



# Preliminary analysis of facial expressions and body movements of four types of laughter

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## Abstract

In the present work, we explored the facial expressions and body movements of different laughter types. 1806 laughter events were extracted from a multimodal dataset of three-party conversations, categorized into four types: mirthful, boosting, smoothing, and softening. The results showed that laughter performing different social functions is related to different visual expression patterns. Mirthful and boosting laughter showed a similar tendency that be accompanied by larger changes in facial expressions and body movements than smoothing and softening laughter, for example, higher cheeks raising, wider mouth open and apparent upper body frontward. We also attempted to analyze the dynamic changes occurring within a laughter event. Our findings provide hints for the design of human-like conversational agents.

**Index Terms:** laughter types, facial expression, body movement, spontaneous conversation

## 1. Introduction

Laughter is an important nonverbal behavior in human communication. It not only arises from humor and amusement, but also occurs in a wide range of social contexts [1, 2]. Given that different types of laughter contain diverse functions in specific situations, what kind of cues do humans use to recognize and discern them?

Some previous works have suggested that genuine mirthful laughter can be distinguished from voluntary polite laughter based on acoustic features, such as duration, vowel quality, and voice quality [3-5]. Moreover, research on laughter has also expanded to explore its multimodal expressions, particularly in the field of laughter synthesis in communicational agents. However, most of them focused on symbolic facial expressions, and may ignore the variations or dynamic features in smiling faces according to different types of laughter [6].

In this study, we used a face-to-face free-topic conversation dataset to investigate the relationship between different laughter types and their facial expressions and body motions.

## 2. Analysis data

### 2.1. Dataset

In this study, we used a three-party conversation dataset. It includes several sets of free-topic conversations (such as family, recent work and past experiences), each lasting 15 to 20 minutes. The participants were colleagues from the same workplace and all of them were Japanese speakers. Headset microphones and cameras were set up for each speaker, so that multimodal data including audio, visual, and motion data were collected. For the present analysis, 1806 laughter events were extracted from a

total of approximately 12 hours of conversation data by four male and four female speakers. The annotation of laughter was conducted at the bout level, according to the definition of laughter bout in [7, 8].

### 2.2. Four types of laughter

Referring to several previous works on classifying laughter functions [9-11], we categorized laughter into four main types based on its function in the conversation: (1) Mirthful laughter is characterized by a sense of delight or pleasure in response to something funny, amusing, or enjoyable, which is typically spontaneous. (2) Boosting laughter is prompted by a desire or conscious effort to create a positive atmosphere, such as making jokes or self-mockery. (3) Smoothing laughter serves to facilitate social interactions and maintain human relationships, often occurring in situations that are not necessarily humorous, such as showing comprehension, expressing interest or simply acting as a backchannel. (4) Softening laughter is used to reduce awkwardness or intrusion, for example, making negative comments or sharing different opinions from other speakers, and to signal that the speaker does not intend harm or offense.

The laughter function was annotated by three research assistants, all Japanese native speakers, based on audio and video of the laughter events with 5-second pre- and 6-second post-context. The post-context is set to be longer than the pre-context to account for body movements after a laughter bout.

Decisions were made by the majority vote of three annotators. 470 cases of perfect agreement (26%), 953 cases of agreement between two annotators (53%), and 383 cases of complete disagreement (21%) were obtained. The four predominant laughter types (mirthful, boosting, smoothing and softening) account for 40%, 12%, 9%, and 8%, respectively. Other laughter types, for example, self-conscious laughter, dumbfounded laughter, and bitter laughter were also observed. As for the few appearances, they were not used in the analysis.

### 2.3. Annotation of multimodal expression

The label sets used to annotate the visual features are shown as follows. The degree of movement was also taken into consideration, for example, 3 levels of cheeks raising (3 levels: 0: not; 1: slightly; 2: clearly) (Fig. 1), 2 levels for mouth open, and 3 levels for body frontward. The label "other" in the facial expressions includes motions difficult to identify due to other modalities like head downward or hands covering the face.

- *Cheeks:* not raised, raised1, raised2, other
- *Eyes:* closed, narrowed, normal, open, other
- *Mouth:* closed, open1, open2, other
- *Upper body:* front1, front2, front3, back, left/right, turn back, shoulders tremble, shoulders move, other, no motion
- *Head:* up, down, front, tilt, other, no motion

The annotation was conducted by the first author and three research assistants. They were instructed to choose the most predominant expressions for each modality within a laughter event, and the perceived degree. If there are clear changes in the expression, multiple labels are allowed. The agreement of 4 annotators was measured by Cronbach’s alpha of the motion degrees for cheeks, lip corners, eyes, mouth and Fleiss’ kappa for the label categories in upper body and head, with 400 samples (25 samples per each of the 8 speakers) annotated by all four annotators. The values were 0.75, 0.51, 0.82, 0.68, 0.59, and 0.53, respectively.

### 3. Results

#### 3.1. Analysis of facial expressions

Fig. 2 shows the distributions of the facial expressions (cheeks, eyes and mouth) according to the different laughter types. Chi-squared tests were conducted to verify if the occurrence rates of specific labels are significantly higher ( $\blacktriangle p < 0.05$ ,  $\blacktriangle\blacktriangle p < 0.01$ ) or lower ( $\nabla p < 0.05$ ,  $\nabla\nabla p < 0.01$ ) among the four types of laughter. The meanings of symbols are the same in Figure 3.

From the results of cheek movements, it can be observed that over 90% of laughter involved cheek raising in all four types. However, mirthful laughter and boosting included a higher occurrence of level 2 raising, which was significantly higher than the proportions of the other two laughter types. Conversely, level 1 raising in smoothing laughter and softening laughter were both over 70%. Besides, we also observed minor cases of raising degree increasing from level 1 to level 2 (“raised 1+2”) within a laughter event in all laughter types.

Regarding eye motions, around 80% of laughter involved eye narrowing in all four types. The rate of normal eye openness was higher in smoothing laughter and lower in mirthful laughter, while the occurrence of eyes closed was more often in mirthful laughter. Additionally, changes in the degree of eye openness (“smaller” and “bigger”) during laughter events were also observed. In mirthful and boosting laughter, further eye narrowing (“smaller”) was slightly more common. This dynamic change may be influenced by the degree of mirth or the intention to liven up the atmosphere.

Although eye narrowing is associated with cheek raising, the proportion of normal eyes open is higher than cheeks not raised in boosting, smoothing, and softening laughter. In other words, cheeks raising is not necessarily accompanied by eyes narrowing. Moreover, we examined whether the crow’s feet (wrinkles around the eye corners) appeared in the smiling face. As a result, 66% of mirthful laughter, 70% of boosting laughter and only 34% of both smoothing and softening laughter were observed. The results indicate that eye behaviors may be the cue to distinguish involuntary laughter from voluntary ones.

Regarding mouth opening, over 90% of laughter was accompanied by mouth opening. However, mirthful and boosting laughter tend to involve wider open compared to smoothing and softening laughter. Conversely, despite the lower rates, keeping the mouth closed occurred more often in smoothing and softening laughter.

#### 3.2. Analysis of body movements

Fig. 3 shows the distributions of the body movements (upper body and head motions) according to the different laughter types. Overall, in around half of the cases of smoothing and softening laughter, the upper body remains relatively still

(“no motion”). However, mirthful and boosting laughter involved more upper body movement than smoothing and softening laughter, particularly evident in large upper body forward (“front2” and “front3”), returning to the normal position (“turn back”) and shoulders trembling.

Furthermore, two types of shoulder movements were observed in our data: rapid rhythmic trembling (“shoulders tremble”) and single movement (“shoulders move”), both assumed to be influenced by vocalization. Rhythmic trembling movements were relatively more common in mirthful and boosting laughter, while single movements were more common in softening laughter. We also observed individual differences in shoulder movements. Two participants exhibited shoulder movements in approximately half of their laughter events, while the other two participants only displayed shoulder movements was less than 10% of cases.

Regarding head motions, as they are easy to be affected by the motion of upper body, only those not synchronized with upper body motions were annotated as head motions. While approximately 80% of laughter showed no head movement, mirthful laughter showed a significantly higher proportion of downward and frontward head movements compared to the other three types.

### 4. Conclusions

In this work, we analyzed facial expressions and body movements for four types of laughter. A general distinction was found between laughter with positive emotions and attitudes (mirthful and boosting) and laughter serves to facilitate interaction, relieve tension, and establish social harmony (smoothing and softening). The former two types tend to be accompanied by larger changes in smiling faces and upper body movements, which indicates that the degree of emotional arousal may affect the behavior of visual expressions. However, mirthful laughter and boosting laughter can still be distinguished by the distribution of head motions.

On the other hand, the patterns of smoothing laughter and softening laughter were very similar and hard to be distinguished only by facial expressions and body movements. Some works show the possibility of laughter with different pragmatic functions containing different gaze patterns [12, 13]. In order to improve the distinction of different laughter types, our next step is to explore the relation between laughter types and gaze behavior, as well as the audio features and contextual information.

The results in the present work show potential for a deeper understanding of the nuances of laughter and its role in communication, which can also be applied to the synthesis of natural and expressive laughter.

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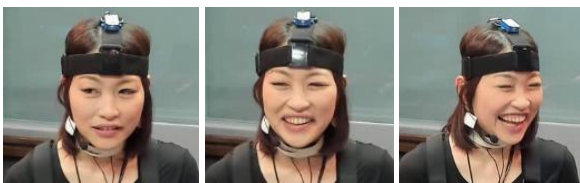


Figure 1: Examples of 3 levels of cheeks raising. From left to right: not raised, slightly raised, clearly raised.

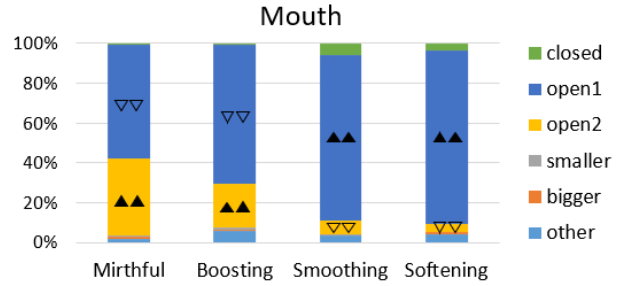
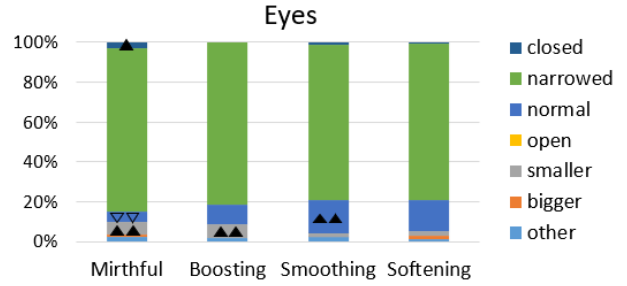
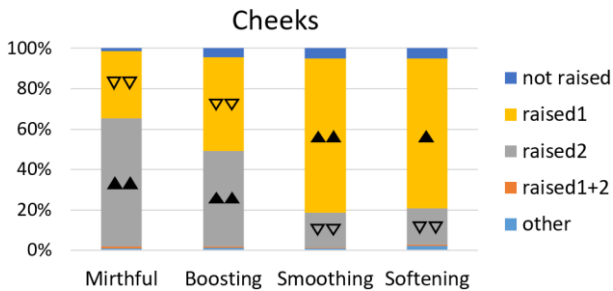


Figure 2: Distributions of lip corners, eyes and mouth motion categories for four laughter types. The symbols within the bars mean significantly higher ( $\blacktriangle p < 0.05$ ,  $\blacktriangle\blacktriangle p < 0.01$ ), or lower occurrences ( $\nabla p < 0.05$ ,  $\nabla\nabla p < 0.01$ ), after chi-squared tests.

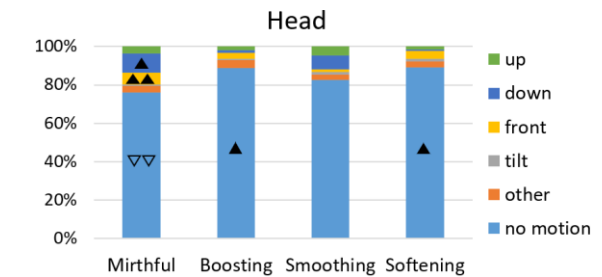
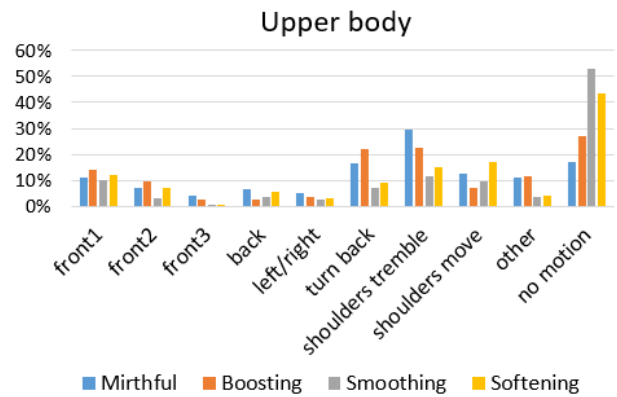


Figure 3: Distributions of upper body and head motion categories for four laughter types.