

Laughter in Child-Robot Communication

Workshop on Laughter etc., Berlin, 2009



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Overview



- database, phenomena and annotations
- phonetics of laughter
- laughter and syntax
- (communicative) function of laughter
- automatic classification
- a taxonomy fragment
- summary

IT's fun but — there was some work to do: the database



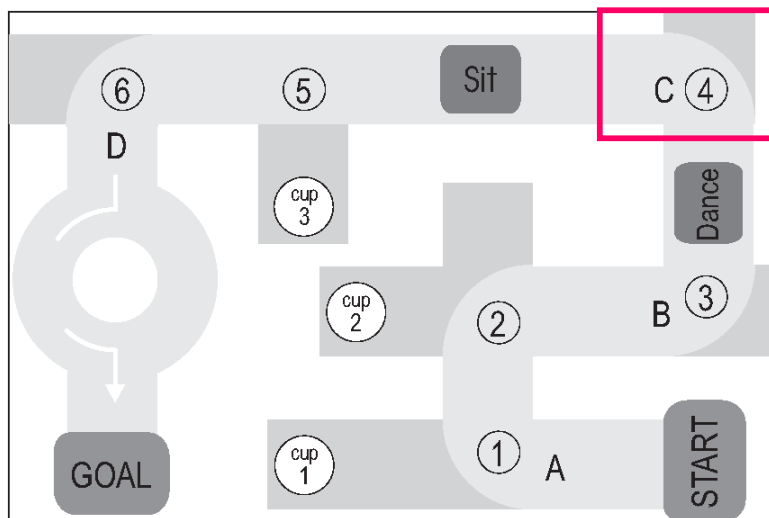
- German children interacting with a pet robot (AIBO), emotion-related states elicited in a WoZ scenario, AIBO controlled over WLAN
- task: directing through "parcours", AIBO behaves disobediently; ~ 40 min per child
- 51 children (10-13 years old, 21 m , 30 f), 2 schools
- 8.9 hours of speech, 48.401 words

Map of the Parcours task



numbers 1-6: crossings;
 A-D: AIBO behaves disobediently
 Dance and Sit: tasks to fulfil;
 goals: cups 1-3 and GOAL

the child wants AIBO to follow his/her commands, in fact, AIBO follows its own script, i.e., the child reacts to AIBO's actions



A. Batliner

POSITION: START

AIBO addresses child : gesture ``Hi''

CHILD: tells AIBO what to do

+ co-operative: gets up

+ co-operative: goes forward

....

POSITION C, 4th crossing

- co-operative: stops

- co-operative: lays down

+ co-operative: stands up

- co-operative: lays down

+ co-operative: stands up

- co-operative: lays down

+ co-operative: stands up

+ co-operative: turns left

AIBO addresses child: turns head towards child

+ co-operative: goes forward

Annotations



- transliteration incl. non-verbals
- emotional user states, word-based
- prosodic peculiarities, word-based
- manual corrections: segmentation, pitch
- syntactic chunking
- ...

Prosodic Peculiarities, Word-based



- very long pauses (child waits for AIBO to fulfil a command): [PAUSE_LONG]
- unusual pauses between phrases: [PAUSE_WORD]
- pauses within a word, between syllables: [PAUSE_SYLL]
- lengthening of syllables: [LENGTH_SYLL]
- insertion of syllables, for instance /stop/ ['StO: |hOp]: [INS_SYLL]
- marked emphasis: [EMPHASIS]
- shouting: [SHOUTING]
- shift of accent position, for instance /Aibo/ [aI |'bo:]: [ACC_SHIFT]
- very clear articulation: [CLEAR_ART]
- ➔ ■ laughter: [LAUGHTER] *
- vocative (only for the word *Aibo*): [VOCATIVE]

Emotional User States, Word-based, 5 Labellers (Majority Voting)



- joyful (101)
- surprised (0)
- motherese (1260)
- neutral (default: 39169)
- rest (non-neutral, not belonging to other categories: 3)
- bored (11)
- helpless, hesitant (3)
- emphatic (2528)
- touchy (=irritated: 225)
- angry (84)
- reprimanding (310)

Annotation of Non-Verbals



hesitation (vocal, nasal)	<"A">	20	1.1 %
hesitation (vocal)	<"a">	35	2.0%
hesitation (nasal)	<m>	23	1.3 %
noise	<#>	809	46.2 %
breathing	<A>	570	32.5 %
human noise	<G>	151	8.6 %
cough	<H>	32	1.8 %
→ laughter *	<L>	110	6.3 %
Σ		1749	100.0 %

* re-annotated

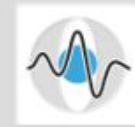
Laughter and Speech Laughter *






- 102 turns with 110 laughters <L>: **L**
- 94 speech laughters [LAUGHTER] in 59 turns (0.2 % of all words): **SL**
- in 22 turns, both L and SL

* note: preliminary figures, to be checked

Examples



- **Mont_10_041** da hin **p3** los **s1** lauf **s3** *aufstehen*
<L> 
- **Ohm_19_074** <L> *der *is witzig* 
- **Ohm_18_256** <G> lauf auf dem Teppich **v1** Aibo **v2**
*n bisschen nach links drehen <L> **v1** Aibo **v2** keine
Fax'n machen hier <L> 
- s_n : clause, p_n : free phrase, d_n : dislocation, v_n :
vocative, ...

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The Phonetics of Laughters



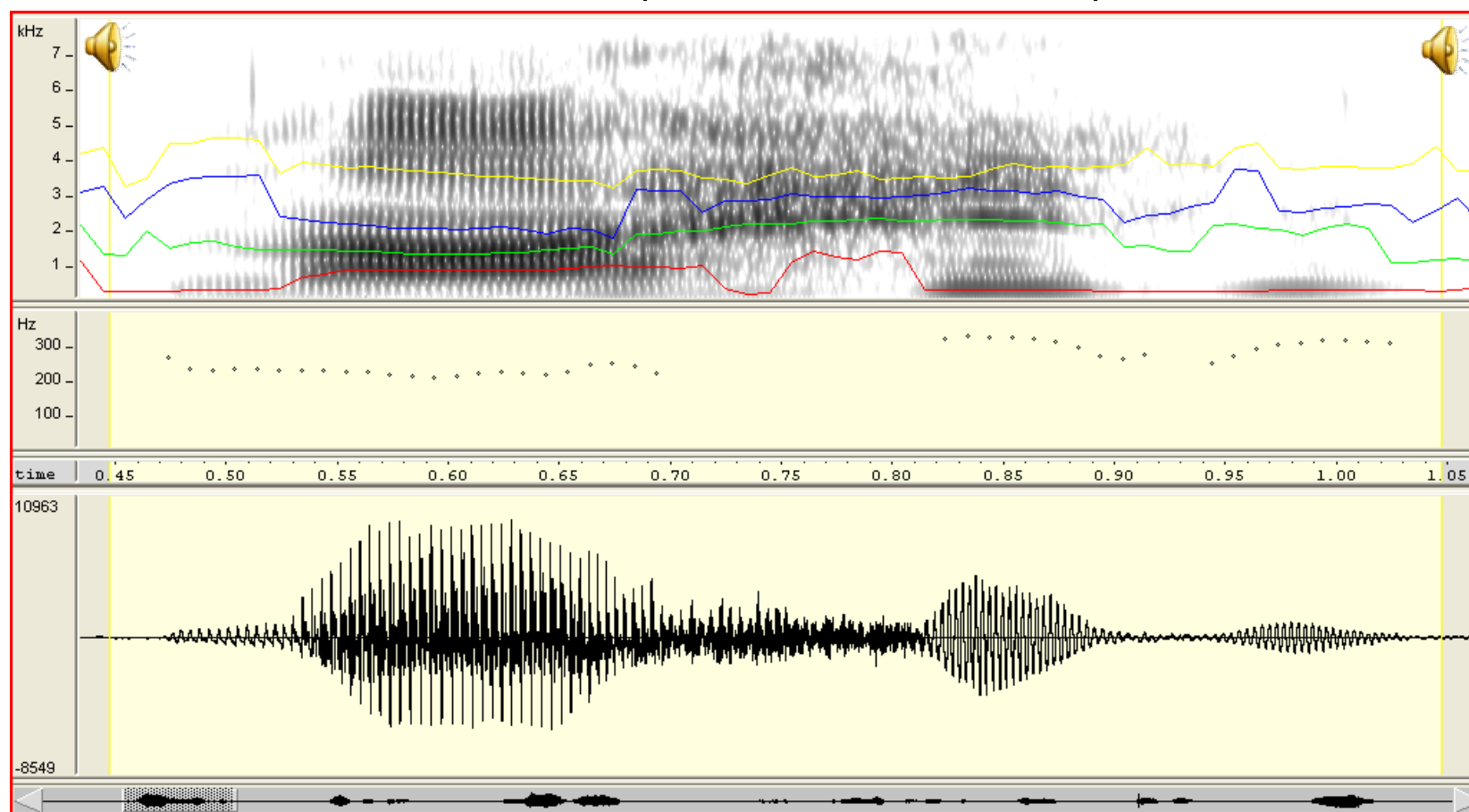
- Speech Laughter SL
 - tremolo with 2- n pulses/cycles
 - more or less breathy

- laughter L: *[h@]*
 - laryngealizations between pulses, or
 - voiceless expiration, or
 - ingressive, in a few cases

An Example



n a: | h l | ? n



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Examples for Syntactic Position



- **Ohm_14_217** <L> <A> <L> war ja klar **s2** dass er sich *gleich wieder hinsetzt* 📢
- **Mont_06_075** *steh* auf **v1** Aibo 📢
- **Mont_13_003** und was passiert **s2** wenn er in die giftige *Sch"ussel geht* **d2** zur giftigen Sch"ussel geht 📢
- s_n : clause, p_n : free phrase, d_n : dislocation, v_n : vocative, ...

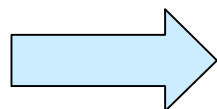
Syntactic Positions of Laughter in Percent



%	-	-	-	# words in sequ.	# word-sequ. *
L	28	5	68		
SL	13	2	24	61	
SL	21	3	38		38

* 2.6 words per SL-sequence on average, all SL-sequences adjacent to -|

laughter positions:



- few in chunk onset,
- almost none in chunk nucleus
- most in chunk offset or co-extensive with whole chunk

Overview

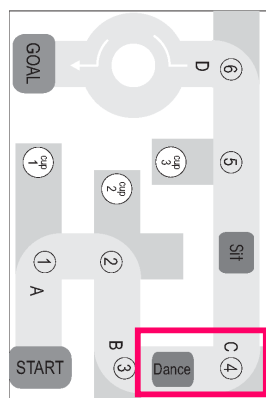


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AIBO Disobedient at Position C: from **Motheresing** to *reprimanding*/**Angry**



g'radeaus Aibolein ja **M** fein **M** gut **M**
 machst **M** du **M** *da **M** | *tz l'aufst du
 mal bitte nach links | stopp **E** Aibo
 stopp | nach links **E** umdrehen | nein **M**
 <*ne> nein **M** <*ne> nein **M** <*ne> so
M weit **M** *simma **M** noch **M** nicht **M**
 aufstehen **M** Schlafm"utze **M** komm **M**
 hoch **M** | ja **M** so **M** ist **M** es **M** <*is>
 guter **M** Hund **M** lauf mal jetzt nach
 links | nach links Aibo | Aibolein **M**
 aufstehen **M** *son **M** sonst **M** werd' **M**
 ich **M** b"ose **M** hoch **E** | nach **A** links **A**
 | Aibo **A** nach **A** links **A** | Aibolein **A**
 ganz **A** b"oser **A** Hund **A** jetzt **A** stehst
A du **A** auf **A** | hoch **A** | dreh dich ein
 bisschen | ja **M** so ist es <*is> gut
 stopp Aibo stopp | *tz lauf g'radeaus |

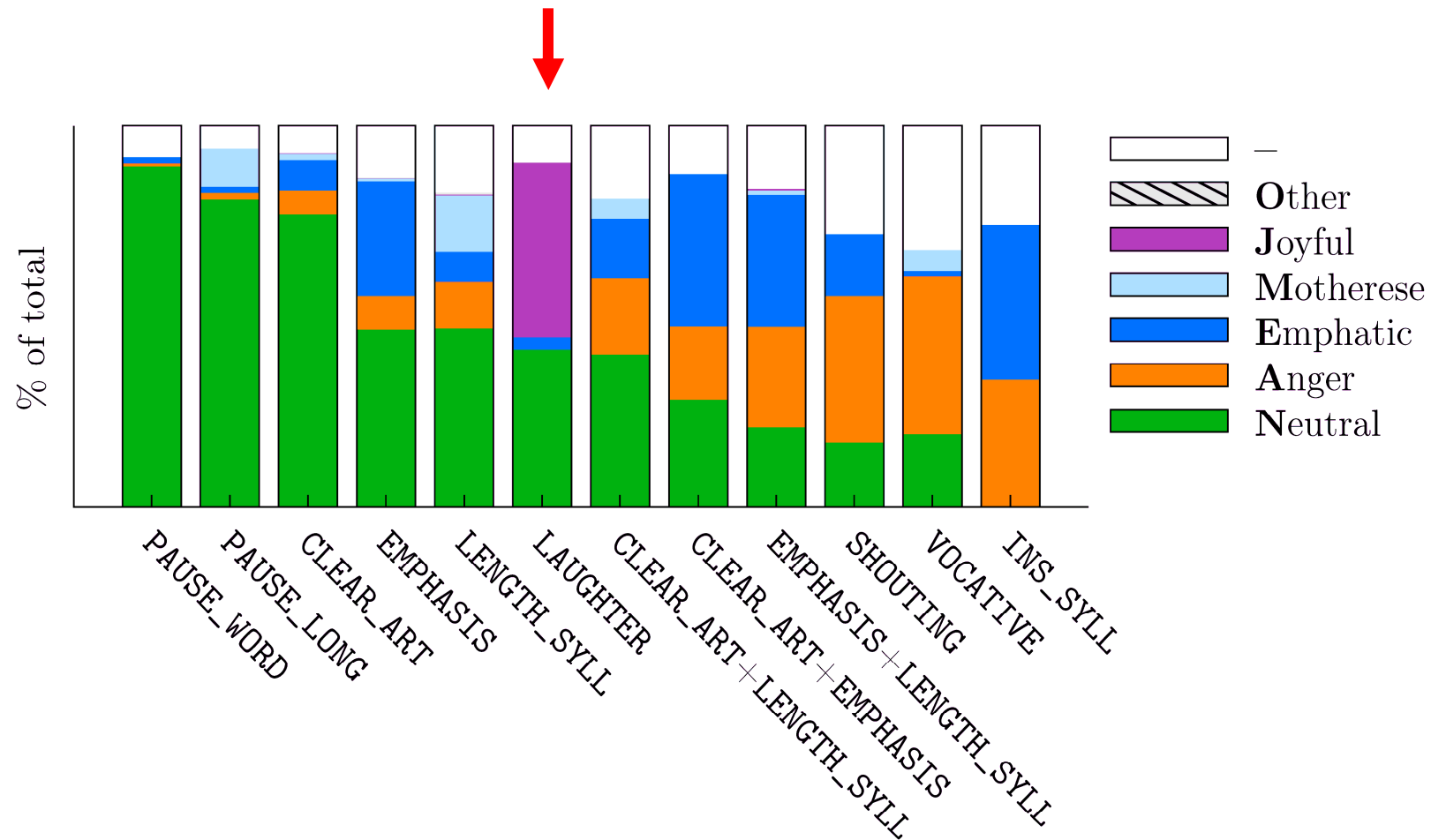


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conceptualization: pet dog



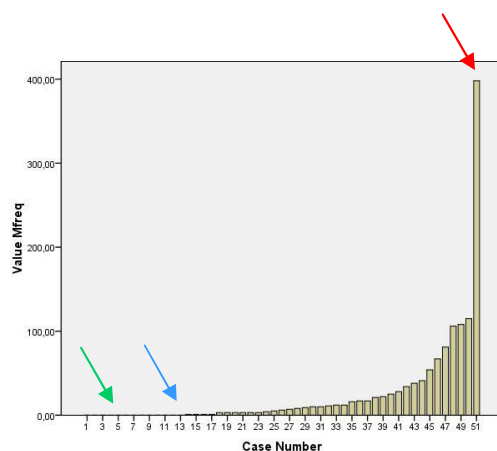
Prosodic Peculiarities vs. Emotional User States, Word-based: Frequencies in Percent of Total



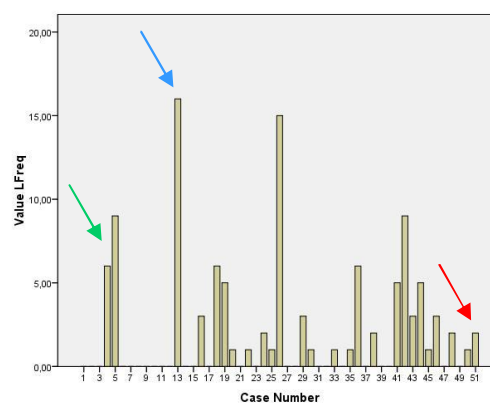
Motherese vs. {L, SL}



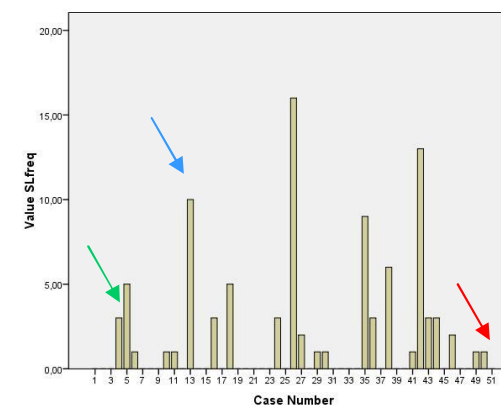
- Mann-Whitney test: no sign. diff. between m and f as for $\#\{\text{motherese, L, SL}\}$
- Spearman's r for correlation of $\#$ motherese with:
 - $\#$ laughter: .24
 - $\#$ speech laughter: .09



motherese



laughter *



speech laughter *

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Automatic Classification

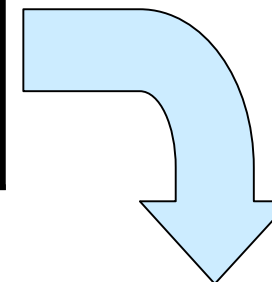


- large feature vector with 5,967 features
 - 39 low level feature contours: energy, pitch, HNR, MFCC, Spectral
 - many functionals (means, regression,)
- single vector for every word or word-like unit
- 94 words without SL selected from the corpus
- Support-Vector-Machines
 - linear kernel
 - SMO

Classification Performance



CL %	with FS	w/o FS
M/O	62.6	66.0
LOSO	64.1	72.0



% class. as	S	SL	L	#
S	51	40	9	53
SL	16	74	10	38
L	4	21	75	56

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A Tentative Taxonomy Fragment of Speech Laughter in Communications



- uncontrolled (bursts of laughter)
 - \pm [*equal, solidary, intimate*]
- "controlled" - sort of
 - symmetrical [*+ equal*], [*+ solidary*]
 - asymmetrical
 - submissive [*+inferior*], [\pm *solidary*], [*- intimate*]
 - caring (= *motherese*) [*+superior*], [*+solidary*], [*+ intimate*]
 - **amused** [*+superior*], [*0 solidary*], [*- intimate*]
- note: here, no "full-grown" interaction because
Aibo is "only" a "tin-box": Ohm_18_322 *Blech"uchse aufstehen*



Summary



- phonetics and syntactic position of laughter and speech laughter as expected/looked for
- confusion matrix for automatic classification as expected/hoped for
- most interesting is the relationship of interactional attitude and the (non-) occurrence of laughter



Thank you for your attention