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# Laughter in French spontaneous conversational dialogs

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## Abstract

This paper presents a quantitative description of laughter in height 1-hour French spontaneous conversations. The paper includes the raw figures for laughter as well as more details concerning inter-individual variability. It firstly describes to what extent the amount of laughter and their durations varies from speaker to speaker in all dialogs. In a second suite of analyses, this paper compares our corpus with previous analyzed corpora. In a final set of experiments, it presents some facts about overlapping laughs. This paper have quantified these all effects in *free-style conversations*, for the first time.

**Keywords:** laughter, conversation, analysis

## 1. Introduction

Laughter can be conceived of as a non-linguistic or paralinguistic event. However with the amount of interest for the conversational speech data, laughter appears as an essential component of human spoken interaction (Glenn, 2003). Frequency of occurrences of laugh items suggests that laughter, like spoken language, is a major form of human vocal communication (Provine and Fischer, 1989). The study (Provine, 1993) is a description of who laughs during naturally occurring conversations (speaker and/or audience). Most laugh episodes were recorded from subjects sitting at adjacent tables in dining areas, standing near the observer in a public meeting area or in a queue, or walking on a sidewalk or hallway. Among others, the author observed that speakers laughed significantly more than their audience. He also found that when speakers laughed, they were more often female than male and when audiences laughed, they were also more likely to be female. Another study (Smoski and Bachorowski, 2003) has shown that both the sex and familiarity of a social partner influence the amount of laughter produced. The study in (Vettin and Todt, 2004) showed that participants frequently laughed after their own verbal utterances.

There are numerous studies showing that conversation includes a substantial amount of overlapping speech, also called “cross-talk”, as for example (Shriberg et al., 2001; Heldner and Edlund, 2010). Furthermore, some studies (Smoski and Bachorowski, 2003; Laskowski and Burger, 2007) show that laughter tends to overlap with laughter. Importantly, laughing time and speaking time do not appear to be correlated across speakers (Laskowski and Burger, 2007), and laughter does in fact occur significantly with more overlap than speech; in relative terms, the ratio is 8.1% of meeting speech time versus 39.7% of meeting laughter time (estimated on ICSI meeting recorder corpus (Janin et al., 2003)).

More recently, laughter in conversations has been analyzed as partner-specific adaptation and joint vocal action. (Trouvain and Truong, 2012) focused on two task-oriented corpora: HCRC Map Task Corpus (Anderson et al., 1991), and the Diapix Lucid Corpus (Baker and Hazan, 2011) where two people are recorded while conversing to solve a ‘spot the difference’ task. They observed that laugh-

ter as a cue for entrainment/convergence is mirrored by a number of laughs of conversational partners and especially by their temporal alignment resulting in overlapping laughs. Other studies on laughter in conversation focus on acoustic features (Tanaka and Campbell, 2011; Truong and Trouvain, 2012b) and/or Phonetics (Truong and Trouvain, 2012a; Trouvain and Truong, 2012). (Truong and Trouvain, 2012b) showed that acoustic features of overlapping laughs are different from non-overlapping laughs. This study focused on 4 different corpora: 2 task-oriented corpora (HCRC and the Diapix Lucid Corpus), and 2 meetings corpora (ICSI and the AMI corpus (Carletta et al., 2006)). The present study focuses on a French conversational corpus that were *designed to elicit humor*. There is a consensus in literature on humor to distinguish between humor and laughter (Priego-Valverde, 2003; Priego-Valverde, 2005; Chafe, 2007; Campbell, 2007; Tanaka and Campbell, 2011; Warner-Garcia, 2014). Laughter can appear in earnest context and function as nervous social or polite cue among others. However, we can suppose that laughter related to humorous context will be frequent in our corpus. Regardless the function of laughter, we present here quantitative observations related to other corpora. Previous studies (Truong and Trouvain, 2012a; Truong and Trouvain, 2012b) showed that the corpus condition gives rise of different characteristics of laughter (frequency, duration, overlapping vs non-overlapping, ...). The present study enable to compare with other corpora and for the first time to highlight the inter-individual variability facts.

The paper is structured as follow. Section 2. presents the conversational corpus used in this study, including a description on how this corpus has been processed. Section 3. is related to general figures for the laugh items, including detailed information about inter-individual variability. This is followed by a comparison between overlapping and non-overlapping laughter (Section 4.) and compared to some existing public corpora.

## 2. Corpus description

### 2.1. Overview

The present analysis is based on studying laughter included in Corpus of Interactional Data (Bertrand et al., 2008). CID is a publicly available audio-video recording of height

hours of spontaneous French dialogs - 1 hour of recording per session. Each dialog involves two participants of the same gender, who know each other and who have more or less similar ages. One of the following two topics of conversation was suggested to participants:

- unusual situations in which participants may have found themselves (instruction *unusuals* in the following);
- conflicts in their professional environment (instruction *conflicts* in the following).

These instructions have been specially selected to elicit humor in the dialogs. However, they were not exhaustive and participants often spoke very freely about other topics, in a conversational speaking style. Then, contrariwise to the previous studies, CID was simply guided by a “topic” for participants to speak about, with no task to perform nor meeting conditions.



Figure 1: CID experimental design

The corpus includes data recorded in anechoic room, with separated channels for each speaker (see Figure 1), and contains about 120,000 words.

CID includes the following advantages:

- a/ it was recorded with separated channels for each speaker;
- b/ it was annotated with time-alignment of the transcription and audio at various levels: utterance, word, syllable, phoneme, etc.;
- c/ it is - free - and publicly available (CID, 2008).

There are just a few other conversational speech corpora available that fulfill the above-mentioned advantages. Four of such kind of corpora in English were used in (Truong and Trouvain, 2012b; Truong and Trouvain, 2012a; Trouvain and Truong, 2012), for various studies on laughter:

1. HCRC Map Task Corpus, task: finding a route on a map (Anderson et al., 1991);
2. Diapix Lucid Corpus, task: spot-the-difference in a picture (Baker and Hazan, 2011);
3. ICSI meeting recorder corpus, real-life meetings of researchers (Janin et al., 2003);
4. AMI meeting corpus, role-playing and real-life meetings (Carletta et al., 2006).

## 2.2. Processing the corpus

Each audio signal was firstly automatically segmented in segments named IPU - Inter-Pausal Units. IPU are blocks of speech bounded by silent pauses over 200 ms,

and time-aligned on the speech signal. For each of the speakers, an orthographic transliteration is provided at the IPU-level. This transliterations includes all phenomena that can occur in spontaneous speech. Indeed, conversational speech refers to an informal activity, in which participants have constantly to manage and negotiate turn-taking, topic changes (among other things) “on line” without any preparation. As a consequence, numerous phenomena appear such as hesitations, repeats, backchannels, etc. Phonetic phenomena such as non-standard elision, reduction phenomena, truncated words, and more generally, non-standard pronunciations are also very frequent so all of them are mentioned in the orthographic transcription. The specific symbol “@” was added into the transcription convention to mention a laughter item. More than 11% of the IPU contains at least a laughter. Phenomena like “smiled speech” are also mentioned in the orthographic transcription but were not investigated in the present study.

Among other annotations (Blache et al., 2010), this corpus was automatically time-aligned with signal at phone- and token-levels. Phonetization (or grapheme-to-phoneme conversion) is based on the manual orthographic transcription (Bigi et al., 2012). This phonetization process of CID was performed using a tool that contains a set of scripts that transform the enriched orthographic transcription into its phonetic form. Then, phonetic segmentation was performed. It consists in a time-matching process between a given speech utterance and a phonetic representation of the utterance. Results reported in this paper are based on an alignment of CID that was carried out using SPPAS software (SPPAS, 2015; Bigi, 2015). The time-alignment of all the 1546 laughter were manually checked by both the authors of this paper. Such annotation is also publicly distributed. These laughter items were automatically extracted (Bigi and Saubesty, 2015) in the scope of the present analysis.

Figure 2 represents a screen shot of the time-aligned data of an extract. The following reports the corresponding orthographic transcription:

2969.89 – 2971.14 AB ipu.793 @  
 2970.51 – 2973.96 CM ipu.1059 si bien qu’on s’est trouvées arrivées en haut d(u) col avec des gens qui montaient de l’aut(re) côté // so that we arrived at the top of the mountain with people who was going up from the other side  
 2973.42 – 2979.73 AB ipu.794 @ à quat(re) [pattes, pateu] @ // on all fours  
 2974.65 – 2979.70 CM ipu.1060 qui eux étaient debout tranquilles et i(ls) nous ont vues arriver à quat(re) pattes avec les sacs à dos // those who were standing serene and they saw us on all fours with backpacks  
 2979.73 – 2989.58 AB ipu.794 @

Table 1 gives details about the sex of both speakers, the given instruction, the duration of the recording of each dialog. It also indicates the total duration of speech segments (ST) for each speaker involved in the dialog. Both recording durations and speech times are indicated in seconds.

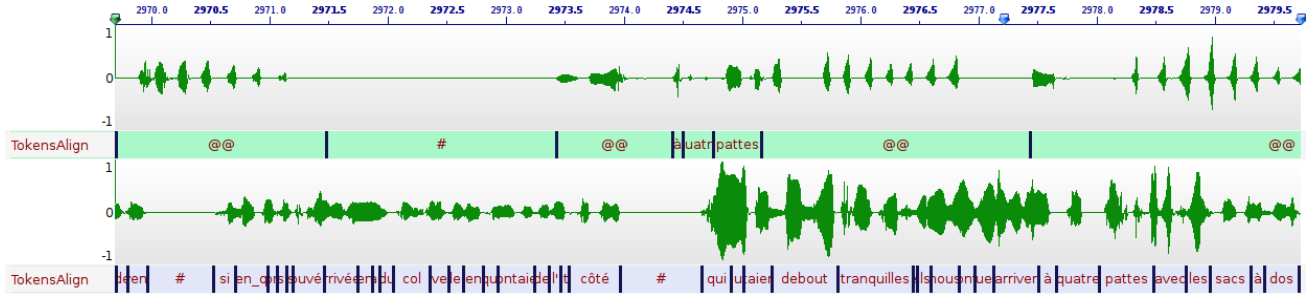


Figure 2: Extract of AB-CM dialog (from 2969.69 to 2979.73). The symbol '#' represents a silence and '@@' represents a time-aligned laughter.

Table 1: Dialogs description of CID.

Sex	Instruction	Recording duration	Spk1 - Spk2 ST1 - ST2
F	unusuals	3562	AB - CM 1535.9 - 1693.0
M	unusuals	3499	AG - YM 1512.8 - 1710.8
F	unusuals	3587	BX - MG 1313.7 - 1686.0
F	conflicts	3840	AC - MB 1366.1 - 2132.4
M	conflicts	3854	AP - LJ 1869.3 - 2047.8
M	conflicts	3831	EB - SR 1362.6 - 1495.0
F	conflicts	3634	IM - ML 1730.5 - 1325.3
F	conflicts	2944	LL - NH 871.5 - 1418.4

### 3. Descriptive statistics of laughter

#### 3.1. Frequency and duration of laughter

Our first variable of interest was the quantity of laughter: the number of occurrences and the laughing time. Table 2 highlights a significant difference ( $z\text{-test}=-7.744$ ) between males and females: the mean indicates that females are laughing more often than males, however, as indicated by the standard deviation, with a higher variability. In the same table, we can also observe that dialogs about unusual situations give significantly rise of more laughter than the other instruction.

Contrariwise to the number of occurrences, Table 3 indicates that where females seem to laugh more often, there is no significant difference ( $z\text{-test}=-2.418$ ) in the average laughing time between male and female speakers, with a mean of 106.5 sec. for males vs 112.8 sec. for females. The instruction both impacts the number of occurrences and the average duration. Both given instructions have elicited laughter. However dialogs about unusual situations have a tendency to increase the number of laughter and their duration, compared to dialogs about conflicts in the professional environment.

Table 2: Number of laughter.

	spks	total (LN)	mean	sd
Male	6	516	86	29.3
Female	10	1030	103	57.0
Unusuals	6	793	132.2	56.2
Conflicts	10	753	75.3	27.3

Table 3: Laughter duration in seconds.

	spks	total (LT)	mean	sd
Male	6	639.2	106.5	47.6
Female	10	1127.6	112.8	58.8
Unusuals	6	844.8	140.8	58.1
Conflicts	10	922.1	92.21	43.3

We also wished to know to what extent these amount of laughter varies from speaker to speaker in all dialogs. Table 4 indicates LN and LT of laugh items for each speaker. A significant number of laughter is observed in each dialog with a high inter-individual variability: mean is 97 and standard deviation is 48. Moreover, the number of laughter between speakers of a same dialog is very different: the mean of the difference is 49 (with sd of 26).

Table 4 also indicates the total duration of laugh items for each speaker. Like for occurrences, a high inter-individual difference is observed: mean is 110.43 sec. with sd equal to 53.31 sec.

This difference is also observed between speakers within the same dialog, even when their speech time is relatively close: both speakers of each dialog are speaking more or less the same time but one is much more conducive to laugh than the other. So, the differences that is observed depending on the gender or the instruction do not prevent to have this kind of interesting observation, as inter-individual variability.

Another interesting observation is given by Table 5: the majority of speakers who are speaking more in a dialog are also laughing more. More globally, the longer the speaking time, the more the laughing time as well, except for 3 dialogs. In AC-MB and LL-NH, MB and NH have a dominant position in terms of speaking time while they also

Table 4: Number of laughter and total laughing duration of speakers.

	LN		LT	
AB CM	91	<b>195</b>	171.65	182.23
AG YM	59	102	55.08	109.85
BX MG	156	190	113.41	<b>212.54</b>
AC MB	78	55	65.28	55.01
AP LJ	68	130	44.45	159.46
EB SR	100	57	149.27	121.15
IM ML	80	54	108.91	<b>48.88</b>
LL NH	94	<b>37</b>	113.53	56.18

laugh considerably less. In the third dialog EB-SR in which both speakers have a quasi similar speaking time (slightly longer for SR), EB laughs considerably more than SR. This high inter-speaker variability will have to be interpreted in terms of discursive roles (more listener/more speaker) and in relation with other items such as feedbacks.

Table 5: Total laughing duration related to total speech duration (ST).

	LT / ST	
AB CM	0.112	0.108
AG YM	0.036	0.064
BX MG	0.086	0.126
AC MB	0.048	<b>0.026</b>
AP LJ	0.023	0.078
EB SR	0.110	0.081
IM ML	0.063	0.037
LL NH	<b>0.130</b>	0.042

### 3.2. Duration of laugh items

In a second suite of analyses, we are interested in the duration of laughter in CID compared with some other corpora publicly available and previously analyzed in (Truong and Trouvain, 2012a). The following list reports the duration in seconds of laugh items pooled over 4 other corpora:

- HCRC (2 participants): mean=0.838, sd=0.652
- DiaPix (2 participants): mean=0.899, sd=0.689
- AMI (4 participants): mean=1.042, sd=1.184
- ICSI (3-11 participants): mean=1.661, sd=1.298

The mean duration of a laugh item in CID is 1.143 seconds and it follows a distribution represented in Figure 3. 95% of items are during less than 3.2 sec, and 80% are during less than 1.65 sec. Compared to the other corpora with the same number of participants, laughter in CID are much more longer: HCRC is 0.838 sec and DiaPix is 0.899 sec. The mean duration in CID represents an increase of respectively 36% and 24%. Furthermore, CID has durations with higher variability with an sd value of 1.049. Future studies will examine which are the causes of both these differences,

however it can already be assumed that the free conversational style of CID is an important factor.

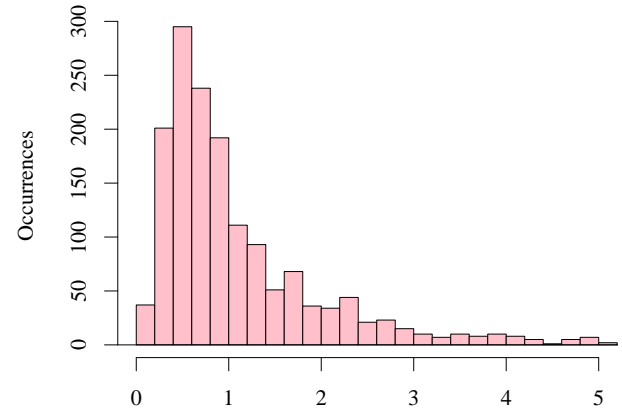


Figure 3: Histogram of laughter durations. Mean is 1.143 sec. and standard deviation is 1.049. Items with duration > 5 sec. were computed but not shown for illustrative reasons.

Yet a high inter-individual variability is observed, as shown in Table 6. The mean duration can vary from 0.654 seconds (AP) up to 2.125 seconds (SR) who are both males with the *conflicts* instruction. Furthermore, the standard deviation, min and max values clearly indicate that laughter duration are widely varying for each speaker. A very high sd value is observed for AB speaker which is mainly due to the presence of some non-prototypical laughter: 6 items are during more than 5 sec. - all of them are giggles. Four non-prototypical items are also observed for SR; and only one for CM, IM, LL, MB, MG, NH.

Table 6: Duration of laugh items for each speaker.

spk	mean	sd	min	max
AB	1.886	1.946	0.069	9.299
CM	0.935	0.768	0.094	5.595
AG	0.933	0.735	0.190	4.309
YM	1.077	0.959	0.178	4.980
BX	0.727	0.563	0.110	4.705
MG	1.119	0.821	0.150	5.763
AC	0.837	0.517	0.095	2.483
MB	1.000	0.989	0.309	6.518
AP	<b>0.654</b>	0.758	0.060	4.158
LJ	1.227	0.879	0.221	4.976
EB	1.493	1.112	0.133	4.619
SR	<b>2.125</b>	1.779	0.200	8.018
IM	1.361	1.026	0.140	5.143
ML	0.905	0.638	0.124	2.999
LL	1.208	0.935	0.171	7.565
NH	1.518	1.209	0.230	5.643

### 3.3. Position of laughter related to IPUs

As a first step, the localization of laughter related to IPUs was explored. All laughter items were categorized into 4 categories:



- an *isolated* laughter is surrounded by pauses (34.8%);
- an *end* laughter is ending an IPU (29.4%);
- a *begin* laughter is starting an IPU (19.4%);
- a *during* laughter is inside an IPU (16.4%).

So, only one laughter over six occurs during speech. Most of the time, a silence is surrounding, starting or ending laughter. This distribution is relatively constant over dialogs (Pearson’s Chi-square is 35.67,  $p < 2 * 10^{-9}$ ), as shown in Figure 4.

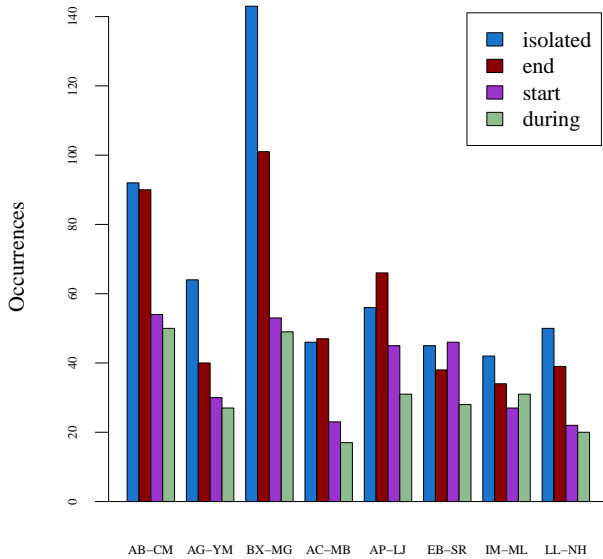


Figure 4: Distribution of laughter in dialogs depending on their position related to IPUs.

## 4. Laughter in interaction

Spoken interaction is a joint activity that requires coordination between participants. Laughing together can reveal a form of such joint activity. This interaction is observed at various linguistic levels (as Phonetics for example), and cross-activities are frequent. This final set of experiments investigates the overlaps, first for speech segments then laughter.

### 4.1. Speech overlaps

In order to compare CID with other corpora, we preliminarily investigated speech overlaps. Table 7 reports cross-talks (CT) described in (Truong and Trouvain, 2012b), except that we omitted results on ICSI corpora from 7 to 11 participants which are very far conditions compared to CID. We then added CID in this table in a consistent manner. Results indicate that cross-talks are significantly much more frequent in CID (related to the group size): 18.39% of a speaker speech segment is produced while the other one is also speaking.

This preliminary study highlighted that speech overlaps are very frequent in CID and they are much more frequent compared to the other corpora. The question then arise about laughter overlaps.

Table 7: Comparison of CID with other public corpora. CT is the total cross-talk duration and ST is the total speaking time, both in seconds.

Corpus	Group size	# conversations	Dur. (hrs)	CT / ST (%)
HCRC	2	96	11.4	4.91
DiaPix	2	52	6.8	7.95
AMI	4	160	91.3	13.24
ICSI	3	1	0.6	11.13
ICSI	4	3	2.7	17.55
ICSI	5	14	12.9	13.65
ICSI	6	21	19.8	17.58
CID	2	8	15.9	<b>18.39</b>

### 4.2. Laughter overlaps

The study in (Truong and Trouvain, 2012b) indicates the percentage of the number of overlapping laugh (OL) related to the number of laugh items, and the average duration of overlapping laughing time related to the laughing time, as follow:

- HCRC (2 spks): OL/LN=36.4%; OL/LT=9.72%;
- Diapix (2 spks): OL/LN=40.5%; OL/LT=12.64%;
- AMI (4 spks): OL/LN=35.2%; OL/LT=12.37%;
- ICSI (with 4 spks): OL/LN=45.3%; OL/LT=18.31%.

We then added CID in this list in a consistent manner:

- CID (2 spks): OL/LN=**33.8%**; OL/LT=**19.93%**.

CID contains lesser overlapping laugh items, while the duration of overlapping laughing time is higher in CID than in all other corpora.

As it was previously reported in (Laskowski and Burger, 2007), in CID laughter gives rise to more overlap than speech does, in average (18.39% vs 19.93%). In spite of that, this difference in CID is less important than in other corpora which is probably due to the larger amount of cross-talks.

### 4.3. Overlaps durations

Figure 5 shows the average durations of the 8422 speech overlaps vs the durations of the 538 laughter overlaps of CID. The cross-talk mean duration is 0.55 sec. (sd is 0.48) while the cross-laughter mean duration is significantly higher with 0.64 sec (sd is 0.52).

However, the difference between speech overlaps and laughter overlaps hugely depends on speakers (Table 8): some are overlapping speech more than overlapping laughter (BX, MG, MB, EB, SR, ML, NH), some are doing the contrary (AB, CM, YM, AC, AP, LJ), and some are about the same overlapping rates (AG, IM, LL). These differences seem to not depend neither on the gender nor the instruction.

In addition, whatever overlaps (speech or laughter), results still show a high inter-individual variability. For cross-talks, the rate can vary from 7.33% (SR) up to 30.49% (AP), who are both males with the same instruction. And

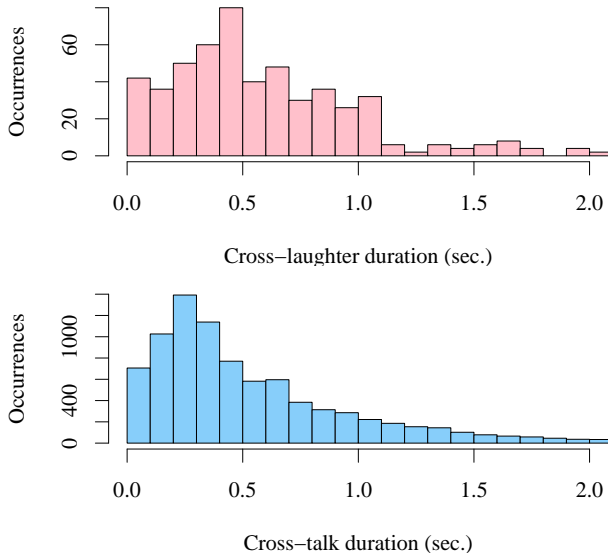


Figure 5: Durations of cross-laughter and cross-talks. Both items with duration > 2 sec. were computed but not shown for illustrative reasons.

Table 8: Comparison of overlaps. CT is the total cross-talk duration, ST is the total speaking time, CL is the total cross-laughing duration and LT is the total laughing time.

	CT / ST (%)		CL / LT (%)	
AB CM	25.52	23.15	8.95	8.51
AG YM	26.39	23.33	26.98	13.53
BX MG	12.01	9.29	34.43	18.39
AC MB	23.44	15.02	14.75	21.94
AP LJ	<b>30.49</b>	27.83	15.65	<b>4.34</b>
EB SR	8.04	<b>7.33</b>	36.29	<b>44.54</b>
IM ML	12.85	16.77	14.18	31.87
LL NH	15.53	9.54	17.51	34.20

for cross-laughter, the rate varies from 4.34% (LJ) up to 44.54% (SR), and again both speakers are males with the same instruction.

#### 4.4. Overlapping laughter vs Non-overlapping laughter

Like it was previously observed in (Truong and Trouvain, 2012a) on AMI, ICSI, HCRC and DiaPix corpora, overlapping laughs are longer than non-overlapping laughs in CID too. Nevertheless, compared to the other corpora, the mean duration of non-overlapping laughs is significantly higher in CID, except compared to ICSI meetings corpus, which is probably due to the higher number of participants (see Table 9).

Figure 6 indicates that duration of non-overlapping laughs is higher for most of the speakers. However, four of them (i.e. 25%) are not following this schema: mean duration of overlapping laughter is the same that non-overlapping laughter for AG and is lesser for CM, MG and AP (2 males, 2 females).

Table 9: Mean duration and standard deviation in seconds of non-overlapping laughs and overlapping laughs: pooled over CID and other public corpora, as described in (Truong and Trouvain, 2012a).

	Group size	Non-Overlapping		Overlapping	
		mean	sd	mean	sd
HCRC	2	0.715	0.524	1.052	0.784
DiaPix	2	0.755	0.495	1.107	0.860
AMI	4	0.775	0.842	1.541	1.521
ICSI	3-11	1.195	0.753	1.929	1.460
CID	2	1.037	0.924	1.348	1.233

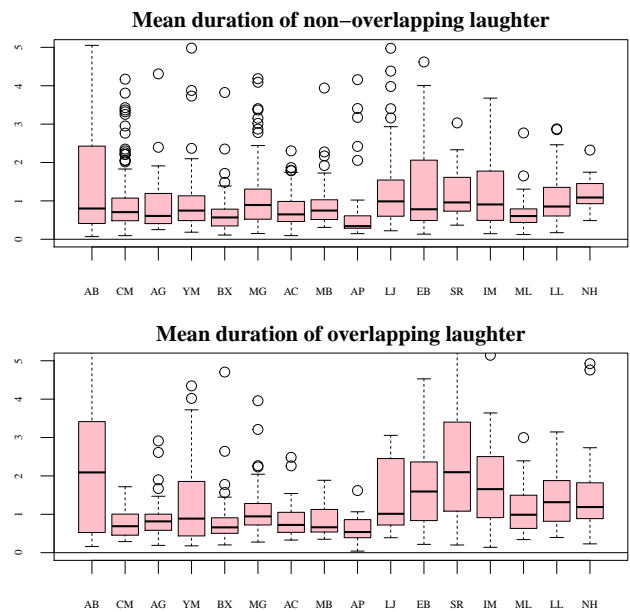


Figure 6: Duration of non-overlapping and overlapping laugh items (items with duration > 5 sec. were computed but not shown for illustrative reasons).

## 5. Conclusions

This paper presented an analysis of laughter of a large, publicly available corpus of French spontaneous conversations. Such analysis was carried out in terms of frequencies, durations and overlaps. Results showed significant differences with other corpora and a substantial inter-individual variability. Thanks to the later, further studies could examine if patterns of speakers raise. Concerning the gender differences, we confirm that females are laughing more often, while there is no significant difference for the average duration of laughter between males and females. Concerning overlaps, CID contains 33.8% of overlapping laughter, which is important even if less than other corpora. Moreover, CID exhibits a higher overlapping time of laughter. One of the main result of this study is the high inter-individual variability about duration and frequencies of the whole set of laughter.

Future studies will examine more specific dialog activities within conversations, like story telling. Depending on the role of speakers - main speaker or listener, durations and frequencies of laugh items should reveal higher regularities.

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