Brain and Language **75,** 390–398 (2000)
doi:10.1006/brln.2000.2362, available online at http://www.idealibrary.com on IDEAL®

# An Aphasia Database on the Internet: A Model for Computer-Assisted Analysis in Aphasiology

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A web-based software model was developed as an example for data mining in aphasiology. It is used for educating medical and engineering students. It is based upon a database of 254 aphasic patients which contains the diagnosis of the aphasia type, profiles of an aphasia test battery (Aachen Aphasia Test), and some further clinical information. In addition, the cerebral lesion profiles of 147 of these cases were standardized by transferring the coordinates of the lesions to a 3D reference brain based upon the ACPC coordinate system. Two artificial neural networks were used to perform a classfication of the aphasia type. First, a coarse classification was achieved by using an assessment of spontaneous speech of the patient which produced correct results in 87% of the test cases. Data analysis tools were used to select four features of the 30 available test features to yield a more accurate diagnosis. This classifier produced correct results in 92% of the test cases. The neural network approach is similar to grouping performed in group studies, while the nearest-neighbor method shows a design more similar to case studies. It finds the neurolinguistic and the lesion data of patients whose AAT profiles are most similar to the user's input. This way lesion profiles can be compared to each other interindividually. The Aphasia Diagnoser is available on the Web address http://fuzzy.iau.dtu.dk/aphasia.nsf and thus should facilitate a discussion about the reliability and possibilities of data-mining techniques in aphasiology.
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*Key Words:* aphasia classification; artificial neural networks; nearest neighbor; Internet.

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This work was supported by ERUDIT, a European network in uncertainty techniques developments for use in information technology, supported by the European Commission. The aphasia project is a collaboration between ERUDIT's Training and Education Committee and ERUDIT's Human, Medical and Healthcare Committee (http://www.erudit.de/erudit/committees/).

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0093-934X/00 $35.00
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## INTRODUCTION

The increasing amount of data in many medical environments requires efficient computer-assisted analysis. In the past few years much research has focused on the discovery of information hidden in large collections of medical data. Data mining (also called knowledge discovery in databases, KDD) is the extraction of regularities hidden in the data as well as the search for relationships and global patterns (Prather et al., 1997; Lavrac, 1999). It combines statistics, visualization, machine learning, and other techniques to analyze large medical databases (Borok, 1997; Lavrac, 1999; Zupan et al., 1999). Thus data mining is an increasingly popular interdisciplinary field (Zupan et al., 1999).

Therefore there will be increased demand for medical students and postgraduates to work with these tools in the future and to learn about data-mining techniques as well as for engineering students to be exposed to medical information analysis.

Classification of patients is a traditional approach in medicine. Making a diagnosis leads to a special therapy. Nevertheless, much of the available medical data is imprecise and incomplete. Our intention was to develop a tool for teaching medical students, postgraduates, and engineering students about data modeling and its medical applications. Therefore a database consisting of medical information about aphasic patients was used (Naujokat & von Keyserlingk, 1996; Naujokat et al., 1996). This aphasia database is a model for possible techniques of data mining in aphasiology, and it represents some inherent conflicts in the classification of aphasic syndromes.

## MATERIALS AND METHODS

### *Aphasia Database*

Data of 254 aphasic patients, treated in the Department of Neurology at the RWTH Aachen, were collected in a database since 1986 (Naujokat et al., 1996). This aphasia database comprises clinical diagnosis; classification of the aphasia type made by an expert; anamnestic data; neurological, neuropsychological, and linguistic status, as well as the lesion profiles of 147 patients examined by Computed Tomography (CT).

The aphasia test battery used here was the Aachen Aphasia Test (AAT), which is the commonly used test battery in German-speaking countries (Huber et al., 1983, 1984). The AAT is a standardized neuropsychological test battery and consists of six major subtests: spontaneous speech, token test, repetition, reading and writing, confrontation naming, and comprehension.

### *Standardization of 3D Cerebral Lesion Profiles*

The series of CT scans of 147 of the patients in this database were assessed as described earlier (von Keyserlingk et al., 1988, 1997; Niemann et al., 1988). The individual coordinates of the lesions were adjusted to a three-dimensional statistical computerized model of the human brain. This brain model was derived from 80 well-prepared intact cadaver brains. The borders of the lesions were digitally registered and the 3D coordinates of the individual lesions were transformed to the reference space using the anterior commissure and posterior commissure

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