

The “Magdeburger Prosodie-Korpus”

Beate Wendt & Henning Scheich

Leibniz-Institute for Neurobiology
Brenneckestr. 6, 39118 Magdeburg, Germany
wendt@ifn-magdeburg.de

Abstract

Previous studies on prosody perception showed inconsistent results concerning the functional role of the hemispheres. One argument for this might be the stimulus material was not sufficiently evaluated. Thus, we developed a corpus which fulfils this requirement.

The "Magdeburger Prosodie-Korpus" which was specifically developed for the requirements of fMRI and MEG studies contains two parts. The first part consists of German nouns, the second part of pseudo-words, with both parts being spoken with different emotional prosodies by an actor and an actress. All nouns were evaluated with respect to the emotional connotation (positive, negative, neutral) of their semantic content. The results showed that only a small number of nouns received the same emotional assessment from the participants. The different emotional prosodies of the pseudo-words were assessed by a group of expert (phonetician) and non-expert listeners who are all native German speakers. All emotional prosodies (happiness, sadness, fear, anger, disgust, and neutral), spoken by the man and the woman, were identified by more than 70% of all listeners, except for sadness of the man. There were no significant differences with respect to the gender of the listeners or the speakers.

The acoustic analysis showed differences in specific acoustic features of the various emotional prosodies, for example, pitch contour, duration, stress, and intensity. The results were added to the database of the "Magdeburger Prosodie-Korpus".

1. Introduction

In clinical investigations, disturbances were described with prosody processing primarily after right hemisphere lesions. Based on these investigations, different theories regarding the laterality of prosody processing are discussed:

- Prosody processing takes place in right hemisphere regions which on the left side are responsible for language processing. (Ross and Mesulam 1979; Heilman et al. 1975; Tucker et al. 1977; Ross et al. 1997)
- Emotional aspects of prosody the right hemisphere whereas linguistic aspects of prosody are processed on the left side (Behrens 1985)
- Pitch differences are processed primarily in the right hemisphere, durational parameters however on the left side (Van Lancer, Sides 1992).
- Negative emotions are processed in the right hemisphere, positive emotions however on the left (Davidson 1992)
- Deficits in the processing of spectral and temporal acoustic information are responsible for the disturbed perception of prosody (Cooper 1981)
- The fundamental frequency is processed in the right hemisphere and integrated with semantic and syntactic

information from the left hemisphere via the corpus callosum. It is assumed that the acoustic parameter duration is processed in the left hemisphere. (Clouda et al. 1988)

Non-uniform results were found regarding the functional role of the hemispheres in prosody processing .

Different reasons were stated as the cause for the various findings regarding patients with unilateral brain damage. Many clinical studies aim at selecting patients with unilateral brain damage regardless of the specific location of the damage.

Cognitive deficits represent a general problem for the investigation of patients with brain damage, which can occur in addition to prosodic deficits. Often, it is unclear whether the patients' deficit itself is responsible for bad results in prosody tests (Tompkins and Flowers 1985).

Inconsistent results can lead to methodological differences between the studies. Often, the prosodic stimulus material is not sufficiently validated (Myers 1999), so that the desired emotion can not be detected even by healthy control subjects (Tompkins 1991).

The use of language material is another important reason for the non-uniform findings. In most prosody studies, semantic and syntactic processing involves a stronger activation of the left hemisphere. This additional activation of the left hemisphere could possibly conceal a processing of prosodic features in the right hemisphere (Ackermann et al. 1993).

The use of such language material may explain the results of an fMRI study of processing prosodically intoned adjectives from Stiller et al. (1997). For the detection of the phoneme /a/ in the adjectives, the volunteers were split into two subgroups with similar right or left hemispheric lateralisation of activity. During detection of affective prosodies, lateralisation was maintained through the laterality index slightly changed .

For the reasons stated above, it is presently unclear whether the processing of prosody is a dominant function of one hemisphere or only a gradual difference in the effectiveness of the processing between the hemispheres. Therefore, different hypotheses exist for the prosody perception.

2. The evaluation of the “Magdeburger Prosodie-Korpus”

Investigations of language perception with healthy and non-healthy persons were executed predominantly based on written language. These investigations can be completed by a spoken language corpus allowing the perception of spoken language as well as prosody. Beyond that, standardised stimulus material is a substantial factor for validating fMRI-studies on prosody processing imaging.

2.1. Structure of the spoken language corpus

The new "Magdeburger Prosodie-Korpus" which was specifically developed for the requirements of fMRI and MEG studies contains two parts. The first part consists of German nouns, the second part of pseudo-words.

When using pseudo-words as stimuli, the semantic meaning is missing and the prosody thus becomes a central storage medium (Stock, 1993). By using nouns and pseudo-words it is among other things possible to determine to what extent aphasic patients are able to process this information.

Both parts are spoken by an actor and an actress.

2.1.1. nouns

- two-syllable, a master morpheme, nominative singular. The nouns (over 3000) were spoken of a man and a woman (actor) in German standard pronunciation (according to the "Ausspracheduden" or the "Großes Wörterbuch der deutschen Aussprache"). At present, the digitised recordings are linked to a data base. The database contains, among other things, the following description features: word accentuation, word length/ speech rate, abstraction/concreteness, categorisations, phonetic minimal pairs.

2.1.2. pseudo-words

- in an educated manner from sound permutations in the two-syllable nouns. They are phonetically balanced and correspond to the phonotactic and phonetic rules of the German language. The 200 pseudo-words selected as representative sample from the corpus are spoken by the two professional speakers (man and woman) with 6 different emotional prosodies (happiness, sadness, fear, anger, disgust, and neutral). Similarly to the corpus of the nouns, these recordings in digitised form are also linked with a database.

This database contains, among other things, the following description features: word accentuation, word length/ speech rate, emotional prosodic quality.

2.2. Evaluation of nouns

All nouns were evaluated with respect to the emotional connotation (positive, negative, neutral) of their semantic content.

For the classification of the semantically emotional content of the nouns, this corpus was evaluated with the help of a questionnaire. For the evaluation, a rough division (positive - neutral - negative) was selected.

In each case 18 men and women were questioned. The average age of the persons was 29 years at the time of questioning (from 19 to 52 years).

The results showed that only a small number of nouns received the same emotional assessment from the participants. In relation to the number of given nouns (over 3000), there is only rarely a complete agreement of all persons.

Table 1: Examples of the emotional semantic allocation of the nouns with highest priority of the evaluation [number of voices of 36]

<u>positive:</u>	Hoffnung / hope [34]
	Freundschaft/ friendship [34]
	Genuß / treat [33]
	Rettung / rescue [33]
	Chance / chance [32]
	Märchen / fairytale [32]

<u>neutral:</u>	Bereich / area [36]
	Becher / cup [34]
	Leitung / administration or main [34]
	Zeile / line [34]
	Henkel / handle [33]
	Ablauf / order [31]
<u>negative:</u>	Herpes / herpes [36]
	Folter / torture [36]
	Faschist / fascist [35]
	Schande / disgrace [35]
	Tumor / tumour [35]
	Satan / devil [34]

2.3. Evaluation of pseudo-words

The different emotional prosodies of the pseudo-words were assessed by a group of expert (phonetician) and non-expert listeners who are all native German speakers.

To validate the corpus, an untrained group of listeners was asked for the suitability of the emotional prosodic expressions of the pseudo-words. With the help of a questionnaire, 73 listeners (aged 24 to 56 years) were asked to evaluate the spoken stimuli according to the emotion the speakers expressed in each case in their point of view. In addition, 180 pseudo-words selected in randomised order from the corpus were presented. The acoustic presentation took place in two sections of 10 minutes with a five minutes break.

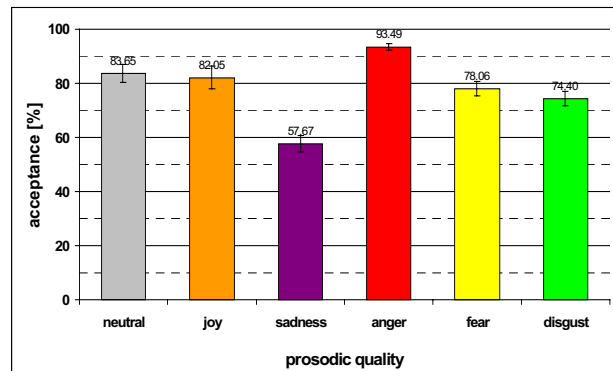


Figure 1: Shows the acceptance of all emotional prosodies of the untrained group.

All emotional prosodies (happiness, fear, anger, disgust, and neutral) were identified by more than 70% of all listeners. Only the sadness prosody identification was somewhat fewer (57%).

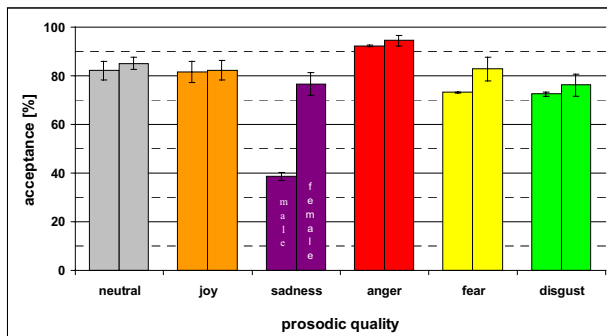
There were no significant differences with respect to the gender of the listeners or the speakers.

Table 2 shows the results of two similar studies (taken from Banse and Scherer 1996).

Table 2: Comparison of accuracy percentages for individual emotions in two empirical studies.

Study	Fear	Disgust	Joy	Sadness	Anger
van Bezooijen (1984)	58	49	72	67	74
Scherer et al. (1991)	52	29	59	72	68

Figure 2: Shows the acceptance for both speakers (male/female voice) from all listeners.



The sadness expressed by the man was not accepted by the group of listeners and had to be repeated. The sad prosody of the man was spoken again and must still be evaluated. The listeners accepted all other prosodies from both speakers.

3. Discussion and Conclusion

During the creation of the speech-corpus, different aspects were considered, regarding measuring method and measuring design (e.g. fMRI, MEG). Recordings and questioning were executed in standardised form, so that we are able to describe and classify our language material exactly. As a consequence, we have now built stimulus files for a number of specific measurement tasks.

The validated questionnaire allows us to interpret the results of the imaging techniques by additionally questioning each individual.

Studies of the perception of prosodies with linguistically meaningful (words) and meaningless (pseudo-words) material on healthy persons are executed. These studies serve as a basis for the expansion of the questions on clinical groups of patients with aphasia and schizophrenia.

4. Acknowledgement

This study was supported by the Deutsche Forschungsgemeinschaft (SFB 426).

5. References

- [1] Banse, R. and K. R. Scherer 1996. Acoustic profiles in vocal emotion expression. *J Pers Soc Psychol* 70(3): 614-36.
- [2] Behrens, S. J. 1985. The perception of stress and lateralization of prosody. *Brain Lang* 26(2): 332-48.
- [3] Cooper, W. E. 1981. The analytic/holistic distinction applied to the speech of patients with hemispheric brain damage. *The Behavioral and Brain Sciences* 4: 68-69.
- [4] Davidson, R. J. 1992. Anterior cerebral asymmetry and the nature of emotion. *Brain Cogn* 20(1): 125-51.
- [5] Heilman, K. M., R. Scholes, et al. 1975. Auditory affective agnosia. Disturbed comprehension of affective speech. *J Neurol Neurosurg Psychiatry* 38(1): 69-72.
- [6] Klouda, G. V., D. A. Robin, et al. 1988. The role of callosal connections in speech prosody. *Brain Lang.* 35: 154-171.

- [7] Myers, P. S. 1999. Prosodic deficits. Right hemisphere damage. *Disorders of communication and cognition*. P. S. Myers. San Diego, Singular Publishing Group: 73-90.
- [8] Ross, E. D. and M. M. Mesulam 1979. Dominant language functions of the right hemisphere? Prosody and emotional gesturing. *Archives of Neurology* 36: 144-148.
- [9] Ross, E.D., R.D. Thompson, et al. 1997. Lateralization of affective prosody in brain and the callosal integration of hemispheric language functions. *Brain and Language* 56: 27-54.
- [10] Stiller, D., B. Gaschler-Markefski, et al. 1997. Lateralized processing of speech prosodies in the temporal cortex: a 3-T functional magnetic resonance imaging study. *MAGMA* 5: 275-284.
- [11] Stock, E. 1991. Emotionserkennung und Stimme. *Sprache und Sprechen*. Bd. 25, Kutter, U. and R. W. Wagner. Frankfurt/M.: 173-182.
- [12] Tompkins, C. A. 1991. Automatic and effortful processing of emotional intonation after right or left hemisphere brain damage. *J Speech Hear Res* 34(4): 820-30.
- [13] Tompkins, C. A. and C. R. Flowers 1985. Perception of emotional intonation by brain-damaged adults: the influence of task processing levels. *J Speech Hear Res* 28(4): 527-38.
- [14] Tucker, D. M., R. T. Watson, et al. 1977. Discrimination and evocation of affectively intoned speech in patients with right parietal disease. *Neurology* 27: 947-950.
- [15] Van Lancker, D. and J. J. Sidtis 1992. The identification of affective-prosodic stimuli by left- and right-hemisphere-damaged subjects: All errors are not created equal. *J. Speech Hear. Res.* 35: 963-970