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‘Speech-Smile’, ‘Speech-Laugh’, ‘Laughter’ and Their Sequencing in Dialogic Interaction1

Klaus J. Kohler
Institut für Phonetik und digitale Sprachverarbeitung, Universität Kiel, Kiel, Germany

Abstract
Laughing is examined auditorily and acoustico-graphically, on the basis of exemplary speech data from spontaneous German dialogues, as pulmonic air stream modulation for communicative functions, paying attention to fine phonetic detail in interactional context. These phonetic case descriptions of laughing phenomena in speaker interaction in a small corpus have as their goal to create an awareness of the phonetic and functional parameters that need to be considered in the future acquisition, acoustic analysis and statistical evaluation of large spontaneous databases.

1. Introduction

1.1 Types of Laughing Phenomena

Phonetic analyses of laughing are relatively rare. Existing classification [Bachorowski et al., 2001; Chafe, 2007; Trouvain, 2001, 2003] differentiates (free) laughter and speech-synchronous forms of laughing. The latter may be either speech-laughs [Nwokah et al., 1999], which are characterized by typical sequential laughter attributes co-occurring with speech articulation, or speech-smiles, with long-term f0 and spectral raising on speech events, due to articulatory prosodies of lip-spreading and palatalization. Speech-smile is likely to be preceded and followed by the facial expression of a smile without sound, speech or paralinguistic vocalization, and is then only visible. Where this paper makes reference to smiling, only audio aspects are considered. For an analysis of smiling in the wider sense it would be necessary to have video recordings, which are not part of the database under discussion.

1 A first-draft version of this paper was presented at the Satellite Workshop on the Phonetics of Laughter, 16th ICPhS, Saarbrücken, 4–5 August 2007.
Sequences of speech-smile – speech-laugh (– laughter) and the reverse order are attested in spontaneous speech corpora. But irrespective of this syntagmatic binding, these types of laughing phenomena are different production categories, and therefore do not vary along one articulatory scale; they are also perceived as belonging to different categories and have different communicative functions [Trouvain, 2001].

1.2 Functions of Laughter

Laughter fulfils a large spectrum of functions: (1) It may be physiologically conditioned rather than communicative, as in reaction to tickling. (2) It may be marginally communicative, being outside reciprocal communicative interaction between dialogue participants, as in watching a funny film or listening to an entertainer on stage in an audience or on TV. This function has provided a common paradigm for data acquisition, such as presentation of video clips [Bachorowski et al., 2001] or a reading task with DAF [Kipper and Todt, 2005]. (3) It may be integrated into communicative acts as an essential ingredient controlling the interaction. In this function it alternates with verbal exchanges, and also occurs simultaneously with them, resulting in speech-laugh. In their integrated communicative function, laughter and speech-laugh show varying degrees of high-intensity expressiveness, which may be amusement and hilarity at what has been done or said by the dialogue partner(s), including the laugher, and which may range from a subdued chuckle to uproarious laughing. With highish vowel resonances, it may be the expression of nervousness and submissiveness, as captured by the English terms ‘giggle’ or ‘titter’, or, with low vowel resonances, of coarseness and dominance, as in ‘guffaw’ or ‘horse laugh’ [cf. the frequency code in Ohala, 1983, 1984]. The expression of amusement and hilarity may be real, acted, faked or ironical, although the manifestations may all be different and recognizable as such. Answers to all these impressionistic functional categorizations and their physical substantiations need to be provided by empirical research. The basis of data acquisition for these functions are spontaneous dialogue corpora [Chafe, 2007].

1.3 The Interactional Function of Laughter in the Conversation Analysis Perspective

It has been pointed out by Jefferson [1979, 1985, 2004] that laughing occurs quite frequently although the speaker does not find any ‘laughable’ in the discourse, but may react verbally at first and only laughs after the co-participant has started laughing. Jefferson interprets the occurrence of this type of laughter as being triggered by interactional considerations rather than cognitive factors inside the laugher. Here are two samples2 from among a large number she analysed with a Conversation Analysis perspective to illustrate her point.

Sample 1

2 I am grateful to John Local for providing the references and the audio files.
In Jefferson’s [2004] interpretation ‘Leslie’ initially produces speech in response to what Philip has said (lines 3 and 4). It is following a few particles of laughter by Philip that Leslie [sic] laughs (lines 5 and 6), i.e. she joins his laughter rather than independently laughing. … she has not found Philip’s utterance cause for laughter, it is only upon his starting to laugh that she laughs.’ This is certainly a case of laughs having an interactional function, where neither speaker expresses hilarity at something ‘laughable’. But, at the same time, the phonetic make-up of the laughs and their functional interchanges with speech need to be considered, and suggest a more subtle appreciation of the dialogic exchange.

Phil finishes his talk about his daughter having three weeks holiday but only spending one with her parents by a kind of nervous and resigned laugh, with half-close and breathy vowel resonance, meaning something like ‘she has more important things to do than being with us’. Lesley senses this and joins in with a sympathetic laugh with similar phonetic features, and she then verbalizes this sympathy by saying ‘s’pose she’ll be here for Christmas, won’t she’. This is, in turn, confirmed by Philip, and Lesley offers a supportive ‘yes’, overlapping Philip’s assertion. So, both laughs express their own meanings over and above the second one just being a sequel to the first. In one sense, Jefferson is right in saying ‘she joins his laughter rather than independently laughing’; being a compassionate laugh, it presupposes the occurrence of Philip’s resigned laugh, but it is at the same time Lesley’s own controlled continuation of the interaction, which then turns into speech again. Lesley’s laugh marks the transition to her speech turn, to which it is closely linked in time and meaning. These laughs alternate with speech in the interactional functions of expressing and comforting feelings; the prosodies used by the two speakers on the verbal sections signal the same emotional content.
In Jefferson’s [2004] account, Hal does not see anything laughable but joins Lesley’s laughter out of gallantry. Again, these laughs fulfil an interactional function, but I think that their phonetic manifestations and embedding in the verbal dialogue demand a more elaborate interpretation. After Lesley has mentioned that she has to come to the dance because she has bought a new skirt Hal makes the ambiguous remark ‘That would be lovely,’ with a final low rise. It means ‘lovely you will be coming’ and ‘lovely to see you in your new skirt’. The low rise accentuates this meaning of intimacy. Lesley reacts to this verbal utterance by a kind of embarrassed laugh, with half-close, rather than open, vowel resonance, and breathiness. Hal enjoys his double meaning having got across and expresses it by joining in the laugh, but with open vowel resonance. In this interpretation, the two laughs replace verbal interactions with very simple but highly expressive, cognitively controlled vocalizations to transmit subtle situational meanings.

In both cases, Jefferson’s interpretations seem to me to be too superficial, by only looking at the sequencing of speech and laughter in ‘male-female’ interaction, and misguided by a behaviourist interaction approach, which, at the same time, leaves out important fine phonetic detail in the laughs. Hal, for instance, does laugh at a laughable, namely his ambiguous utterance and Lesley’s reaction to it. This raises an important issue about the epistemological status of Conversation Analysis, in the sense of a paradigm of communication research, where functional concepts are supposed to emerge from the unfolding of speech interaction. This contrasts with my philosophy of science perspective, according to which partners acting in dialogue introduce their cognitive assessment of the world and of the context of situation in which the interaction is taking place. The recipient reacts on the basis of an overlapping knowledge of cognitive and social speech functions, which are given outside the hic et nunc interaction. They are very similar within the same language and social environments, but will be different between different languages and social groups, resulting in all sorts of misunderstandings. In spite of this difference in outlook, however, such a cognitive approach to speech interaction can learn a great deal from Conversation Analysis with respect to a fine-grained investigation of conversational data in their formal and functional sequencing and intertwining between dialogue partners. This is the stance I am taking in the example-based analysis of laughing phenomena in this paper. The examples are discussed with reference to graphic data in figures and transcripts, as well as to the corresponding audio data in wav files, which are made available as online supplements at www.karger.com/pho-kohler-audio. The indexing of the audio files follows the numbering of the figures or the naming of the transcripts.

1.4 Speech-Smiles

Different from all the high-intensity hilarity and interactional functions and manifestations of laughter, speech-smile is a signal of low-intensity expressiveness. In his comparative approach to the phylogeny of laughter and smiling, van Hooff [1972] proposed a two-dimensional representation of laughing phenomena in humans, in which the abscissa maps ‘playfulness and mirth’ and the ordinate ‘non-hostile friendly attitude’. In such a display, the extremes of ‘broad smile’ along the ordinate and of ‘wide-mouth laugh’ along the abscissa bear formal and functional resemblance with ‘silent bared-teeth display’ and ‘relaxed open-mouth display’ in other primates:
Laughter then fits neatly in the phylogenetic developmental range of the relaxed open-mouth display, a metacommunicative signal, designating the behaviour with which it is associated as mock-aggression or play. Smiling fits well as the final stage of the development of the silent bared-teeth display. Originally reflecting an attitude of submission, this display has come to represent non-hostility and finally has become emancipated to an expression of social attachment or friendliness, which is non-hostility par excellence. The situations in which the silent bared-teeth display occurs have in common that a certain amount of uncertainty about the social relationship is overcome. [van Hooff, 1972, p235f]

Speech-smile may lead or trail laughter or speech laugh, or it may stand on its own, as an expression of happiness and friendliness. For example, as a part of sequence closing at a supermarket cash desk, German tschüss (‘bye’) may be spoken with an auditorily identifiable smile, to establish social accord. Example 1 in figure 1 and audio 1 gives a stylized instance (produced outside a real situational interaction by the author), showing a strengthening of high frequencies in spectrum and f0.

The phonetic and functional features of speech-smiles discussed in this paper converge with the data by Tartter [1980]. She got American English speakers to produce words, logatomes and sentences straight-faced and smiling. The smiled utterances had raised fundamental and formant frequencies for all speakers. Smiled and straight-faced tokens of the same utterance were paired in a perceptual discrimination experiment. One group of listeners judged which of an item in a pair sounded ‘smiled’, a second group was instructed to select the item that sounded ‘more cheerful’ or ‘happier’. Both groups performed their tasks of auditory smile perception and of happiness interpretation significantly better than chance for all speakers. These results confirm that listeners can hear speech-smiles on the acoustic basis of frequency raising, and that they associate perceived speech-smiles with a positive expression of social relationship, happiness, cheerfulness and friendliness, in accordance with Ohala’s [1983, 1984] frequency code.
1.5 Phonetic Exponents of Laughter

In the literature [Bachorowsky et al., 2001; Chafe, 2007; Sundaram and Narayanan, 2007; Trouvain, 2003], the following parameters are listed for the phonetic categorization of different types of laughter: (1) voicing, open mouth; (2) voicing, closed mouth, nasal exit; (3) voiceless nasal-cavity turbulence; (4) voiceless laryngeal and oral cavities turbulence; (5) vowel resonance: close–open, front–back; (6) pitch of voiced laugh bursts; (7) number of laugh bursts in a ‘bout’ of laughter; (8) durations of laugh bursts and burst intervals, and (9) initial and final inhalations and exhalations are not always included in the analysis of bouts although they are important in the control of breathing for laughing.

Speaking has been described as modified (pulmonic exhalatory) breathing [Abercrombie, 1967], involving complex supraglottal articulation as well as special subglottal pressure settings [Ladefoged, 1967], peripherally supplemented by inhalatory pulmonic and other air stream mechanisms [Pike, 1943]. Pike [1943] defined laughter as spasmodic articulation, produced by sudden movements beyond the control of the individual, in the same set as cough, sneeze, hiccup, or belching. This characterization is misleading because laughter varies according to the communicative function it is to subserve, even if it may be impressionistically described as spasmodic.

Laughing should be seen as another way of modifying breathing, involving inhalation as well as exhalation, more so than in speaking. Research into the phonetics and communicative functions of laughing needs to analyse breath control (air stream direction, energy time course) as the basic phonetic element, which is modified in complex ways glottally (a wide array of phonation types), but in fairly simple ways supraglottally (oral/nasal cavity, roughly positioned pharyngeal/oral/labial constrictions). This is the reversal of the fine-grained supraglottal articulation superimposed on the relatively simple subglottal setting for speech, which is only modified under special circumstances such as a ‘force accent’ [Kohler, 2005]. In other words, laughing should be analysed as modified breathing in its own right in parallel to speaking, rather than trying to apply speech categories, such as the distinctive vowels and consonants, or CV syllables, of a particular language, while neglecting the fundamental air stream control. Such an independent analysis of laughing will show up the correspondences and divergences between the two ways of controlling the pulmonic air stream, and will then allow us to make insightful inferences as to how the two interact and are combinable in speech-laughs.

Vocal tract resonances are no doubt important in colouring laughter in various ways for functional purposes, and will therefore need acoustic investigation, but these vocalic qualities are different, phonetically and functionally, from the vowel distinctions in the phonological system of the language [cf. also Bachorowski et al., 2001]. The latter are more numerous and more complex in distinctive feature composition, and serve the differentiation of words. The resonances in laughter do not coincide with these qualities in phonological vowel systems and are more elementary, such as ‘highish in the front region’ vs. ‘lowish or rounded in the back region’ vs. ‘central up-down and front-back’. Their function is semantic and pragmatic to distinguish, e.g., ‘giggle’ and ‘chuckle’ (cf. 1.2). Likewise, vocalic qualities of hesitations do not coincide with phonetic ranges in phonological vowel systems [Pätzold and Simpson, 1995]. These are cases of using vocal tract resonance as a suprasegmental carrier as against a local segmental differentiator.
Of course, spontaneous laughter cannot be investigated in physiological laboratory experiments, so the direct observation of subglottal activity in laughing is limited. Thus we have to deduce production, to a certain extent, from the acoustic result, and to this end, need to analyse the acoustic signal, coupled with acute auditory observation, in fine phonetic detail. Up to now, phonetic analysis of laughter has relied on rough acoustic measures, has hardly included the acoustic consequences of air stream direction, dynamics and timing [but see Chafe, 2007], and has applied descriptive and inferential statistics too quickly to roughly analysed and tagged corpora on the basis of acoustic properties without full consideration of communicative function in speech interaction. And synthesizing laughter to make synthetic speech more natural-sounding [Sundaram and Narayanan, 2006] is quite premature. What we need are studies of fine phonetic detail in dialogic interaction on the basis of exemplary spontaneous speech data. This paper provides a few results of such an investigation into the occurrence of laughter, speech-laugh and speech-smile in their function as controls of communicative interaction in dialogues. The phonetic case descriptions of laughing phenomena in speaker interaction in a small corpus have as their goal to create an awareness of the phonetic and functional parameters that need to be considered in the future acquisition, acoustic analysis and statistical evaluation of large spontaneous databases.

2. Database and Method

Two data sources have been used: (1) a stereo recording of a dialogue session, consisting of 6 sub dialogues, between 2 female speakers (institute secretaries), recorded in the Appointment-Making Scenario with overlap [Kohler et al., 2006], labelled but so far not published (f06), and (2) a stereo recording of 2 male speakers from the Video Task Scenario Lindenstrasse [Kohler et al., 2006, Peters, 2001], l06, talking about differences in video clips from the German TV soap series Lindenstrasse presented to them separately beforehand. In both cases, the speakers knew each other well, and they showed a high degree of spontaneity and naturalness.

In f06, the two secretaries jm and mg have to arrange two 2-day business meetings in a 2-month period and thus are to perform a task in an appointment scenario game that belongs to their daily routine in looking after their bosses’ calendars. However, they cannot find mutually suitable dates because the experimenter inadvertently filled their respective calendars in such a way that there are not enough successive daily slots for both. The only solution mg can suggest is to have the two meetings immediately following each other, turning the two 2-day meetings into one 4-day meeting. jm considers it a possibility but not an appropriate one for a secretary who is used to fulfilling the task the way it has been given. She finds this clash between the non-solvable task in the appointment-making game and the hardly conducive adjustment amusing, which she expresses by speech-laugh followed by subdued laughing. It is commented on by mg, with speech-laugh and laughter, as not being important in this kind of appointment-making game. mg’s amusement is in turn picked up by jm, leading to several laugh exchanges between the two speakers.

At the beginning of l06, speaker mpi sets the theme of ‘the utter stupidity’ of the German TV soap series Lindenstrasse, capping his appraisal with boisterous laughter. The whole dialogue then revolves round exchanges on this theme between speakers mpi and tra about the episodes they have been presented with separately. This leads to several exchanges of laughing.

The audio data can be found in audio-jm and audio-mg for f06 and in audio-tra and audio mpi for l06, which provide the two recorded channels of each dialogic interaction. They may be listened to, separately or conjointly, by opening them, for instance, in Cool Edit. In the following orthographic transcripts of these interchanges between jm and mg in f061 and between tra and mpi in l06, sequential turns, with the speakers’ IDs, are numbered from 01. Partial overlap is symbolized by giving the 2 speakers’ turns the same sequential number. Overlays of speech-smile and speech-laugh are annotated
by enclosing the stretch of overlaid speech in <::>; +/.../+ bracket stretches of false starts: <P> = pause, <A> = breathing, <Z> = hesitation.

f061 Audio-jm and Audio-mg
jm01 und im Dezem+/-/ <A>
mg01 ja, wenn wir den zweiten und dritten Dezember <P>
mg02 genommen hatten,
jm02 ja, das würde gehen. <P>
mg03 und dann müssen wir eben dann<Z> daraus ‘nen viertägigen<Z> Verabredung machen. <P>
jm04 das wären ja zweimal zwei Tage hintereinander. <A>
jm05 ja, wenn wir keinen anderen Termin finden. <P>
jm06 ja, das würde natürlich gehen. aber das ist bestimmt nicht so<Z>
mg07 <laughter>
jm07 <::speech-laugh>glücklich:: <laughter>. <A>
mg08 <::speech-smile> ich glaub’, darum geht es hier::<P> <::speech-laugh> nicht::
jm09 <laughter>
jm09 gut, also <P> machen wir das so. <A>
mj10 ja. <A>
jm11 denn machen wir daraus ein <::speech-smile>Viertägiges::.
mj12 <laughter>
mj12 <::speech-laugh> ja:: <laughter>.
jm13 <A> ja, dann hätten wir ‘s, nicht?
jm14 <::speech-smile> ja, gut:: <laughter>.
jm15 <laughter>
jm15 <laughter>

h061 Audio-tra and Audio-mpi
tra01 das ist +/der<Z>/+ der Türke, der auch +/in der in der<Z>/+ in dem Haus wohnt, <A> dieser türkische Doktor.
mn01 <äh>
tra02 <A> dass er den irgendwie anbaggert?
mn03 <äh> null Komma null gesehen.
tra04 <A> mhm, das war nämlich irgendwie die zweite Partyszene, die bei mir irgendwann auftauchte wo wo
+/<v/>+ <äh> <P> der ihn so ’n bisschen anbaggert
mn05 <laughter> ::<::speech-laugh> ah, ej::
tra06 und meint +/du bist/+ <A> du bist doch auch ’n kleines bisschen schwul (::speech-smile) und so:: +/und/+ und
+<häs>
mn06 <laughter> ::<::speech-laugh> <P> Benno mir gar nicht gezeigt::, Alter, hat er mir vorenthalten.
tra07 <laughter>
tra08 ja, woraufhin der Türke natürlich die Party irgendwie beleidigt verlässt.

The recordings were listened to, and the laugh sections in their dialogue settings were excerpted in Cool Edit. The excerpted sections were then acoustically processed (spectrogram, f0, energy) in Praat, and the phonetic and interactional data were described through auditory assessment and visual inspection of the acoustic records, paying attention to fine phonetic detail in relation to speaker interaction.
3. Results

3.1 Sequencing of ‘Speech-Smile’, ‘Speech-Laugh’, and ‘Laughter’

Any sequencing of the three laughing phenomena is possible. In an elaborate form, a speech-smile can develop into a speech-laugh and in turn into laughter, or contrariwise laughter continues into speech and then trails off as a speech-smile.

Example 2 in figure 2 and audio 2 provides an instance of the former order by speaker jm. Here glücklich (‘suitable’) is preceded by nicht so (‘not so’) and a breath intake, and shows a strong energy increase in the accented vowel as well as an f0 rise, indicating low-key amusement over the clash between task and executability. This is followed by a renewed strong energy increase in the second syllable -lich, accompanied by a phonation (and f0) tremor, signalling incoming laughter. There is then long voiceless oral exhalation with high front vowel colouring before two oral cycles of voiceless long breathing in and short breathing out, energy decreasing progressively. This indicates subdued laughter, terminating the laugh section before resuming normal articulation for gut. also machen wir das so. (‘good, let’s do it this way.’).

Example 3a in figure 3a and audio 3a provides a case of a more complex sequencing by speaker mg. ja. (‘yes’) shows energy modulation: the energy rises into the vowel, then falls, and rises again, dividing the vowel into two. This is followed by strong voiceless exhalation, with open vowel resonance, setting in at the energy level of the sonorant vowel and trailing off over 400 ms, changing to a closer vocalic reference and back to a more open one. There are then, embedded in continuing exhalation, 4 voiced energy bursts of approximately the same duration, 70–80 ms, and of the same
abrupt rise-fall of energy, evenly spaced, 140–170 ms, creating a very rhythmical pattern of strong laughter. The first 3 bursts have half-open central vowel resonance and descending f0, the 4th has high-front vowel resonance and a high upward f0 jump. The sequence is followed by a 400-ms pause and another, longer voiced energy burst, 120 ms, on an ingressive air stream, with an abrupt rise to a level 14 dB above the previous

Fig. 3. a f061_mg  /ja/ laughter + /ja/, /gut/ laughter: spectrogram, f0 (plain), energy (dotted). b f061_mg /ja, gut/ vs. f065_mg /na gut/: spectrogram and f0 trace.
4 bursts, accompanied by an abrupt f0 rise from 355 to 512 Hz. The vowel resonance is less high and less front than the preceding burst.

This terminates the laughter and is followed by voiceless exhalation, which turns into speech: *ja, gut* (‘well, all right’) is perceived with a ‘bright’ (as against ‘dark’) tonality feature, relatable, in articulatory terms, to lip-spreading/tongue-fronting throughout, most obvious in [u:] and [t]. This ‘brightness’ is at the same time decoded as a smile, which then develops into a concluding short laugh with which the speaker hands over her turn. The laugh consists of a short voice burst, trailing off in strong voiceless exhalation, followed by another much weaker voice burst, all of mid-central vowel resonance. This concluding laugh pulse lacks the rhythmicity of the other laughter patterns.

Example 3b in figure 3b and audio 3b compare mg’s phrases *ja, gut*, of figure 3a, and *na gut* from another part of the dialogue, with and without a speech-smile, respectively. In the speech-smile, F1 and F2 of [u:] are raised (468 and 1,071 Hz vs. 409 and 936 Hz), [t] has a higher locus frequency as well as an energy concentration of the burst at this raised locus, and f0 rises, thus high frequencies are strengthened across the spectrum.

Example 4 in figure 4 and audio 4 illustrates a speech-smile from the dialogue *106* of the two male speakers in comparison with a corresponding non-smile utterance section. Speaker tra pronounces *[o:]* in *und so* ‘and such like’ (followed by hesitations and then by laughter) with raising of formants (F1 590 Hz and F2 1,160 Hz), compared with his *[o:]* of *Sh* (F1 450 Hz and F2 840 Hz), from another part of the dialogue in a non-smiling context. The sequencing of smiling and laughter in this dialogue occurs within the individual speakers as well as between them and is further discussed in 3.5.
3.2 Air Stream Direction

As illustrated in 3.1, voiced and voiceless breathing occur both egressively and ingressively in laugh turns of \( f_{06} \). Ingressive pulses may fulfil a syntagmatic grouping function by marking the end of a laugh turn, as in example 3a, as well as for \( l_{06} \) in example 6 [cf. also Chafe, 2007]. Final exhalation or inhalation should thus be treated as part of laugh turns and not be ignored in the analysis [Bachorowski et al., 2001].

3.3 Oral and Nasal Air Streams

Example 5 in figure 5 and audio 5 illustrates nasal and oral air streams in laughs of \( f_{061_{-jm}} \). After the utterance \( ja, \ denn hätten wir’s, ne. \) (‘well, that’s it, isn’t it’), there is oral and nasal exhalation, which is followed by an oral closure. In turn, a nasal air stream is modulated, first by short–long breath pulses, then by weak glottal vibration and a strong voice burst, followed by a weaker one, of [m] colouring, and finally by mouth opening and a voice burst with schwa resonance. This results in a triple iambic pattern, first voiceless, then with ascending pitch, a different rhythmicity from the one illustrated in 3.1.

Laughing on a nasal air stream conveys subdued hilarity, a chuckle. In the present case, it occurs in preparation of a less restrained oral laugh on schwa resonance together with the dialogue partner. Speaker mpi of \( l_{06} \) also shows this difference between unrestrained and restrained laughter in example 6 (audio 6) and example 7 (fig. 7, audio 7); example 6 is shown in two sections in figures 6a, b (audio 6a, audio 6b) because due to the total length of almost 4 s, compression into one figure would have blurred the acoustic traces. The unrestrained laughter occurs right at the beginning of the dialogue after mpi.
has emphatically stressed the utter stupidity of the TV series, by saying *ich hatte schon ‘n bisschen vergessen, wie extrem unglaublich schwachsinnig die «Lindenstrasse» ist.* (‘It had already somewhat slipped my mind how extremely unbelievably idiotic Lindenstrasse is.’). He gives *schwachsinnig* a force accent [Kohler, 2005]. (He is the speaker who has the highest number of force accents for negative emphasis in the whole corpus.) He then highlights his own characterization of the series by unrestrained laughter with a wide-open mouth. Later on, he reports on scenes that were presented to him in
his video clip and refers to one by the non-word *didelidu*, which he again finds hilarious but is less emphatic about, so restrains his laughter to a chuckle by closing his mouth and modulating a nasal air stream.

### 3.4 Rhythmicity

The nasal or oral air stream is modulated by alternating phonation from glottal opening to various types of vibration and vice versa, and by imposing a dynamic and a duration structure especially on the voiced sections in a sequence. These syntagmatic modulations create rhythmic patterns. In example 3a, we have seen a sequence of equidistant and equiprominent voice bursts, in example 5 an iambic pattern. In figure 6, the rhythm is even more finely structured: a short voiceless initiating pulse and a subsequent upbeat of 2 short voice bursts is followed by 4 longer double-peaked ones, grouped in twos of strong–weak energy. [Double-peaked pulses have also been found by Chafe, 2007.] The two dyads measure 500 and 470 ms (with a short silence of 110 ms between them), the voiced elements within the dyads are 200–175 ms and 170–180 ms, separated by 125 ms and 120 ms of voiceless breath, respectively. There is thus great regularity in the alternation of strong–weak double-peaked energy patterns and their timing, which is perceivable as a trochaic rhythm. The sequence of voiced laugh pulses is followed by weak laryngeal percussion sounds during 900 ms, which may be connected to swallowing. Then the whole laugh turn is terminated by two voiced pulses, a long ingressive and a shorter egressive one, over a stretch of 930 ms, thus again representing the energy pattern strong–weak.

So, this laugh turn shows a superordinate prosodic structure, with energy forming a descending scale from the second upbeat pulse across the two dyads, then fading...
away in percussion sounds and finally receiving a terminal marker. Laughing can thus have prosodic phrase structure, comparable to speech, although it uses different means, appropriate to its fundamental air stream control. In this particular example, the parallel to speech may even have gone one step further. The speech section preceding the laugh turn – _unglaublich schwachsinnig_ – uses emphatic strong–weak patterns in both words with strong intensification of the first, stressed syllable and strong reduction of the unstressed ones. The word _extrem_ with stress on the second syllable leads up to this double emphasis pattern. And it is this emphatic verbal characterization of the TV series which the speaker finds hilarious and comments on by unrestrained expressive laughter. So, he may have superimposed his emphatic speech patterns on his laughing.

In example 7, the first 4 voice bursts are evenly spaced and of equal energy on an ascending pitch scale. The next 3 form another block of still evenly spaced but longer bursts, of which the first 2 have well developed f0 upglides (perceivable as such), whereas in the third f0 jumps up abruptly from a low creaky section muffling the rising pitch movement. This together with the decreasing energy in this block creates a dactylic pattern. Then follows a third block of quite short and weaker voice bursts on a high rising pitch level, still evenly spaced.

### 3.5 Laughing Interaction in Dialogue

Laughing phenomena are not only sequenced and timed carefully within one speaker according to the communicative functions they are to fulfil but also as part of the interaction with another speaker in dialogue. In [f061], mg makes an isolated laugh burst just before jm’s utterance of example 2, seeing the funny side of the clash between task and execution, which jm is leading to. During jm’s subdued laughter section in example 2, mg produces laughter, followed by speech-smile and then by speech-laugh on the utterance _ich glaub, darum geht es hier nicht._ (‘I don’t think that’s an issue here.’), finally turning into laughter. Then jm agrees: ‘_dann machen wir daraus ein viertägiges._’ (‘In that case we turn it into a 4-day meeting.’), ending in a smile, followed by laughter, during which mg joins in with the speech-laugh and laughter of example 3a. Towards the end of the latter, jm says _gut. also machen wir das so,_ on which mg comments with a smiling _ja, gut._ (‘All right.’). Then both speakers join in laughter finishing off the dialogue. The two speakers’ laughing is coordinated action as part of their joint task-solving in the Appointment-Making Scenario.

In the Video Task Scenario of [l06], the situation is quite different. The speakers are not engaged in a joint task-solving goal, but simply talk about the differences they have observed in their respective video clips of the TV series. Speaker mpi sets the theme of emphatic evaluation which he embellishes with amusing wordings accompanied or followed by boisterous laughter. Then the two speakers mutually trigger laughter by facetious descriptions of the soap opera excerpts they have seen. In this, it is mpi who dominates the dialogue and who, in particular, stimulates speaker tra into laughing, which is never so uproarious as his own. However, tra is also the motor for laugh exchanges when he gives an account of a scene where a gay chap makes advances to a Turkish doctor; he calls it _ein bisschen anbaggen_ ‘a little digging’, which sends mpi off into uproarious laughter, partially overlapping tra’s continuation of his story, and his punchline: _du bist doch auch ‘n kleines bisschen schwul, und so ‘you are a little bit gay yourself, aren’t you, and such like_; _und so_ is said ‘tongue in cheek’
with a speech-smile (see example 4 and discussion in 3.1). This gets mpi into a hilari-
ous mood again because he did not have this episode in his video clip, and refers to the
person who spliced the videos as withholding the juicy scene from him. He produces
the long utterance \textit{w/\textsc{H11021}Z/\textsc{H11022}solche Szenen hat \textsc{P} Benno mir gar nicht gezeigt}
with a speech-smile throughout. It sends tra into laughter partially overlapping mpi’s
turn. So, here we have instances of speech-smile developing into laughter, and vice
versa, within one speaker, and laughing phenomena controlling the interaction
between the speakers.

4. Discussion and Conclusions

Starting from sampled instances of three types of laughing phenomena – laughter,
speech-laugh, and speech-smile – this paper has looked at their phonetic patterning and
communicative functions in interactive speech processes, considering laughter pul-
monic air stream modulation in its own right, in alternation with, or superimposed on,
the air stream modulation in the speech channel.

From the limited data presented in this paper, a few generalizations can neverthe-
less be deduced if they are also related to the results known from the literature.

(1) In laughter, the air stream is controlled by systematic adjustment of direction,
energy, voiced, voiceless and other phonatory modulation, and oral or nasal outlet.
Like any supraglottal articulation, vocal tract shape for various resonances is not as
fine-grained as in speech.

(2) Due to the characteristics of energy radiation at mouth and nose, a nasal air stream
with the mouth closed produces the weakest signal, which functions as subdued
laughing, as in example 7, and in example 5, where it subsequently turns into less
restrained laughter on a central vowel resonance. The wider the mouth opening the
greater is the radiation of acoustic energy, and this allows to grade a laugh on a
scale from restrained, with highish, to unrestrained, with lowish vowel resonance,
as in examples 2, 3a, and 5. Concomitantly, different vocal tract shapes from high
to low vowels change the energy distribution across the spectrum from higher to
lower sections. In view of the frequency code [Ohala, 1983, 1984], the additional
functional dimension from \textit{submissive} to \textit{dominant} is thus added. This is very
obvious in the comparison of speakers tra and mpi in l06.

(3) Laugh turns are syntagmatically structured by gradation of acoustic energy, f0 pat-
terns and timing, resulting in various rhythmical patterns. There are indications
that rhythmical patterns may be transferred from speech into laughing. If an effect
from speech to laughing, in addition to the opposite effect from laughing to speech
in speech-laughs, can be further substantiated this will have far-reaching theoreti-
cal consequences for the study of laughing in different languages. It will then fol-
low that different laughing patterns can be predicted for languages with very
different rhythmical structures, such as German or English, and French. The for-
mer would favour trochaic and dactylic patterns, the latter regular sequencing with
final strengthening or iambic patterns.

(4) Laugh turns also have a prosodic phrasal structure by the superposition of energy
and f0 structures that span the whole turn, and by terminating ingressive markers
and initiating voiceless markers.
The superposition of laughing onto speech results in breaking up syllables, as in examples 2 and 3a, by double-peaked pulses as in laughing of example 6.

Speech-smile is carried by raising f0 and spectrum, as in examples 3b and 4.

When laughing phenomena are part of reciprocal communicative speech acts in dialogue interchange they fulfill a bonding function, particularly when the participants know each other well, as was the case in the dialogues analysed in this paper.

Laughing may unite them in the joint execution of a task or in the joint verbal (critical or facetious) assessment of people and events outside the speakers’ context of situation. f061 is an example of the former, l06 one of the latter. Various degrees of expressiveness, ranging from speech smile via subdued laughing to unrestrained laughter, help to maintain these bonding functions. Unrestrained laughter is quite likely to accompany smart assessment of situations by verbal play, as in l06, whereas more subdued forms of laughing characterize the joint task bonding of f061. A lot more data are necessary to come to any valid generalization of function-dependent expressiveness in laughing, and, moreover, individual personality traits no doubt also play an important role. But this function–substance relationship should be kept in mind for future research into laughing.

Even though the database is very small it suggests that fine phonetic detail of laughing is highly structured in its link with dialogic interaction. Its fine-grained analysis in instances of communicative settings can provide insights into the acoustic make-up, including rhythmic factors, as well as into the pragmatics of laughing in interaction. But such an approach presupposes good channel separation of speakers in the data recording, to guarantee not only the correct auditory and acoustic analysis of each speaker’s laughing but also their mutual timing, for an insightful interpretation of the unfolding interaction in dialogue. A large number of laughs in mono-recorded telephone conversations, analysed in the Conversation Analysis framework, do not fulfill this prerequisite; this defeats the fine-detail perspective, limiting the conclusions to be drawn.

The auditory, acoustico-graphic and functional approach advocated here needs to be extended to a broad database of spontaneous speech from various scenarios, followed by a statistical analysis of the acoustic patterns found in the data sets. The investigation will also have to consider to what extent the phenomena are determined by the language and by the individual speaker. And finally, we need to develop a methodology of data acquisition that allows us to collect data in natural communicative settings for reciprocal interaction (laughter function 3) rather than in situations of external laughter stimulation (laughter functions 1 and 2).

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References

Chafe, W.: The importance of not being earnest. The feeling behind laughter and humor (Benjamins, Amsterdam 2007).
http://www.ipds.uni-kiel.de/pub_exx/bp2001_1/Linda21.html