

Expectations for Discourse Genre Identification: a Prosodic Study

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Abstract

Speech can be divided into discourse genres based on the contextual environment it occurs in (e.g. political speech, sport commentary speech, etc.). The present study investigated whether listeners can distinguish between speech from different discourse genres on the basis of acoustic prosodic cues only¹. In a perception experiment with delexicalized speech 70 listeners with varying experience in French (native speakers, non-native speakers, and non-speakers) were asked to identify four different types of discourse genres (church service, political, journal, and sport commentary). Results revealed a fair identification ability with a significant increase in performance with increasing experience in French. Identification confusion was used to cluster discourse genres according to their perceptual similarity. The possible application of the results for the evaluation of speaking style speech synthesis will be discussed.

Index Terms : discourse genre, speaking style, prosody, perception, speech synthesis.

1. Introduction

The concept of discourse genre (DG) has been studied widely in rhetoric and literature and more recently extended to the oral domain, in particular at the interface of written and oral ([1, 2]).

According to the old assumption that underlies the analysis of discourse genres in linguistic ([3, 4]) : to a given situation and a given social context corresponds a specific mode of production which is associated to specific formal markers that bear the traces at all levels (semantic, syntactic, phonological) of the DG. Following these studies, research in textual typology aims to : 1) describe the diversity of discourses (literary , legal, political, religious, etc.) ; 2) understand their articulation into genres ([5]) ; 3) estimate their formal markers, in particular the co-occurrence of specific cues that can be considered as being typical of a genre. The challenge is to provide a robust and shared DG's typology. However, it remains very difficult to go further than conventional generic types (private, professional, public speech) and subdivisions (face to face conversation, phone conversation, public debates, radio and TV broadcasts, unprepared vs. planned speech, etc. [2]). In the absence of a comprehensive representation of discourse genres and classes, each domain defines specific classification criteria which best account for its purpose (social, language activity, and formal spaces [6, 7]).

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In strictly phonetic terms, studies focus on the description of phonostyles ([8, 9]). In particular, public discourse (such as political, religious, journalistic and sport), considered as cultural stereotypes, are related to expressive strategies that acts as markers of a phonostyle ([10]).

Recent attempts have been proposed to relate achievements in phonostylistic ([11]) to text segmentation and classification in semantic in order to provide a unified interpretation framework : thematic content and informational sequence, semantic-syntactic structures and prosodic patterns (for recent work on French, see [12, 13]).

This study aims at : 1) assessing whether the acoustic prosodic patterns of DGs are perceptually salient ; 2) estimating a classification of DG's on the basis of perceptual proximity ; 3) providing a reference for the evaluation of a speaking style speech synthesis system. For that purpose, a perceptual experiment was carried out in which listeners of different native language backgrounds had to identify different French DGs based on prosodic patterns.

The paper is organized as follows : section 2 presents the design of speaking style corpus from which the stimuli for the present experiment were derived ; section 3 presents the experimental setup ; finally, results are presented and discussed in sections 4 and 5 respectively.

2. Speaking Style Corpus Design

2.1. Corpus Design

For the purpose of speaking style speech synthesis, a 4 hours French multi-media corpus was designed from which for the present perceptual experiment were derived. The corpus consists of four different DG's : catholic mass ceremony, political, journalistic, and sport commentary. In order to reduce the DG intra-variability, the different DGs were restricted to specific discourse contexts (see list below) and to male speakers only.

Following is a description of the 4 selected DG's :

- **mass** : christian sermon (pilgrimage and sunday high-mass sermons) ; single speaker monologue, no interaction.
- **political** : new year's speech ; single speaker monologue ; no interaction.
- **journal** : radio review (press review ; political, economical, technological chronicles) ; almost single speaker monologue with a few interactions with a lead journalist.
- **sport commentary** : soccer ; two speakers distributed on monological sequences with speech overlapps during intense sequences and speech turn changes ; almost no interactions.

Speech samples were collected from *real speech* multi-media contents. Recordings date from the 2000's with the exception of the political discourse which homogeneously ranges from 1975 to 2007. Speech samples are compressed audio (mp3 format at various and unknown encoding bit rates) with strongly variable audio quality (background noise : crowd, audience, recording noise and reverberation). The sample selection was especially designed in order to provide well-balanced DG's corpora (total DG's duration ; mean duration per speaker)². Corpus properties are summarized in table 1.

speaking style	media	# speaker	speaker gender	mean duration / sample	mean duration / speaker	total duration
mass	none	7	7M	12mn	11mn	1h20
political	TV	5	5M	12mn	14mn	1h10
journal	radio	5	5M	4mn	14mn	1h10
sport	radio	4	4M	20mn	9mn	35mn

TABLE 1 – Description of the speaking style speech corpus.

The corpus was enriched in particular with the following linguistic annotations : orthographical transcription ; phonemic alignment and breath detection using *ircamAlign* [14], then manually corrected ; syllabification on inter-pausal groups.

3. Experimental Design

The experiment consists in a multiple choice DG's identification task based on speech prosody global perception. As it was not possible to control the linguistic content of the speech utterances which is an evident cue for DG's identification (a single keyword would be sufficient to identify a DG), it was necessary to remove lexical access and thus to focus on the prosodic dimension only. Speech utterances were extracted from the speaking style speech corpus, filtered to remove linguistic access and then presented as a multiple choice identification experiment to multi-language speakers in a source-crowding framework.

3.1. Subjects

70 subjects participated to this experiment. This includes : 37 native French speakers, 20 French speaker, 15 non-French speakers ; 46 expert subjects, 24 naïve subjects. *Expert* subjects were actually coming from various domains (speech and audio technologies, linguistic, musicians). 7 subjects were removed because they did not process the experiment entirely or because they did the experiment several times (same ip adress or same name). In the case of multiple participation of a subject, his first participation was used for analysis only. Subjects were aged from 20 to 65 years, with a strong proportion (65%) within the 20-35 year range.

3.2. Stimuli

40 speech utterances (10 per DG) were selected in the speaking style corpus. Such selection was conducted in order to provide various and representative prosodic patterns for each DG. Firstly, segmentation into speech utterances was accomplished according to the *prosodic period*. Prosodic period is strictly acoustically defined as being a sequence of inter-pausal groups which ends with a conclusive frontier (combination of three

²This was reached with the exception of the sport commentary which has half duration than the other DG's

acoustic criteria : low pitch accent, long syllable duration, followed by a long pause). It is in particular supposed to be related to discursive speech units (a prosodic object as a marker of a communicative and discursive object). However analysis of speech samples reveals that the definition of the *prosodic period* fails to account for some specific speech sequences or more generally to some DG. In particular, it was regularly observed that journalistic utterances do not end with a major frontier (low pitch accent which is not followed by a pause, or even high-pitch accent which is followed or not by a pause, or inconsiderable long prosodic periods). This was especially observed for spontaneous speech such as the sport commentary where prosodic periods could not be directly associated to discursive units. Consequently, segmentation into speech utterances was finally decided by an expert linguist according to discursive-prosodic considerations in such conflictual cases. In particular, speech segmentation was chosen as being prosodic objects which were not necessary formally defined by prosodic constraints only but combining prosodic cues to weak discursive, syntactic and semantic dependencies to the discursive context.

Secondly, the selection criteria were derived from a classification of speech utterances into discursive sequences as well as prosodic structure and complexity. In particular, *archetypal speech utterances* were selected depending on the DG (mass : "au nom du père et du fils, et du Saint-Esprit, ainsi soit-il", in the name of the Father, the Son, and the Holy Spirit, Amen. ; political : "mes chers compatriotes, vive la République et vive la France", my fellow countrymen, long live the republic ! Long live France ! ; sport commentary : "oh le but de Babel ! le but de Babel ! le but de Babel !", What a goal by Babel ! Goal by Babel ! Goal by Babel ! ; journal : no specific speech utterance was observed). Then, speech utterances were classified into *discursive sequences* depending on the DG. For instance, journalistic chronicles can be formally described as a sequence of topic sequences with punctual interaction with a lead speaker during topic changes. Speech utterances were thus classified into global introduction from a lead speaker ("l'Eco du jour" : c'est l'actualité économique de ce lundi 26 octobre 2009 vue par Philippe Lefebure, "Eco du Jour" is the economic news for today, Monday, October 26, 2009 hosted by Philippe Lefebure), and initial, medium, terminal and transitional sequences for each topic (initial : "MacDo va quitter l'Islande : conséquence directe de la crise, raconté dans L'Humanité", MacDonald's is quitting Iceland : a direct result of the financial crisis, story in "l'Humanité". ; conclusive : "les français disent qu'on va dans la mauvaise direction, une seule réponse du côté de l'UMP : il faut y aller plus vite", The French say we have taken the wrong path, the only reply from the UMP is : "We must go faster".). Sport commentary sequences were classified according to actional and situational (current action, past action, off-line comments) as well as emotional (more or less intense) criteria. Other DG's speech utterances were classified in the same manner. Such classification interestingly relate to specific prosodic patterns. Then various *prosodic sequences* were chosen for each DG (in particular : low, medium, and high terminal pitch accent, intermediate lexical pitch accents as well as hesitations).

Thirdly, as it was observed that speech utterance's duration strongly depend on the DG, speech utterances were classified into short ($4 \pm 0.5s.$) and long ($10 \pm 1s.$) utterances that were homogeneously distributed for each DG.

Finally, 2 speech utterances were selected for each speaker in order to remove any identification based on speaker recognition.

Then, speech samples were processed as follows : a) background noise and reverberation removal with a noise cancela-

tion algorithm ([15]); b) semantic access removal using a band-pass filter. Pass-band was chosen that insure that the lowest frequency of the fundamental frequency and the highest frequency of its first harmonic was included ([15]); this was done to extract speech prosodic characteristics only c) active speech mean level normalization at -20dBov [16]; d) speech samples were compressed in mp3 format at 192Kb/s.

3.3. Procedure

The experiment consists of a multiple choice identification task from speech prosody perception. It was conducted according to source-crowding technique using web social networks³. Subjects were given a brief description of the different speaking styles. No speech sample example was given. This approach was adopted in order to focus the subject on his own mental representation of the different speaking styles and their expected prosodic cues.

They were asked to associate a speaking style to each of the speech samples⁴. For this purpose, subjects were given three options :

- **total confidence** : select only one speaking style when certain of the choice ;
- **confusion** : select two different speaking styles when confusion between two likely speaking styles exists ;
- **total indecision** : select "indecision" when completely unsure. Subjects were asked to use this possibility only as a very last resort.

Additional informations was gleaned from the participants : speech expertise (expert, naïve), language (native French speaking, French speaking, non-French speaking), age, and listening condition (headphones or not). Subjects were asked to process the test with headphones.

4. Results

Identification performance was estimated using a newly developed measure based on Cohen's Kappa statistic. Cohen's Kappa provides agreement between two raters in the case of categorical rating [17]. Our measure monitors the agreement subjects rating and the true answer. The resulting Kappa values are considered as a measure of identification performance. The measure varies from -1 to 1 : -1 is perfect disagreement ; 0 is chance ; 1 is perfect agreement.

Overall score reveals fair identification performance ($K=0.45$). Figure 1 shows that there are differences according to native language background of the listeners. French natives perform better than non-native French-speakers ; non-French speakers perform only slightly.

ANOVA analysis (*one-way analysis of variance* [18]) was conducted in order to asses whether identification performance depends on the langage of the subjects.

Analysis reveals significant influence of the langage effect ($F(2, 59) = 15; p < 0.001$). Post-hoc analysis reveals significant difference between native French speakers and the others ($F(1, 52) = 13; p < 0.001$, $F(1, 43) = 24; p < 0.001$) but no effect between non-native French speakers and non-French speakers ($F(1, 23) = 3; p = 0.07$) (fig. 1).

³Ircam Analysis and Synthesis Perceptual Tests on Facebook : <http://www.facebook.com/group.php?gid=150354679034&ref=ts>

⁴the experiment is available on : <http://recherche.ircam.fr/equipements/analyse-synthese/obin/pmwiki/pmwiki.php?n=Main.SSRecoProso>

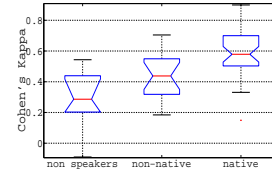


FIG. 1 – Identification performance according to the subject's langage background.

Investigating the results in finer detail reveals that identification performance significantly depends on the DG. Substantial identification performance was observed for sport commentary ($K=0.7$) ; fair identification for the journalistic discourse ($K=0.54$) ; and only slight identification for mass discourse and political discourse ($K = 0.38$ and 0.34 respectively).

Interestingly, identification performance reveals different configurations of the langage effect depending on the DG (fig. 2).

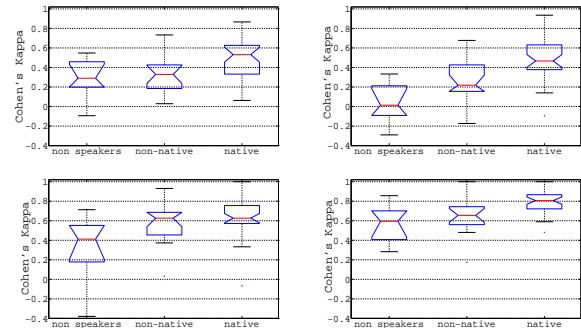


FIG. 2 – Identification performance according to the subject's langage background for each discourse genre. From top to down and left to right : mass, political, journalistic, sport.

For the mass, a significant difference between native French speakers and the others is observed ($F(1, 52) = 6.9; p = 0.01$, $F(1, 43) = 5.8; p = 0.02$), but none among these ($F(1, 23) = 0.19; p = 0.7$). For the political, a significant difference between all langage pairs is observed : native French vs. French speaking ($F(1, 52) = 11; p = 0.001$), native French vs. non-French speaking ($F(1, 43) = 30.5; p < 0.001$) as well as French speaking vs. non-French speaking ($F(1, 23) = 7.8; p = 0.01$). For the journalistic, no significant difference between native French and French speaking ($F(1, 52) = 1; p = 0.3$) and a significant between these and non-French speaking ($F(1, 43) = 13.5; p < 0.001, F(1, 23) = 5.1; p = 0.03$) are observed. For the sport commentary, there is a significant difference between native French speakers and the other ($F(1, 52) = 14; p < 0.001, F(1, 43) = 17; p < 0.001$), but none between these ($F(1, 23) = 0.8; p = 0.37$). Furthermore, it is noticed that non-French speaking participants provides slight and random identification performance in the case of journalistic discourse and political discourse respectively.

Finally, *multi-dimensional scaling* (MDS, [19]) and *hierarchical clustering* ([20]) methods were used to represent and estimate DG's similarity according to the observed perceptual confusion. For each speech sample, the observed confusion matrix was used to define speech utterance coordinates. A similarity distance between speech utterances was then estimated according to the *city-block* metric. The set of pairwise speech utterances similarity was then used to represents speech utterances

into a 2-dimensional according to multi-dimensional scaling. Finally, DGs were clustered using the *complete linkage method*. In parallel, the 4 DG's have been discussed and rated by two expert linguists after the *Koch's conceptual scale* ([7]) with 3 degrees. Then DGs were clustered according to this conceptual description in the same manner. Figure 3 represents speech utterances into the resulting 2-dimensional space and the comparison of the resulting DG's typology.

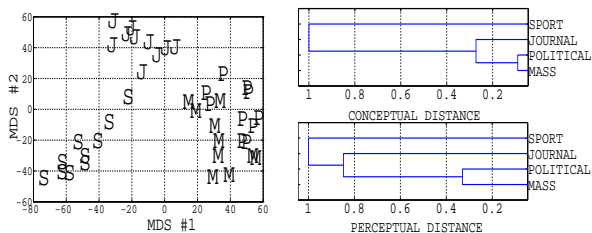


FIG. 3 – (a) Representation of the speech utterances according to their similarity according to Multi Dimensional Scaling. (b) DG's clusters from : conceptual scale (top) and perceptual confusion (down)

5. Discussion

The experiment reveals fair identification performance from prosodic perception. This confirms evidence for the hypothesis that DGs relate to prosodic patterns that do not depend on a specific speaker and that are shared by a group of listeners. Not surprisingly, these prosodic objects dramatically depend on the language backgrounds. This shows that DG's abstract prosodic representation depends at least on the language. It could be hypothesized that such representation could more generally depend on language classes or even on the culture⁵.

More precisely, the experiment reveals that the language factor significantly depends on the DG. This suggests that DG relate to prosodic objects that could be more or less shared regardless to the language. In particular, prosodic cues related to sport commentary appears clearly almost common to all languages while prosodic cues related to political discourse and mass discourse dramatically depend on the language.

Interesting intermediate identification performance of non-native French speakers is observed : if identification performance is systematically situated between native French speakers and non-French speakers, different groupings are observed, depending on the DG (grouping with non-French speakers for mass discourse and sport commentary, grouping with native French speakers for the journalistic discourse, and no grouping for the political discourse). This suggests a native language effect as well as a cultural background dependency.

A comparison of DG clusters as estimated from the conceptual classification and from prosodic perception reveals a similar cluster structure (fig. 3). This confirms that discourse context (situational, spatio-temporal, ... context) consistently relate to prosodic strategies. Moreover, prosodic clusters precise the perceptual distance that in particular clearly distinguishes journalistic discourse from political discourse and mass discourse on the prosodic dimension. This result supports the hypothesis that prosodic strategies act as markers of a specific *speech act* ([21])

⁵such hypothesis is supported by non-French speaking participants which comment that they could not represent themselves "how sounds" a christian sermon (religious dependency) nor political new year's speech (cultural dependency)

(for instance : neutrally describing an event with distanciation for the journalistic discourse vs. arguing and persuading for the political discourse and mass discourse). Sport commentary stands significantly apart from the other DGs. This confirms previous studies on the very specific nature of the sport commentary ([22]), in particular in its iconic dimension : sportscaster does not only describe but vocally mimics the action being observed. This is even more true in the case of radio sport commentary, where sportscaster must supply the absence of the image media.

6. Conclusion

A perceptual experiment on the identification of discourse genres on a speech prosodic perception basis was proposed. Identification performance confirms evidence for the hypothesis that DGs relate to prosodic patterns that do not depend on a specific speaker and that are shared among listeners. If overall factorial analysis reveals a significant language background effect, it is clearly dependent on the DG. A comparison between DG clusters obtained from a conceptual description and perceptual confusion indicates that discourse context consistently relates to specific prosodic strategies. DG perceptual clusters even precise and suggest other discursive effects to explain observed differences of prosodic configuration. In a further study, these results will be used as a reference identification performance to evaluate a speaking style speech synthesis system.

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