Emotions and articulatory precision

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Abstract
The influence of emotion on articulatory precision was investigated in a newly established corpus of acted emotional utterances. The area of the vocalic triangle between the vowels /i/, /u/, and /a/ was measured and shown to be significantly affected by emotion. Furthermore, this area correlated significantly with the potency dimension of a large scale study of emotion words, reflecting the predictions of the component process model of emotion.

Index Terms: Articulation, formants, emotion, vowels

1. Introduction

The area of vocalic triangle between the vowels /i/, /u/, and /a/ has primarily been studied with respect to infant directed speech and differences in vowel inventories between languages[1,2]. Here we investigate the influence of emotion on the size of the vocalic triangle. The component process model [3] predicts several effects of the different appraisal checks on the position of formants. Primarily checks related to pleasantness and coping potential are hypothesized to influence articulation. Here we investigated the effect of emotional speech on articulatory precision as measured by the size of the vocalic triangle.

2. Method

2.1. Corpus

A subset of the Geneva Multimodal Emotion Portrayals [4] was used to investigate the effect of emotion on vocalic area. The subset consisted of 12 emotions expressed by ten actors (five males) in two nonsense utterances: [ne kali barn sud molën] and [kun se mìna lud belam]. Table 1 shows the emotions and the valence times arousal distribution used.

<table>
<thead>
<tr>
<th>Positive valence</th>
<th>Negative valence</th>
</tr>
</thead>
<tbody>
<tr>
<td>elation (joy)</td>
<td>hot anger/rage (ang)</td>
</tr>
<tr>
<td>amusement (amu)</td>
<td>panic fear (fear)</td>
</tr>
<tr>
<td>pride (pri)</td>
<td>despar (des)</td>
</tr>
<tr>
<td>pleasure (ple)</td>
<td>cold anger/irritation (irrit)</td>
</tr>
<tr>
<td>relief (rel)</td>
<td>anxiety/worry (anxiety)</td>
</tr>
<tr>
<td>interest (int)</td>
<td>sadness/depression (sad)</td>
</tr>
</tbody>
</table>

2.2. Portrayal selection

Several utterances were recorded for each actor. A rating study on 1260 portrayals was conducted to select the best expressions of each emotion. Criteria for inclusion in the present corpus depended on recognition accuracy and the believability of the portrayal. Because raters could select more than one emotion per portrayal, we calculated a recognition-index that reflected recognition accuracy for the target emotion and for the second highest category. The total amount of ratings into account. For each emotion, one portrayal by each actor was included (totaling 120 portrayals).

2.3. Segmentation and area calculation

All portrayals were manually segmented at the phoneme level by a linguist collaborating with the authors on the annotation of the corpus. After segmentation, formants were extracted for the vowels /a/, /i/, and /u/ using PRAAT speech analysis software with standard settings. Erroneous formant estimations, notably confusing F3 for /u/ with F3, were removed from the corpus and replaced with the mean.

3. Results and Discussion

Figure 1 displays the vocalic area for all twelve emotions. An ANOVA with vocalic area as dependent, emotion as within and speaker as between subject variable, showed a significant effect of emotion on area size (F [11, 98] = 2.42, p < 0.01).

![Vocalic triangle area per emotion.](image)

Space limitations prohibit testing detailed predictions of [3]. Instead, the correlation of the vocalic area with the four (semantic) dimensions of emotion found in a large scale study of emotion words in multiple languages [5]: arousal, valence, potency and unpredictability was calculated. Only the potency dimension correlated significantly with vocalic triangle area (γ = -0.7, p < 0.05). Emotions with positive factor score on potency (like anger and interest), have larger vocalic areas than those with low potency scores (like fear). This result concerns with the predictions of the component process model: coping potential are most related to formant placement and articulatory precision. Future work will address the specific predictions of the CPM to vocalic area, precise formant locations and bandwidths in emotional speech.

4. Acknowledgements

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5. References