

# Acoustic Features of Different Types of Laughter

## in North Sami Conversational Speech

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### Abstract

This paper describes how various laughter types differ from each other acoustically in a North Sami conversational speech corpus collected and annotated within the DigiSami project. The laughter annotations were done with Praat and included two tag types, the first of which indicated if the laugh was a free laugh or speech-talk (laughing speech), and the second one indicating more specific laughter type. In our study, pitch, duration and intensity were extracted for laughter bouts representing every laughter type, and the paper describes the first analysis of the data. The conversational speech of the Sami languages has not yet been systematically studied, so our analysis can be compared with the results of laughter studies conducted in other languages, while also contributing to empirical observations of the North Sami language.

**Keywords:** laughter, speech-talk, conversation, North Sami

### 1. Introduction

In this paper we describe how speech interactions are organized with respect to laughter in North Sami dialogues, and try to pin down the function of various types of laughter in dialogues. Our corpus is the North Sami dialogue corpus collected within the DigiSami project (Jokinen et al. 2016), and the analysis is the first study of its kind with this language. The ultimate goal of the study is to examine the use of laughs in interaction management, and to provide a starting point for conversational studies on North Sami in general. The analysis can be compared with the analyses conducted in other languages. The model can also be used for enabling natural interactions with situated robot agents which are sensitive to affective signals of the user.

Laughter is usually related to joking and humour, but it also occurs in connection to socially critical situations such as signalling relief of embarrassment. We assume that laughing is, first of all, a means of creating common understanding and rapport among the participants, i.e. an effective feedback signal that the participants use to show benevolent contact and their willingness to continue the interaction. However, we also hypothesize that laughing used as an interaction strategy to distance oneself from the partner and from the discussed topics, i.e. it is an acceptable way to disassociate oneself from the conversation.

The paper is structured as follows. We first give a brief overview of the previous research on laughter in interaction in Section 2. We then describe the data in Section 3, and present the analysis is presented in Section 4. Conclusions and future work are discussed in Section 5.

### 2. Previous Research

Laughter is commonly related to joking and amusement, and it has been studied in humour studies (Chafe, 2007). However, laughter does not occur in humorous contexts only, but in potentially face-threatening situations where it is a sign of politeness and socially acceptable behaviour. In

sociolinguistic research, laughter is regarded as a typical social phenomenon, described as serving a broad range of interactional functions. Goffman (1974) talks about situated interactions and the bursts of laughter that break the ordinary interactional frames. In a seminal work on the organization of laughter in talk with the Conversation Analysis, Jefferson (1984) focussed on interactional consequences of laughter, and pointed out that the partner may choose to be silent in which case laughing and silence are two systematic possibilities for joke completions.

Speech research has focussed on the acoustic analysis of laughter and on the categorization of various forms of laughter for the purposes of emotion recognition or speech synthesizer (Trouvain, 2003; Truong and van Leeuwen, 2007; Owren, 2007; Bachorowski et al., 2001; Tanaka and Campbell, 2011). Acoustic properties of laughter vary a lot between speakers and within a speaker, but it is generally concluded that F0 formant is much higher in laughter than in speech, and that the ratio of the length of unvoiced to voiced parts is greater for laughter than for speech (Bachorowski et al., 2001; Truong and van Leeuwen, 2007).

Classifications of laughter often distinguish between free laughter and speech-laugh, i.e. laughter which is synchronous with speech. Nwokah et al. (1999) found that up to 50% of laughs overlap with speech in their corpus of mother and child communication, and also that the duration of speech-laugh was significantly longer than that of only laughter (1.24s vs. 1.07s). Tanaka and Campbell (2011) used a four-way classification, with the most common distinction between the spontaneous mirthful laugh and polite laugh, which together apparently account for 80% of the laughs.

In recent studies on social and situational signals and their correlation with the interactional context (Bonin et al., 2014; Bonin, 2016) it is shown that when laughter functions as a social signal, its timing is structured and conveys information about the underlying discourse structure. Higher amounts of laughter occur in topic

transition moments than in topic continuation moments and when the temporal distance from the topic boundary increases, laughter becomes more likely to occur. Gilmartin et al. (2013) studied laughter and engagement and noted that a significant change in the amount of laughter occurs at fifteen seconds around the topic changes.

### 3. DigiSami Corpus and its Annotations

The DigiSami Corpus of spoken North Sami has been collected in the areas traditionally inhabited by the Sami people: in Enontekiö, Utsjoki, Inari and Ivalo in Finland, and in Kautokeino and Karasjok in Norway (see the map in Figure 1). North Sami belongs to the Fenno-Ugric language family, and is one of the Sami languages spoken in Northern Scandinavia, Finland and Kola Peninsula (Seurujärvi et al., 1997). The corpus includes read and conversational speech, and the conversations are both recorded and videotaped. All the speakers are native speakers of North Sami, and their age vary between 16 and 65 years. The data are thus versatile, including informants from two different countries and of different ages. See more about the data collection in Jokinen (2014), Jokinen and Wilcock (2014).



Figure 1. The Sami languages and the data collection

In this paper we focus on the North Sami conversational speech data. Although the data is not huge (195 minutes of annotated data), it is valuable because it is the first North Sami conversational corpus. Conversations concern the participants' everyday life, and their styles differ depending on the age of the speaker and their social status. The topics among young students concern the next vacation, driving school, and cars, while two adult men, mutually acquainted with each other, converse about Sami translation and other technological tools for writing North Sami. The conversations between a pupil and a teacher are fairly formal, and the topics stick to the forthcoming task, i.e. things that one could write a Wikipedia article about. For the purposes of measuring engagement and to see how laughs function as part of conversations, we annotated the data with laughter features using Praat. Following the

previous research, the laughter annotation included the markers for the two laughter types free laugh (fl) and speech-laugh (st), and for the more specific characterization: 'm' – mirth, 'e' – embarrassed, 'b' – breath, 'p' – polite, 'd' – derision and 'o' – other. Table 1 presents the laughter types with explanations.

fl	free laughter	laughter without speaking simultaneously
st	speech-laugh	laughter and speech combined
b	breath	heavy breathing, smirk, sniff; unvoiced, glottal sounds and sibilants
e	embarrassed	speaker is embarrassed, confused, uncertain; disassociating
m	mirth	fun, humorous, real laughter, occurring when telling jokes etc.
d	derision	mocking the partner
p	polite	polite laughter showing positive attitude towards the other speaker
o	other	laughter that doesn't fit in the previous categories; acoustically unusual laughter

Table 1. The annotated laughter types

The total number of laughter occurrences was 341 in 8 different conversations. Two of these conversations were recorded in Karasjok, Norway, and the rest in Ivalo and Utsjoki, Finland. There were 19 conversation informants altogether – some of the conversations had 2 and some 3 participants. 11 of the participants were female and 8 were male. Altogether, 59% (201) of the laughter occurrences were performed by a female informant, while 41% (140) were performed by a male informant. Table 2 shows the number of different laughter types in different conversations.

### 4. Laughter Types

The basic statistics are shown in Table 2. Free laughter occurs 58% of the laugh occurrences while speech laugh occurs 42% (see discussion below). Three of the specific laughter types occur significantly more frequently than the other types: mirth 29%, embarrassed 49%, and breath 19%, of the total occurrences, and can be called basic laughter types. The laughter bouts annotated as derision, polite and other together only account for 3% of the total occurrences, and can be considered marked types of laughter.

The differences between different conversations can be seen when the laugh activity is normalized with respect to the time. In our data, the average number of laughs is 4.8 per minute, but this varies from almost three times more in 02\_V to almost one eighth in 07\_SX. Qualitative analysis of the conversations shows that the frequency and types of laughter are linked to how well the participants know each other, how nervous they are, and what kind of relationship they have with each other. For example, in the conversation 02\_V in which the participants laugh and chuckle the most, they know each other very well, whereas in 07\_SX where only a handful of laughs occur, the speakers' relationship is

asymmetrical and the whole interaction more formal.

When studying the most laugh-active and engaging conversation 02\_V more closely, we notice that the relative count of free laughter is 79% and that of speech-laugh 21%, i.e. the percentage of free laughs is almost four times more than speech-laughs. A closer analysis shows that half of the laughter instances are mirthful or embarrassed laughs, and the other half breathy sounds. This is in contrast with the other conversations where laughs seem to be either mirthful or breathy.

It appears that 02\_V is an exception among the conversations in other respects, too: its free laughs account for two thirds of the free laughs in the whole data and it also has most of the embarrassed laughter occurrences. In fact, laughing in 02\_V seems to function quite unlike laughing in the other conversations: it signals uncertainty, confusion or embarrassment. This is supported by observations that conversation topics change very fast and have long silences in them, and that the speakers seem nervous in general.

Conv.	fl	st	m	b	e	d	p	o	Tot.	/min
02_V	138	36	28	87	59	0	0	0	174	13.14
06_PS	0	10	4	4	0	0	2	0	10	8.70
05_TP	18	37	27	27	0	0	0	1	55	6.60
08_VV	12	22	19	15	0	0	0	0	34	2.76
01_S	25	18	14	20	6	2	0	1	43	2.64
04_S	3	4	2	3	1	0	0	1	7	2.16
03_V	2	12	6	8	0	0	0	0	14	1.74
07_SX	0	4	0	2	0	0	2	0	4	0.60
Total	198	143	100	166	66	2	4	3	341	
%	58	42	29	49	19		3		100	

Table 2. The counts of different laughter categories in the DigiSami conversation and the laughter per minute values

Ignoring laughs in 02\_V, we notice that free laughing is reduced to only one third of all the laughing occurrences (60/167), i.e. laughter simultaneously with speech seems to be more common than free laughing, and can obviously be used as an effective signal of the speaker’s engagement and attitude. On the other hand, 02\_V seems to exemplify that laughing is also used as an effective strategy to relieve stress and confusion, besides indicating the speaker’s personal characteristics and conversational roles.

In general, we can hypothesise that in natural conversations where people know each other and show no overt nervousness, the basic laughter types occur in two situations: when the participants have real fun, i.e. when telling jokes or funny stories, or when they provide breathy feedback to the partner to signal their engagement in the conversation. However, if the conversational situation creates nervousness, this can be signalled by two extremes: by excessive laughter, or by lack of laughter. The former is common among peers who can thus jokingly share their confusion, uncertainty and embarrassment, while the latter is common among strangers and participants who have

asymmetrical power relations and thus markedly signal their non-sharing: laughing automatically creates closeness and in-group feeling which makes the partners more equal.

## 5. Acoustic Analysis

Following the previous research, we hypothesize that the different laughter types in our data differ in their acoustic properties, such as pitch, formants and intensity, and also duration. In the following acoustic analysis, only the basic and most common laughter types, mirthful (m), breath (b) and uncertain/embarrassed (e) are included, occurring either in free laughs (fl) or in speech-laughs (st). The analyses have been made with different Praat scripts and further processed for min/max/ave/std values.

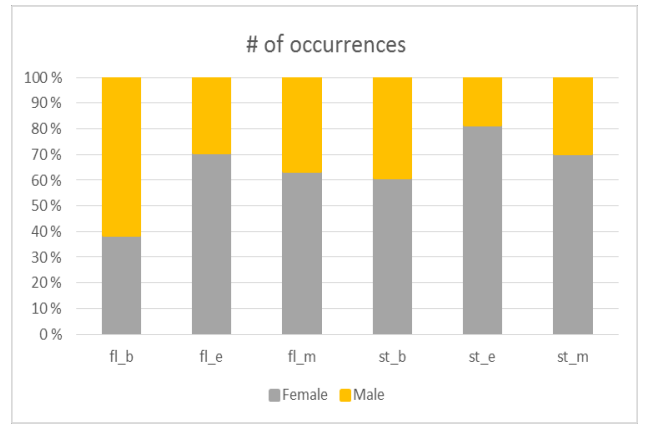


Figure 2. Comparison of the number of laughter occurrences between male and female informants

Our analysis of the acoustic features showed various differences in the investigated laughter types. To compare the results of the acoustic analyses, we calculated average values from the 3 most common types (breath, embarrassed, mirth) of male and female informants separately.

The most common laughter types are shown in Figure 2. As can be seen, female participants produce more laughter signals than men, usually about twice as many. An exception is free laughing breath types where the ratio is the other way round: this is the typical laugh type for the men in our data. It is also interesting that females produce embarrassed and uncertain speech-laughs about four times as many as male participants, being the most typical laugh-type for women in our data.

Figure 3 shows f0 (pitch) values which were extracted with different ranges for male (75-400Hz) and female (100-500Hz) informants; thus comparison of male and female average values is not adequate. However, it was clear that the f0 in free laughter types was higher than f0 in speech-laughter for both male and female informants, which accords e.g. with Truong and van Leeuwen (2007).

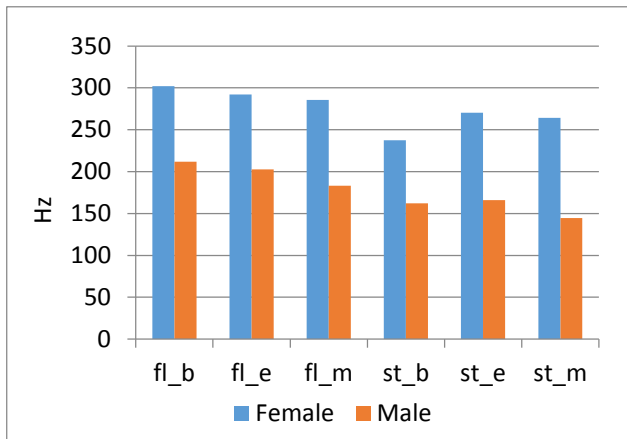


Figure 3. The average f0 values (Hz)

Figure 4 depicts the average duration of the laugh types. There were big differences in duration between the laughter types: durations of embarrassed laughs were significantly longer (2.1s – 3.2s) than all other types for both male and female informants, and breath laughs were the shortest (1.1s – 1.4s). However, our data did not support the findings of Nwokah et al. (1999) since free laughter in our data was not significantly longer than speech-laugh. This may be due to the different interaction activities: our data records people conversing in fairly equal situations compared with a mother and child care-giving interaction.

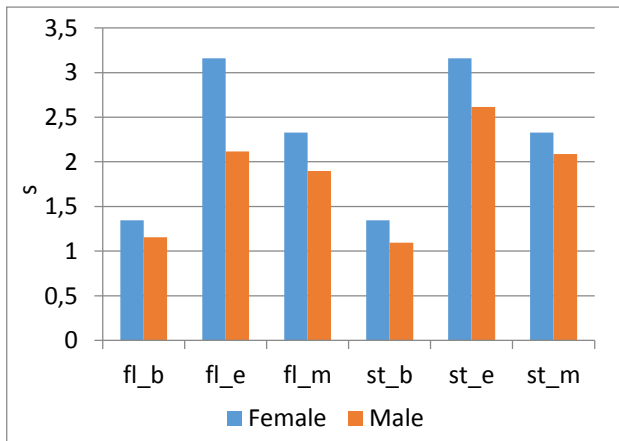


Figure 4. The average duration (s)

The intensity of different laughter types was rather similar in all laughter types, as shown in Figure 5. No significant differences occurred between the different laughter types, but the most surprising difference was that the average intensity with female informants was generally bigger than with males.

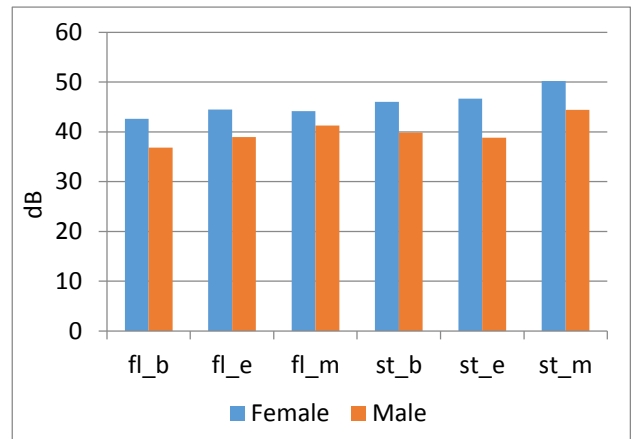


Figure 5. The average intensity (dB).

## 6. Conclusion

In this paper we have studied the interlocutors' laughing in the North Sami interactions and the functions of laughter in conversational engagement. We can conclude that laughter has several functions that range from fun and happiness to a relief burst of embarrassment. We observed that laughter types depend on the situation and the role of the speakers, and we hypothesize that in natural conversations, the basic laughter types occur when the participants have real fun (mirth) or when they give breathy feedback (breath). However, if the situation is embarrassing or uncomfortable to the speaker, this is signaled by two extremes of laughter frequency, which differ depending on the participants' power relation: the peers use excessive laughter so as to share the embarrassing situation with the others, whereas the partners in an asymmetrical relation indicate more formal, non-sharing behavior by the lack of laughter.

Also our hypothesis concerning the acoustic differences of different laughter types was supported. Durations of embarrassed laughs were significantly longer than the durations of all other types for both male and female informants, but we did not get support for Nwokah et al. (1999) finding of speech-laugh being longer than free laugh. As for the distinctions in intensity, this was small between the laugh types, but interestingly the women had higher intensity laughs than the men in our data.

These observations will be substantiated with deeper statistical analysis, and models for joking, laughing and generally positive attitude will be explored further so as to enable appropriate models be implemented in the SamiTalk application (Wilcock et al. 2016). A useful case is e.g. to be able to recognize the user's embarrassment or uncertainty on the basis of the amount of laughter and their role in the conversation, and alleviate such situations appropriately.

Moreover, as the collected data is multimodal, it is possible to study non-verbal as well as verbal communication. As argued in the previous research, the participants' engagement in the conversation and mutual bonding can be measured with the help of multimodal and non-verbal cues, such as the number of laughs or chuckles,



or overlapping speech (Bonin, 2016). Our future studies concern the use of non-verbal information when laughing, to measure the participants' engagement in the interaction.

In addition to studying the functions and acoustic features of laughter in North Sami conversations, our aim is also to raise the visibility of this minority language. Studying North Sami conversation and laughter for the first time opens new perspectives for North Sami language studies and also for the speech community itself. The strength of our conversation corpus is that it presents the language in use and as it naturally is, instead of only focusing on e. g. the grammatical features. Although the basic functions of laughter in North Sami conversations seemed similar to the typical European conversations, it might also be useful to compare different humour types in different cultures. For example, there are Sami comedy TV shows concerning majority peoples' stereotypes about Sami people and self-irony of the Sami people. There are also cases of specific Sami humour in our corpus, which concern the differences between minority and majority cultures, and link the language use into the culture itself.

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