

# Positive and Negative emotional states behind the laughs in spontaneous spoken dialogs

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## ABSTRACT

This paper deals with a study of laughs in spontaneous speech. We explore the positive and negative valence of laughter in the global aim of the detection of emotional behaviour in speech. It is particularly useful to illustrate the auditory perception of the acoustic features of laughter where its facial expression (smile type) is not visible. A perceptive test has shown that subjects are able to make the distinction between a positive and a negative laugh in our spontaneous corpus. A first conclusion of the acoustic analysis is that unvoiced laughs are more perceived as negative and voiced segments as positive, which is not surprising.

## 1. INTRODUCTION

Laughter is a universal and prominent feature of human communication. There is no reported culture where laughter is not found. Laughter is expressed by a combination of speech and facial expressions. In our study, only the audio channel is used. The laugh plays an important role in human social interactions and relationships. Laughs colour speech, they can be spontaneous (uncontrolled) or controlled with a communicative goal. Laughs represent a broad class of sounds with relatively distinct subtypes, each of which may function somewhat differently in a social interaction [1].

This paper deals with the study of laughs in a corpus of human-human dialogs recorded in a French medical call center [4]. Our global aim is the detection of emotion. In [4], laughter feature were used as a linguistic mark (presence or absence of this feature) in emotion detection system.

The majority of laughs in our corpus overlap speech, instead of cutting it. Few works investigate speech with simultaneous laughter; Nwokah [6] gives evidence that up to 50% of laughs in conversations between mother and child (English) overlap speech, Trouvain [12] reports that 60% of all labelled laughs in the German "KielCorpus of Spontaneous Speech" are instances which overlap speech. The so-called "speech-laugh" are around 58% of all the laughs in our French corpus of spontaneous dialogs between a caller and an agent. Our findings agree with Trouvain's and Nwokah's studies

and contrast with Provine [7] who reported that laughter almost never co-occurs with speech. Acoustic manifestations of "speech-laugh" are much more variable and complex than isolated laughs.

Negative forms of laughter are also used in everyday communication. Some studies report that laughter can express negative feelings and attitudes such as contempt [9] and it can also be found in sadness [11]. There is evidence that gelotophobics have difficulties to distinguish between positive and negative forms of laughter. The concept of Gelotophobia can be defined [8] as the pathological fear to appear to social partners as a ridiculous object or simply as the fear of being laughed at. A typical symptom of Gelotophobia is the systematic attribution of (even innocent) laughter as being negative. In the context of spontaneous children speech, other examples of complex positive and negative laughs are laugh-cry, that is, crying that switches to laughter and back and forth and half-cry/half-laugh which is a combination of simultaneous laugh and cry.

In our corpus, there are a lot of negative contexts where laughs have different semantic meanings. The current study aims to analyse the characteristics of laughter in order to define negative laughs and positive laughs. We explore laughter manifestations occurring in our corpus using prosodic cues such as pitch and energy variation and duration measures. We assume, like [9], that the non-verbal events, also called "affect bursts", such as laughs or tears, are among the relevant features for characterizing an emotion. A closer analysis of the acoustic laughter expressed in this study has shown that this cue can be linked to positive emotional behaviour such as "I'm pleased, I'm relief" or negative emotional behaviour "I'm anxious, I'm embarrassed."

First, this paper reports on a perceptive test allowing the annotation of the valence of laughter and proposes a typology of laughter. Then it presents a first prosodic feature analysis of laughs.

## 2. CORPUS

The study reported in this paper is done on a corpus of naturally-occurring dialogs recorded in a real-life call

center. The transcribed corpus contains about 20 hours of data. The service center can be reached 24 hours a day, 7 days a week. Its aim is to offer medical advice. An agent follows a precise, predefined strategy during the interaction to efficiently acquire important information. His role is to determine the call topic and to obtain sufficient details about this situation so as to be able to evaluate the call emergency and to take a decision. The call topic is classified as emergency situation, medical help, demand for medical information, or finding a doctor. In the case of emergency calls, the patients often express stress, pain, fear of being sick or even real panic. The caller may be the patient or a third person (a family member, friend, colleague, caregiver, etc.). This study is based on a 20-hour subset comprised of 688 agent-client dialogs (7 different agents, 784 clients). About 10% of speech data is not transcribed since there is heavily overlapping speech. The use of these data carefully respected ethical conventions and agreements ensuring the anonymity of the callers, the privacy of personal information and the non-diffusion of the corpus and annotations. The corpus is hand-transcribed and includes additional markings for microphone noise and human produce non-speech sounds (speech, laugh, tears, clearing throat, etc.). The corpus contains a lot of negative emotional behavior. There are more tears than laughs. The laughs are extracted from annotations in the human-generated corpus transcripts. For each segment containing a laughter annotation, the segment is labelled as laugher. With more than half of the cases in our corpus, the laughs are associated with negative feelings. Table 1 summarizes the characteristics of the global corpus and the sub-corpus of laughs. Table 2 gives the repartition of non-speech sounds on the corpus.

**Table 1.** The global and laughter corpus:

	Global corpus	Laughter corpus
#callers	784(271M,513F)	82 (28M, 54F)
#agents	7 (3M, 4F)	4 (3M, 1F)
#dialogs	688	82
#segments	34000	119
Size	20 hours	30 mn

**Table 2:** Number of the main non-speech sounds markings on 20 hours spontaneous speech.

#laugh	119
#tear	182
# « heu » (filler pause)	7347
#mouth noise	4500
#breath	243

### 3. PERCEPTIVE TEST

#### 3.1. Experimental corpus

In order to validate the presence of negative and positive laughs and to characterize the related emotion type in our corpus, a perceptive test was carried out. In a first manual annotation phase, two expert annotators created emotional segments where they felt it was appropriate for all the speaker turns of the dialogs (the units were mainly the speaker turns). The expertise here is related to the knowledge of the data and the time passed for emotion definition and annotation (here one year). We evaluated the quality of these annotations on the global corpus using inter-coder agreement (kappa coefficient of 0.57 for callers, 0.35 for agents) and intra-coder agreement (85% agreement) measures, and correlation between different cues that are logically dependent, such as the valence dimension and the classes of negative or positive labels. A subset of 52 segments (balanced on three classes: positive, negative and ambiguous) was selected from the 119 segments containing laugh. These segments were extracted from 49 dialogs between 49 callers (15 M, 34F) and 2 different agents (1M, 1F). 18 of these segments were previously labelled as positive, 18 as negative and 16 as ambiguous. The emotional segments were re-segmented in order to only keep the laugh with the smaller context allowing the same valence of the segments and keeping the privacy of the data. So, this experimental corpus was selected with mainly isolated laughs. Only 37% of the test segments are “laugh superposed to speech”. In the laughter corpus, the proportion of female voice is 68%. 12% of laughs are extracted from agent speaker turns, 88% from callers.

#### 3.2. Protocol

20 French native subjects recruited in the LIMSI French laboratory (14M, 6F) had to listen the 52 segments and to decide of the valence: positive, negative or ambiguous and of the type of laugh. As said in [10], laughing is not only an expression of exhilaration and amusement, but is also used to mark irony or a malicious intention. An important function of laughter is social bonding. In our database, the laugh functions included social, amused and affective functions. 10 different types of laugh were proposed and defined (Table 3). These 10 types were obtained after data observations, annotation and discussions by three experts. The subjects also had the possibility to annotate two types of laugh per segment: one dominant and one in the background.

**Table 3.** Type of laughs

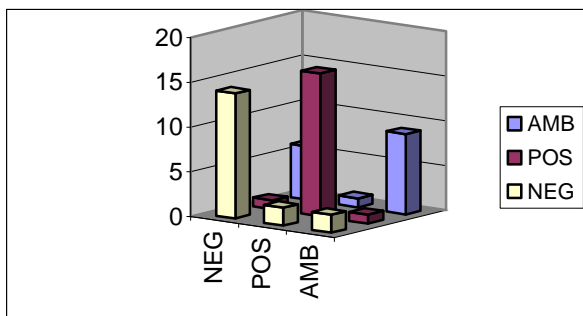
Positive labels	amused laugh joy laugh, sympathetic laugh
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	polite laugh, relief laugh
Negative labels	disappointment laugh, embarrassed laugh, stressed laugh
Ambiguous labels	comment laugh ironical laugh

### 3.3. Results

In order to group the annotations of all the subjects per segment, two decision methods were used: a majority voting technique for the annotation of the valence (see Figure 1) and a soft vector representation [4] for the type of laugh (see Figure 2).

**Figure 1.** Repartition between the first annotations (abscissa) and the majority voting results on valence annotations of the perceptual test



The results in Figure 1 show that the positive laughs (88%) were easier to annotate than the negative laughs (77%). The ambiguous segments were judged mainly as ambiguous (56%) but also as negative laughs (37.5%).

The negative laughs perceived, linked to the mental state embarrassed is dominant for this corpus. For the positive laughs perceived, there are linked to the mental state amused.

**Figure 2.** Global repartition of the type of laughs obtained from the first coefficient of the soft-vector



## 4. PROSODIC FEATURES ANALYSIS

### 4.1. Features

A first prosodic analysis was carried out on positive/negative laughs and also on the four main types of laughs in our corpus: embarrassed (negative), amused (positive), ironical (ambiguous) and polite (positive). The laughter segments were exactly segmented on the laughs for this analysis. We computed some prosodic parameters using Praat software such as F0 statistics (mean, standard deviation), percent of unvoiced frames, energy (Pa<sup>2</sup>s) and duration (ms). We used the “Lobanov” normalization for the F0 parameters.

### 4.2. Analysis

We can observe some trends on this small corpus. The main trends are that the energy and duration are higher for positive than for negative laughs and the percent of unvoiced frames is higher for negative than for positive laughs. When we looked more precisely at the four main types of laugh in the corpus, the trends were the following: the F0 measures are higher for amused laughs than for polite laughs; the duration is also highest for amused laugh, the percent of unvoiced frames is the highest and also the energy is the lowest for embarrassed and ironic laughs. These trends should be confirmed with a larger database.

## 5. CONCLUSIONS

This paper has addressed the less frequently discussed issue of negative laughter. The results of the perceptual test show that the subjects are perceptibly able to distinguish both laughs: positive and negative. A first prosodic analysis was carried out on positive/negative laughs and also on the four main types of laughs in our corpus. We have found some trends to characterize positive and negative laughs. These trends should be confirmed with a larger database. As a first conclusion, we can say that negative laughs are more unvoiced segments and positive laughs are more voiced segments what are not surprising [1].

## 6. REFERENCES

- [1] Bachorowski, J-A, (1999) Vocal expression and perception of emotion, *Current Direction in Psychological Sciences*, 8, 53-57, 1999.
- [2] Bachorowski, J-A, Owren, M.J. (2001). Not all laughs are alike: voice but not unvoiced laughter elicits positive affect in listeners. *Psychological Science*, 12, 252-257.
- [3] Campbell, N, Kashioka, H., Ohara, R., (2005) “No Laughing Matter”, *Interspeech 2005*.
- [4] Devillers, L. Vidrascu, L., Lamel, L., (2005). “Challenges in real-life emotion annotation and

- machine learning based detection”, *Neural Networks* 18, pp. 407-422.
- [5] Kennedy L., Ellis, D., 2004, “Laughter Detection in Meetings”, NISTRT 2004.
- [6] Nwokah, E.E, Hsu, H.C., Davies, P. & Fogel. A., 1999, “The integration of laughter and speech in vocal communication: a dynamic systems perspective.” *J of Speech, Lang & Hearing Res*, 42, 880-894.
- [7] Provine, R., 1993, “Laughter punctuates speech: linguistic, social and gender contexts of speech of laughter”, *Ethology*, 95, 291-298.
- [8] Ruch, W. & Proyer, R.T. (2005). Gelotophobia: A useful new concept?, 9th European Congress of Psychology, 3-8 July 2005, Granada.
- [9] Schröder, M, 2000, “Experimental study of affect bursts”, *Proc. ISCA workshop “Speech and Emotion”*, Newcastle, Northern Ireland, 132-137.
- [10] Schröder, M.: 2003, *Experimental Study of Affect Bursts. Speech Communication*, 40 (2003) 99-116
- [11] Stibbard, R., 2000, “Automatic extraction of ToBi annotation data from the Readings/Leeds emotional speech corpus”, *Proc. ISCA workshop “Speech and Emotion”*, Newcastle, Northern Ireland.
- [12] Trouvain, J., 2001, “Phonetic Aspects of “Speech-Laugh””, conference on Orality and Gestuality ORAGE 2001, Aix-en-Provence, 634-639.