west of Sardinia, in a city of 40,000 inhabitants called Alghero. We are especially interested in three topics involving Algherese intonation: a) the role of tonal scaling in distinguishing declarative sentences from yes-no and wh-questions; b) how narrow focus is produced by Algherese speakers (the first collected data seem to point to the existence of tritonal accents); and c) the role of intonation in marking emphasis in vocatives (group members in charge of this subproject: Teresa Cabré and Maria del Mar Vanrell). With the purpose of analyzing the issues mentioned above, a series of production experiments will be conducted. Since Algherese speakers are not generally familiar with Catalan orthography, reading tasks are not valid. Instead, conversational games for eliciting this kind of data will be designed.

Similarly, as a complement to this project, we are interested in how young infants acquire intonation contrasts. The goal of this subproject is to propose a description of the phonological acquisition process of Catalan and Castilian Spanish during the first stage of life (from 1 to 3 years of age). The central focus of this project is prosodic acquisition, that is to say, the acquisition of syllabic and metrical structure and intonation, and its corresponding relationship with lexical and syntactic development. The project is currently completing the phonetic transcription using the program PHON of an extensive longitudinal database of 4 Catalan-speaking children (Serra-Solé corpus, CHILDES) and 2 Spanish-speaking children (Ornat corpus and Llinás-Ojea corpus, CHILDES). Also, the project is completing the analysis of production data on pitch accent acquisition to learn about the acquisition of prosodic structure in early childhood (1 to 3 years of age).
This chronogram must indicate the persons involved in the project, including those contracted with project funds. Underline the name of the person responsible of each task.

<table>
<thead>
<tr>
<th>Actividades/Tareas</th>
<th>Centro Ejecutor</th>
<th>Persona responsable y otras involucradas</th>
<th>Primer año (*)</th>
<th>Segundo año (*)</th>
<th>Tercer año (*)</th>
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</table>
| 1. Description of the prosody and intonation of Occitan  
*Atles interactiu de l’entonació del català*  
a. Data collection / Obtención de datos  
b. Posting on the website / Colocación en la web  
c. Data analysis / Análisis de los datos | UPF-UAB | Cabré, Prieto  
Crespo, Vanrell  
Co-workers/  
Colaboradores:  
Borràs, Sichel  
Hired staff /  
Personal contratado | [x|x|x|x|x|x|x|x] | [x|x|x|x|x|x|x|x] | [x|x|x|x|x|x|x|x] |
| 2. Description of the prosody and intonation of Occitan  
*Atles interactiu de l’entonació de l’occità*  
a. Data collection / Obtención de datos  
b. Posting on the website / Colocación en la web  
c. Data analysis / Análisis de los datos | UPF-UAB | Prieto  
Co-workers/  
Colaboradores:  
Sichel  
Hired staff /  
Personal contratado | [x|x|x|x|x|x|x|x] | [x|x|x|x|x|x|x|x] | [x|x|x|x|x|x|x|x] |
| 3. Description of the prosody and intonation of Spanish  
*Atlas interactivo de la entonación del español*  
a. Data collection / Obtención de datos | UAB | Prieto  
Crespo, Vanrell  
Co-workers/ | | | |
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<tr>
<th>Task</th>
<th>Organization</th>
<th>Collaborators</th>
<th>Notes</th>
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<tr>
<td>b. Posting on the website / Colocación en la web</td>
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<td>c. Data analysis / Análisis de los datos</td>
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<td>4. Prosodic structure: interaction morphology/prosody.</td>
<td>UAB</td>
<td>Cabré, Ohannesian, Vanrell</td>
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<td>a. Data collection</td>
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<td>b. Analysis</td>
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<td>c. Writing up of the results</td>
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<td>Experimental part 1-15</td>
<td>UAB, U-Cambridge</td>
<td>Prieto, Astruc, Estebas-Vilaflana, Borrás, Crespo, Vanrell</td>
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<td>(see Work Plan)</td>
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<td>a. Experiments intonational contrasts: Production and perception experiments, 1-4</td>
<td>UNED</td>
<td>Sichel, Co-workers/Colaboradores: Sichel</td>
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<td>b. Experiments intonational contrasts: Production and perception experiments, 5-8</td>
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<td>Hired staff / Personal contratado, Technician</td>
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<td>c. Experiments intonational contrasts: Production and perception experiments, 9-12</td>
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<td>Técnico contratado</td>
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<td>Experiment on intonational contrasts and ERPs</td>
<td>UPF, UB</td>
<td>Prieto, Borrás, Vanrell</td>
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<td>(in collaboration with Escera’s group at the UB)</td>
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<td>a. Experimental design and pilot studies</td>
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<td>b. Data collection and analysis</td>
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<td>c. Analysis and writing up of the results</td>
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(*) Colocar una X en el número de casillas (meses) que corresponda
5. BENEFITS DERIVED FROM THE PROJECT, DIFUSION AND EXPLOITATION OF RESULTS
(maximum 1 page)

The following items must be described:

♦ Scientific and technical contributions expected from the project, potential application or transfer of the expected results in the short, medium or large term, benefits derived from the increase of knowledge and technology.

♦ Diffusion plan and, if appropriate, exploitation plan of the results.

The findings of this project will be reported in a series of international conferences like *Speech Prosody 2010, 2012, Tone and Intonation in Europe 2009, 2010, 2011, and 2012, International Congress of the Phonetic Sciences 2011*, as well as in other specific workshops. Similarly, we will publish the results in internationally peer-reviewed journals like *Language and Speech, Phonetica, Journal of Phonetics, and Journal of the Acoustical Society of America*, among others.

Apart from contributing to conferences and journal publications in our field, we are organizing three workshops that are closely related to the content of this research proposal and which will help to deliver better results and establish further collaborations in the field. With the goal of discussing the current challenges that face our discipline with the most prominent researchers working on intonation and meaning, our group has organized the *Workshop on Intonation and Meaning*, which will be held 17-19 September 2009 in Barcelona ([http://prosodia.uab.cat/prosodyandmeaning](http://prosodia.uab.cat/prosodyandmeaning)). The Barcelona workshop is co-organized by Pilar Prieto (ICREA-UPF), Gorka Elordieta (EHU), and Joan Peytaví (U. Perpinyà – IEC). The workshop forms part of the activities of the *Forms and Functions of Prosodic Structure* research network, of which Carlos Gussenhoven and Yiya Chen are the main convenors and Gorka Elordieta, Sónia Frota, Aditi Lahiri, Pilar Prieto, Tomas Riad, and Lisa Selkirk are coordinators). Recent developments in language research have increasingly put the spotlight on the phonological status of intonation and its relationship with meaning. This workshop is intended as a venue for exchanging ideas and methodologies and for stimulating discussions and collaborative work between researchers coming from different perspectives. The workshop will consist of invited talks by scholars from inside and outside the network, a number of selected talks, and a poster session.

Similarly, the *Workshop on Sp_ToBI*, organized by Pilar Prieto, will be held in Las Palmas de Gran Canaria in June 2009. The workshop has the goal of discussing the AM model of transcription of intonation by using data from the Spanish language ([http://prosodia.uab.cat/prosodyandmeaning](http://prosodia.uab.cat/prosodyandmeaning)). Because this workshop involves researchers from the US and Latin America, it will contribute to the development of the *Atlas de la entonación del español*. Finally, the *Workshop on Cat_ToBI* will take place on 19 July 2009 in Barcelona.

Last but not least, we are working on digital projects that all have international exposure and value. First, the *Interactive Atlas of Catalan Intonation* ([http://prosodia.uab.cat/atlesentonacio/](http://prosodia.uab.cat/atlesentonacio/)) and the *Interactive Atlas of Occitan Intonation* ([http://prosodia.uab.cat/atlesentonacio/](http://prosodia.uab.cat/atlesentonacio/)) systematically present a series of audio and video materials for the study of prosody and intonation in the various dialects of Catalan and Occitan. They are intended as the first step in a comprehensive study of the great dialectal diversity present in the intonation of that language. By means of interactive maps of linguistic domains, the user can conveniently access various audio and video materials exemplifying the diverse Catalan and Occitan varieties, as well as the Cat_ToBI proposal for the prosodic labelling of Catalan.
6. BACKGROUND OF THE GROUP
(In the case of a coordinated project the topics 6. and 6.1. must be filled by each partner)
(maximum 2 pages)

♦ Indicate the previous activities and achievements of the group in the field of the project:

If the project is related to other previously granted, you must indicate the objectives and the results achieved in the previous project.

If the project approaches a new research field, the background and previous contributions of the group in this field must be indicated in order to justify the capacity of the group to carry out the project.

The current research proposal is very partially related to our previous project Prosodic structure and acquisition of prosodic structure in Catalan and Spanish, funded by the Ministerio de Educación y Ciencia and the Atles de l’entonació del català, funded by the Càtedra Alcover-Moll-Villangómez and the Generalitat de Catalunya. In these two projects, we only started investigating the intonational phonology of Catalan and Spanish and discovered some of the phonological contrasts we would like to pursue further in this research project.

The team that presents this research project is an established team of researchers who are part of the Group of Prosodic Studies (GrEP: Grup d’Estudis de Prosòdia). As we will see below, the research objectives of the group members focus on the interaction between prosody and segmental phonology, the interface between prosody and pragmatics, prosody and syntax, as well as the construction of theories and models about those aspects of prosody that interact with other disciplines. Specifically, the three recent contributions of the group in the specific area of the project are the following:


Dr Pilar Prieto is a phonetician with a long track record in (often grant-funded) research in prosody and intonation, as well as prosodic development. She is an ICREA research professor (Institució Catalana de Recerca i Estudis Avançats) and a member of the Departament de Traducció i Ciències del Llenguatge, Universitat Pompeu Fabra. Her research interests focus on the interactions between phonology and phonetics in intonation, prosodic phrasing, phonetics modelling of tonal articulation, the description of Catalan and Spanish intonation, and variation in intonation. Further interests include the acquisition of phonology, and the phonetics and phonology of pathological speech. Her work is carried out within the framework of Laboratory Phonology.

Dr Teresa Cabré has been a key member of our research team since the beginning. She works on Prosodic Phonology in the framework of Optimality Theory, and she has worked particularly in three areas with special emphasis on the role of stress position: truncation process (the subject of her thesis and several articles thereafter), the adaptation of neologisms and vowel contact resolutions. Among her recent articles on vowel contacts we can single out Cabré, T. & Prieto, P. 2006. "Positional Prominence and metrical effects on vowel sandhi in Catalan" in Prosody, ed. by Sónia Frota, Marina & Vigário Maria Joao Freitas. Mouton de Gruyter: The Hague, and “Exceptional hiatuses in Spanish” in Optimality-Theoretic Advances in Spanish Phonology, ed. by S. Colina & F. Martinez-Gil. John Benjamins: Amsterdam/Philadelphia. She has also coordinated the “Atles de l’entonació del català” (Prieto & Cabré 2008).
Dr. María Ohannesian will also contribute greatly to the project. Her research has focused on the study of stress in Spanish in her thesis work (2004, La asignación del acento en castellano). One important line of investigation in her work is the evolution of the prosodic structure from Latin to Romance languages, in particular Spanish. She also works within the frameworks of Prosodic Phonology and Optimality Theory, and has worked on the Phonology-Morphology interface, particularly on contact vowel resolutions in Spanish verbal morphemes. Of particular note here is Cabré & Ohannesian (in press) “Stem boundary and stress effects on syllabification in Spanish”, *Interactions in Phonetic and Phonology*, ed. by Marina Vigario et al. John Benjamins: Amsterdam/Philadelphia.

Dr. Lluïsa Astruc works as an Affiliated Lecturer at the *University of Cambridge*. Her main research interest is the intonation of Catalan, Spanish and English, which were also the topics of her master and doctoral theses, both obtained at the University of Cambridge. She has worked on speech technology (Speech Technology Group, Toshiba Research Europe, Cambridge), designing and carrying out perceptual experiments to assess the quality of synthetic voices. She has also researched the acquisition of prosody (The acquisition of rhythm in English, Catalan, and Spanish, an Oxford-Cambridge-UAB collaborative project led by Dr Prieto) and the interrelation between the acquisition of prosody and the acquisition of literacy (as a Post-Doctoral Fellow at the Centre for Neuroscience in Education, University of Cambridge). She has thus acquired ample experience designing and carrying out psychoacoustic experiments with adults and children. Her experience in this matter ensures a valuable contribution to the group.

Dr. Eva Estebas-Vilaplana is specialised in Catalan intonation, with interests in speech perception and the acquisition of intonation. Her contribution to the project will be of great importance. From their outset, she has been a member of many of the research projects directed by Dr Prieto. She has centred her research on characterizing the alignment of the tonal pitch accents of English, the topic of her doctoral thesis for the *Department of Phonetics and Linguistics, University of London*. She has conducted experiments that allow us to describe the patterns of association between tonal inflections and segments in English and Spanish and has published the results in journals such as *Journal of English Linguistics*, *Speech, Language and Hearing*, and *Atlantis*.

Mr. Joan Borràs has been a predoctoral student in the Consolider-Ingenio project since March 2008. His main research interest is the description of adult and infant phonology of intonation. For his recent MA thesis, he carried out production experiments related to the production of syllabic structure by 2-year old children, focusing on the acquisition of codas by monolingual and bilingual infants. His particular contribution to the project will be to work directly in Carles Escera’s group on the study of the brain correlates of tonal contrasts.

Ms. Verònica Crespo is a predoctoral student who holds a fellowship from a project that is currently creating the *Atlas of Catalan/Valencian Intonation*, funded by the Acadèmia Valenciana de la Llengua. For her recent MA thesis, she undertook a production experiment to study the differences between yes-no questions in two varieties of Catalan (Valencian and Central Catalan). She will participate in the UP F tasks of the project and will carry out several production and perception experiments related to the project.

Ms Vanrell is a predoctoral student in our group and has been an important member of the group from the start. She holds a predoctoral FPI grant with the group and has undertaken the perception experiments reported in Vanrell (2006, 2007). She is specialised in Catalan intonation, with interests in speech perception and acquisition of intonation. She has participated in many of the funded group projects and will conduct many of the planned production and perception experiments by using the techniques of categorical perception. She is currently very actively involved in most projects of the group.

The research of PhD candidate and collaborator Mr R. Sichel Bazin focuses on the study of phonology and dialectology of Occitan, especially with regard to intonation. He is carrying out his doctoral research under the direction of Dr. Prieto, on the alignment of the leading tones in statements in Occitan. Together with Dr. Prieto, he is heavily involved in a project coordinated by the group, the *Interactive Atlas of prosody of Occitan*. Now he collaborating in the development of the training materials for the Cat_ToBI transcription system, with examples of labeled utterances and labeling exercises. It is intended to be a practical tool for learning how to label prosodically diverse speech data in Catalan (http://prosodia.uab.cat/cat_tobi/en/index.php).
### 6.2 Public and Private Granted Projects and Contracts of the Research Group

Indicate the project and contract grants during the last 5 years (2004-2008) (national, regional or international). Include the grants for projects under evaluation.

<table>
<thead>
<tr>
<th>Title of the project or contract</th>
<th>Relationship with this proposal</th>
<th>Principal Investigator</th>
<th>Budget</th>
<th>Funding agency and project reference</th>
<th>Project period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prosodic Structure and Focus</td>
<td>2</td>
<td>Dr. Carlos Gussenhoven (Radboud University)</td>
<td>54,300 €</td>
<td>Internationalization Grant for the project “Prosodic Structure and Focus”. NWO Dutch Research foundation</td>
<td>January 2008 – January 2011</td>
</tr>
<tr>
<td>Proyecto</td>
<td>Catedra/Generalitat</td>
<td>Allocations</td>
<td>Reference</td>
<td>Duration</td>
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<td>--------------------------------------------------------------</td>
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<tr>
<td>Papel de los factores articulatorios, aerodinámicos y prosódicos en la implementación de los procesos fonológicos y de cambio fonético</td>
<td>Dr. Daniel Recasens (UAB-IEC)</td>
<td>29.000 €</td>
<td>Proyecto BFF2003-09453-C02-C02, Ministerio de Ciencia y Tecnología (McyT) y FEDER</td>
<td>C December 2003 - December 2006</td>
<td></td>
</tr>
<tr>
<td>Procesos segmentales y estructura prosódica y morfológica en catalán</td>
<td>Dr. Joan Mascaró (UAB)</td>
<td>26.000 €</td>
<td>Proyecto BFF2003-06590, Ministerio de Ciencia y Tecnología (McyT) y FEDER</td>
<td>C December 2003 - December 2006</td>
<td></td>
</tr>
<tr>
<td>Grupo de Fonética Experimental UAB-IEC</td>
<td>Dr. Daniel Recasens (UAB-IEC)</td>
<td>20.434,41 €</td>
<td>Generalitat de Catalunya, Pla de Recerca de Catalunya, AGAUR. 2001SGR 00425</td>
<td>C 2001-2005</td>
<td></td>
</tr>
<tr>
<td>Xarxa de Gramática Teórica</td>
<td>Dra. Teresa Cabré (UAB)</td>
<td>9000 €</td>
<td>Generalitat de Catalunya, Pla de Recerca de Catalunya, 2002XT 00036</td>
<td>C 2002-2004</td>
<td></td>
</tr>
<tr>
<td>Acción complementaria para el congreso Phonetics and Phonology in Iberia (PaPI)</td>
<td>Dra. Pilar Prieto (ICREA-UBA)</td>
<td>--</td>
<td>Ministerio de Ciencia y Tecnología (McyT) y FEDER</td>
<td>S 2005</td>
<td></td>
</tr>
</tbody>
</table>

(1) Write 0, 1, 2 or 3 according to: 0 = Similar project; 1 = Very related; 2 = Low related; 3 = Unrelated.
(2) Write C or S if the project has been funded or it is under evaluation, respectively.
7. TRAINING CAPACITY OF THE PROJECT AND THE GROUP
(In the case of Coordinated Projects this issue must be filled by each partner)

This title must be filled only in case of a positive answer to the corresponding question in the application form. Justify that the group is able to receive fellow students (from the Suprograma de Formación de Investigadores) associated to this project and describe the training capacity of the group. In the case of coordinated projects, each subproject requesting a FPI fellowship must fill this issue.

Note that all necessary personnel costs should be included in the total budget requested. The available number of FPI fellowships is limited, and they will be granted to selected projects as a function of their final qualification and the training capacity of the groups.

The training capacity of the group is amply attested to by the wealth of experience of its members in this regard. First, the senior and postdoctoral members of the research team are renowned researchers in the field of prosody and intonation. The following members of the group (Cabré, Prieto, Astruc, Estebas) are engaged in academic responsibilities and in training research graduates. In particular, they participate in the following MA and Doctoral programs:

(1) T. Cabré and P. Prieto participate in the Interuniversity MA and PhD Program in Catalan language and Catalan Philology.
(2) T. Cabré and P. Prieto participate in the InterUniversity MA and PhD Program in Cognitive Science and Linguistics, which awarded an endorsement of quality by the Spanish Government the 2003-2004 academic year. The Linguistics part of this MA Program is coordinated by P. Prieto at the UAB.
(3) Lluïsa Astruc teaches undergraduate courses at Cambridge University and supervises dissertations (in the Year Abroad Project). She has also led workshops to train lecturers in the use of virtual language environments such as Moodle (The Open University, September 2007) and CamTools (Cambridge University, May 2008).
(4) E. Estebas and P. Prieto participate in the MA de Estudios Fónicos, organized by the CSIC in Madrid, and they teach the course Intonational Phonology. Similarly, E. Estebas participates in the English Studies Program organized by the UNED’s Department of Foreign Languages and Linguistics.

All the information about the research lines of the group, publications, and teaching, can be found in our web page at http://prosodia.uab.cat/.

Second, this solid team shares the use of common theoretical models and methodology, in particular, Prosodic Phonology, Laboratory Phonology, and the Autosegmental Metrical Model of intonation (Cabré, Ohannessian, Estebas, Prieto). For this reason, the inclusion of trainees in the project would offer such trainees the great advantage of working in a single group under experienced researchers trained and familiar with different models and studies in the area of prosodic phonology, yet integrated directly into their program of studies. The group is keen to develop training tools for teaching at both the undergraduate and postgraduate levels. For example, the group is now developing a webpage which contains the training materials for the Cat_ToBI transcription system, with examples of labeled utterances and labeling exercises. It is intended to be a practical tool for learning how to label prosodically diverse speech data in Catalan (you can see it at http://prosodia.uab.cat/cat_tobi/en/index.php).

Finally, the strong ties the group has with other international labs will make it possible for our students to undertake short research stays at other labs. The group has strong links to other groups working on intonation in Europe and is part of the Research Network Tone and Intonation in Europe (2007-2012) coordinated by
scholars of international repute like Carlos Gussenhoven (Nijmegen) [Network Organizer], Yiya Chen (Leiden), Gorka Elordieta (Basque Country), Sónia Frota (Lisbon), Esther Grabe (Oxford), Aditi Lahiri (Konstanz), and Thomas Riad (Stockholm). The goal of this conference is to bring together researchers working on the field of prosody and meaning. Recent developments in language research have increasingly put the spotlight on the phonological status of intonation and its relationship with meaning. This workshop is intended as a venue for exchanging ideas and methodologies and for stimulating discussions and collaborative work between researchers coming from different perspectives. The workshop will consist of invited talks by members of the network and outside the network, a number of selected talks, and a poster session.

On an final note, we believe that the activities and tasks to be assigned to the FPI interns and hired staff will have immense educational value as they will allow them to fully participate in the studies being prepared. As noted above, both interns and staff will play a vital role in the development of the three Atlases, as well as in conducting cutting edge production and perception experiments on prosodic features.