Neurolinguistics
What is neurolinguistics?

Neurolinguistics studies the relation of language and communication to different aspects of brain function, i.e. it tries to explore how the brain understands and produces language and communication.

This involves attempting to combine theory from neurology/neurophysiology (how the brain is structured and how it functions) with linguistic theory (how language is structured and how it functions).
• "human language or communication (speech, hearing, reading, writing, or non-verbal modalities) related to any aspect of the brain or brain function" (Brain and Language: "Description")

• The common problem area of relating aspects of language or communication to brain function in this dynamic formulation, is stated as a common question by Luria in "Basic problems in neurolinguistics":

• "what are the real processes of formation of verbal communication and its comprehension, and what are the components of these processes and the conditions under which they take place"

• (Luria, 1976, p.3)
Interdisciplinary enterprise

- linguistics, neuroanatomy, neurology, neurophysiology, philosophy, psychology, psychiatry, speech pathology and computer science, neurobiology, anthropology, chemistry, cognitive science and artificial intelligence.
- Thus, the humanities, as well as medical, natural and social sciences, as well as technology are represented.
Different views on the relation between brain and language

- **Localism** tries to find locations or centers in the brain for different language functions. **Associationism** places language functions in the connections between different areas of the brain, making it possible to associate, for example, perceptions of different senses with words and/or “concepts”.

- **Dynamic localization of function** assumes that functional systems of localized sub-functions perform language functions. Such systems are dynamic, so that they can be reorganized during language development or after a brain damage.
• **Holistic** theories consider many language functions as handled by large parts of the brain working together.

• **Evolution based** theories stress the relation between how brain and language evolved over time in different species, how they develop in children and how adults perform language functions.
The central questions of neurolinguistics

- What happens to language and communication after brain damage of different types?
- How did the ability to communicate and the ability to use language develop in the evolution of the species? How can we relate this development to the evolution of the brain?
- How do children learn to communicate and use language? How can we relate their acquisition of language to the development of their brains?
- How can we measure and visualize processes in the brain that are involved in language and communication?
- How can we make good models of language and communication processes that will help us to explain the linguistic phenomena that we study?
- How can we make computer simulations of language processing, language development and language loss?
- How can we make experiments that will allow us to test our models and hypotheses about language processing?
Acquired language disorders

- Aphasia is an acquired language disorder, often defined as a focal lesion (i.e. a lesion of specific areas).
- Acquired disorders are also caused by **progressive neurological diseases, e.g. dementias**.
- Language and memory are closely connected and interdependent, especially in complex higher cognitive functions.
Developmental language disorders

- Not only acquired language disorders, but also developmental language disorders, i.e. disorders that are found in children without any specific lesion event, are of interest to neurolinguistics. Neurolinguistic approaches to developmental language disorders, including SLI (specific language disorder), and developmental reading and writing problems, including dyslexia.
Language evolution

- The development of language and speech and prerequisites for language and speech in the evolution of the species also need to be considered by neurolinguists. The changes in the structures and function of the brain are compared to the ways of living of different species. Animal communication systems are studied under natural conditions, especially those of primates, and experiments with primates being taught human communication systems are carried out.
• For a neurolinguist, an essential source of knowledge is the possibility of measuring brain activity during language tasks in normal and lesioned brains. Static pictures of the brain, where lesion sites can be seen, such as the CT scan (computer tomography scan), which constructs a 3-dimensional picture of a lesion from X-rays of many planes of the brain, or the MRI (magnetic resonance image) is standard information in hospitals today.
• The measurement of dynamic activity in the brain during language tasks by methods such as PET, fMRI and MEG is a relatively new tool. (PET = positron emission tomography, fMRI = functional magnetic resonance imaging, MEG = magnetic encephalography).
Psycholinguistics, provides the basis for neurolinguistic **modeling** of processes for language comprehension, linguistic memory, language production, language acquisition and language loss. The models can be the basis of **computer simulations** using serial (i.e., basically “box-and-arrow”) models, models with parallel processes running at the same time,

- Computer simulations involving so called “artificial neural network” (ANN) or connectionist networks are also used.
- The models are also the basis of **off-line** and **on-line** (i.e., with real-time measurement of processes) **experiments** of language functions.
Assignments

1. Try to think of three important questions about language and brain, that you would like to find an answer to. Think about the different contributing disciplines and what type of investigations, methods and potential findings of relevance they might come up with to help answer the question.

2. Imagine a study you would like to make on one of these questions. Try to make an outline of the actual design using methods that the different disciplines might contribute.

3. Try to describe what you think happens when you (silently) read a) a word, b) a text.
   Which different functions are needed and in what order?

4. Now, try to describe what happens when a child reads his first words. How does this differ from when you read a word?
   - Keep your answers to these questions and return to them when you have read the main parts of the book.
The development of theories about brain and language

Contents:
• Different views of the brain-language relation
• Ideas about brain and language before the 19th century
• The foundations of neurolinguistic theories in the late 19th century
• Further developments in the 20th century
Localism

Localism stands for the differentiation of different “higher functions” that are localized in different centers of the brain, mainly the cortex. Either these centers can be seen as “sisters” being equally important or one center, e.g. the prefrontal area (to the front of the frontal lobes) can be seen as superordinate to the others.
Associationism

Associationism assumes that higher functions are dependent on the connections between different centers in the cortex. Linguistic ability is seen as the relation between images and words. Aphasia results from broken connections between the centers that are needed for linguistic function. Representatives of this view are Wernicke, Lichteim and Geschwind. This view is also sometimes called the classical (Wernicke-Lichtheim) and neoclassical (Geschwind) view.
Dynamic localization of function

• In this type of theory, different sub-functions are seen as localized in different parts of the brain. These sub-functions must be combined in order to achieve more complex functions, which can be “put together” in a number of different alternative ways. The relation between a localized lesion and the functions that are disturbed becomes more complex in this case. This is the view of Luria.
Hierarchical or evolution based view

- Evolution based theories emphasize the layered structure of the brain from inner/lower and more primitive structures to the later developed and superimposed cortical layer and the role of all of these layers in language and communication. Jackson is an early representative, Brown a contemporary one.
Holism

Holism is the opinion that the brain, at least concerning higher functions, works as a whole. The cortex is said to handle, for example, “higher cognitive function”, “symbolic thinking”, “intelligence” or “abstraction” and aphasia is a sign of a general cognitive loss, not a specific language loss. This view has also been called “cognitivism” and some representatives are Marie, Head and Goldstein. The hierarchical views are also sometimes counted as holistic and Jackson is regarded as the founder of the “cognitive school”. 
Other terms: Unitarism and equipotentiality

- Other terms, that are used for *one unitary* function of the brain are “unitarism”, the view that the soul is one and cannot be divided, and “equipotentiality”, which means that all parts of the cortex have the same functional potential and that the size of a brain lesion determines the extent of the aphasia (= mass effect).
Ideas before 19th century

• Egypt: 3500 BC ”Edwin Smith papyrus” language loss-head-trepanation
• Greece: Hippocrates 400 BC language disorders-hemiparesis-mnemonikon-ventricles
• Plato 400-300 BC Parts of soul in different parts of brain - center of all senses
• Aristotle - brain only ”cooler”, soul in heart
  Flow chart: . sense organ —> sensation —> perception —> cognition —> memory
• Rome: Galen (300-200 BC) pneuma in different ventricles “instruments of the soul”
Middle Ages to 1800

• 15th c. Guainerio - word sparsity, naming errors - disturbance of memory 4th ventricle
• 16th c. Varolius, Vesalius - psychological functions in soft substance of brain, brain volume important
• 17th c. Unitarism - soul indivisible
  Descartes - pineal gland
  Willis - corpus callosum
  1770 Gesner Speech amnesia - speech disorders as memory disorders, inertia in connections
Meyer: localism (cortex-memory, connections - imagination, sense, basal brain - apperception, volition, corpus callosum, cerebellum - integration
Case studies
Foundations of neurolinguistics
19th century

**Gall** - localization of cognitive abilities in cortex - map, cranioscopy

- Gall made several assumptions as the basis for his theory:
  - that a number of innate abilities exist
  - that it is impossible to reduce these abilities to a unity and that they are independent of each other
  - that the real nature of the abilities cannot be examined, only their material conditions, which are in the organism
  - that these material conditions must be in the cortex.

Attacked by Flourens - unitarism
Bouillaud - Auburtin

- Speech areas - frontal lobes
- Supported Gall
- Cases, demonstrations
- Paris Anthropological Society
Gall’s original map
Paul Broca

- 1861 Leborgne (Tan)
- 1865 Cases with damage in Broca’s area LH and speech production disorder

- 1) that it was possible to localize psychological functions to brain convolutions
- 2) that linguistic symptoms were caused by lesions in the left hemisphere and that language, thus, was lateralized, which was totally unexpected.
Leborgne’s brain

Broca’s area:
third frontal convolution:
pars triangularis, pars opercularis,
BA 44, 45
Carl Wernicke

• 1874

• Wernicke’s area, the posterior part of the first/superior temporal gyrus and adjacent areas (parts of the angular gyrus, the supramarginal gyrus and the second temporal gyrus are included) first temporal convolution

• Language comprehension disturbed
Wernicke imagined a specific “language gyrus” from Wernicke’s area (with receptive function) to Broca’s area (with expressive function). Lesions in one of these areas or in the connection between them would cause aphasia.
Important parts of Wernicke’s theory are:
- the identification of symptom complexes,
- the idea about flow of information (a sort of high level “reflex arc”),
- the idea of representation. Broca’s area is said to have a “motor representation” of speech, while Wernicke’s area is said to have an “auditory sound representation” of it.
Lichtheim found it necessary to postulate a third language center with unspecified localization, the “concept center”, in the model of language function which he theoretically constructed departing from Wernicke’s model.
Aphasia forms in Lichteim’s model

- Broca’s aphasia: disturbed expressive function
- Wernicke’s aphasia: disturbed receptive function
- Conduction aphasia (disrupted connection Wernicke - Broca): normal comprehension, speech as in Wernicke’s aphasia, disturbed repetition
- Transcortical sensory aphasia (disrupted connection Wernicke - Concept center): disturbed comprehension, normal spontaneous speech, normal repetition
- Transcortical motor aphasia (disrupted connection Concept center - Broca): normal comprehension, disturbed spontaneous speech, normal repetition.
J. H. Jackson

- 1874
- two levels of language: *automatic* and *propositional*.
- The automatic level consists of stereotyped sentences, certain neologisms (= newly made words) and swearing.
- The propositional level is defined partly by its form (sentences that express a relation between two objects) and partly by its degree of flexibility (that it can be determined by semantics and by the situation).
- The use of propositions is seen as a superimposed level. Speech is seen as a part of thinking.
- Aphasia stands for an inability to “propositionalize”, i.e., to use language in the service of thought, which is why intelligence is necessarily reduced.
Jackson applied Spencer’s evolutionary principles and considered the nervous system functioning and developing in a hierarchical way:

- a) from simple to more complex
- b) from lower centers to higher centers
- c) from more organized centers to more complex centers
- d) from automatic to intentional
• He distinguished three levels of function: *elementary reflexes, automatic actions and intentional actions*. These levels are not localized to any centers.

• Localization rather is vertically oriented, from low level (spinal column and brain stem) to intermediate level (motor and sensory) and further to high level (frontal).
Jackson’s warning

• “localization of symptoms can never be identified with localization of function”
Some more terms

• Ferrier and Finkelnburg: “asymbolia”, i.e., a generally decreased ability of symbolic thinking behind aphasia

• Kussmaul: “asemia” (= inability to use signs).
Freud

- 1891 "On aphasia"
- other symptom complexes were as frequent as the ones Lichtheim’s model, this model was, thus, incomplete.
- Language can be represented in a “field” in the border area between the temporal, parietal and occipital lobes, where all properties of an object were connected in a network (smell, taste, look, sound representation etc.). Lesions in the periphery of this network would be common in aphasia
Further developments in the 20th century

- The strengthening of holism:
  - Marie, von Monakow, Head, Goldstein, Lashley, Bay and Brown
  - Marie: Intelligence (+ articulation)
  - Von Monakow: localization in time (lower-to-higher areas)
  - Head: elaborate theory - holistic
  - Goldstein: abstract attitude
  - Lashley: mass effect, equipotentiality
  - Bay: multimodal, e.g. sculpting disturbance of semantic features
• Head found four different types of aphasia, which he claimed represented different “aspects of symbolic thinking”: verbal aphasia (motor), syntactic aphasia (agrammatism), nominal aphasia (naming disorder) and semantic aphasia (meaning disorder) and he also in fact tried to localize them.

• The principles behind Head’s theory are:
  • 1) When all levels of an activity are damaged, the most complex and most recent are damaged first and most.
  • 2) Negative manifestations of a lesion are noticed at the damaged level.
  • 3) A lesion causes effects that are positive and disinhibit activities that are normally controlled by functions at the damaged level.
  • 4) The functions of the central nervous system have developed slowly in a process from lower to higher functions.
  • 5) The integration of the function of the whole nerve system is based on competition between many physiological activities for the possibility to be expressed
“Abstract attitude” according to Goldstein involves being able to:

- take initiatives
- change and choose aspect
- simultaneously keep different aspects in memory
- extract what is important from a totality
- plan symbolic use
- distinguish the self from the external world

Abstract attitude is lacking in patients with anomia (= inability to name), since they cannot categorize, and in patients with agrammatism (= difficulties in using grammatical morphemes and function words), since they cannot use elements that “have no meaning in isolation”.
Localization and associationism

- Brodmann areas
- Associationism rediscovered by Geschwind 1965: ”Disconnection syndromes in animals and man” - Boston
- Wernicke-Lichtheim model revived
Dynamic localization of function

• Vygotsky emphasized that it is necessary to first investigate *what* is to be localized, before posing the question *where*. Functions must be analyzed with respect to the ontogenetic development. Vygotsky sees a function as a complex adaptive activity of the whole organism to a task. The activity can be performed in different ways, by the cooperation of several organs. This dynamic cooperation is controlled by neural structures which monitor different organs and are localized in different places. Vygotsky also has a theory about the development of language and thinking, which has become very influential.

• Luria studied aphasia within the framework of the theory of dynamic localization of function. Luria’s theory has been one of the most influential in aphasia research and especially in clinical work.
Testpsychological tradition

• Weisenburg & McBride
Linguistic influence

• Jakobson 1941, 1965
• Chomsky, Lenneberg
• Whitaker
Assignment

1. Discuss what would be the main reasons for assuming localization of language in
   - a central structure in the brain, like pineal gland or corpus callosum
   - the ventricles (i.e., central cavities in the brain filled with cerebrospinal liquid)
   - brain substance
   - different specified areas or convolutions of the cortex
   - widespread functional systems or networks of sub-functions involving large parts of the brain
   - hierarchical layers of brain structures
3. Models and frameworks

- **Contents:**
- Linguistics, psychology, clinical work, neuroimaging, computer simulation
- **Clusters of influence**
  - Two basic frameworks: the neoclassical and dynamic localization of function approaches
- **Areas in strong development:** linguistic and cognitive linguistic theories, communication research, cognitive neuropsychology
Therapies

• Based on Boston framework - specific abilities (using other parts of brain) - symptom based
• Based on Lurian framework - restoration of dynamic functional systems (inter- and intrasystemic)
• Cognitive neuropsychology
• Communication/pragmatics based, including strategies, compensation, AAC
• Social approach
Therapy types now

cf Howard & Hatfield 1987

REORGANIZATION OF FUNCTION
SCHOOL (i.e. Luria)
NEO-CLASSICAL SCHOOL.

PRAGMATIC SCHOOL
NEUROLINGUISTIC SCHOOL
COGNITIVE NEUROPSYCHOLOGY
SCHOOL,
Important influences - fast technological development

• Neuroimaging
• Computer simulation
• Developments in linguistics
• Evaluation and outcome of therapy
Classical

- The predominant cluster of influences in neurolinguistics during the nineteen-seventies and eighties, and also today, is a cluster combining the following parts: 1) classical influence from the Lichtheim-Geschwind models, 2) linguistic structuralism and/or generative grammar, 3) test psychology, group studies using statistics (lately also case studies), 4) serial modeling and 5) therapy of mainly "neoclassical" or "cognitive psychology" type (in the terminology of Howard and Hatfield 1987).
Neuropsychological modeling

• Another cluster is based on the Russian tradition in neuropsychology, i.e., ideas from Vygotsky and Luria, together with ideas from general systems theory (Bertalanffy, 1968). In linguistics, structuralism as well as generative grammar have also been used in this cluster, case studies are widely used (although group studies also have their place) and serial modeling is mostly used. This cluster has a strong therapeutic tradition, see above.
3. Pragmatic, social, functional

- A third cluster, which has fairly recently become further developed in neurolinguistics, is based on philosophical, anthropological and linguistic ideas in the field of pragmatics. Representatives of this cluster are often influenced by holistic and/or evolutionary approaches, as well as functionalism. Connectionist modeling is seen as more promising than serial modeling. Therapy methods are pragmatically and communicatively oriented.
Hierarchical/evolution-based cognitivist frameworks

• The hierarchical (evolution based), cognitivist frameworks and a number of the ideas presented in more holistic theories are also still around, being separately pursued, as in Jason Brown’s structural model and theory about microgenesis, but also partly integrated into new approaches, like cognitive semantics, functionalist approaches, pragmatics and embodied and/or multimodal communication.
Neoclassical ”Boston” framework

- Geschwind brought associationism into today’s neurology, when his theory was presented in “Disconnection Syndromes in Animal and Man” in 1965. It is anatomically based and comprises aphasia, agnosia (inability to identify sensory impressions) and apraxia (inability to perform intentional actions). Aphasia is connected to sensory and motor systems. A cortical center is 1) an anatomical site, and 2) a collection of linguistic representations, associated with 3) some aspect of “processing” of these representations. Geschwind gives a careful anatomic description of connections between the right and the left hemisphere and within each of the hemispheres. When there are disruptions of the connections, different disconnection syndromes arise, among them forms of aphasia. The theory is an extension of Lichtheim’s model (see Chapter 2).
Boston Group

• Geschwind was very influential in the so called Boston school, a group of aphasia researchers connected to the Aphasia Research Center in Boston. This was the most influential group in aphasia research in the U.S. and in large parts of the western world from the 1960’s. It was also strongly influenced by Noam Chomsky’s linguistic theories and by test psychology tradition.
Boston Group

- The Boston group developed the Boston Diagnostic Aphasia Examination (BDAE) (Goodglass & Kaplan 1973), which is used for classifying aphasics in most linguistic research. The Boston classification has been criticized by many researchers as too crude for many research purposes, but the test and the terminology is the most widely used and has been the model of many other tests.
### Aphasia types - Boston

<table>
<thead>
<tr>
<th>Aphasia Type</th>
<th>Fluent speech</th>
<th>Speech comprehension</th>
<th>Repetition</th>
<th>Naming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wernicke</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Transcortical sensory</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Conduction aphasia</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Transcortical motor</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Broca</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Global</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Anomic</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Isolated speech area</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>
Added aphasia types

• *Global aphasia*: the most serious type of aphasia, where the patient basically has no linguistic ability

• *Anomic aphasia*: inability to name

• *Isolated speech area*: transcortical sensory + transcortical motor aphasia.
Typical localization of brain damage - Boston aphasia types

<table>
<thead>
<tr>
<th>Aphasia type</th>
<th>Most typical location of lesion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wernicke’s aphasia:</td>
<td>Wernicke’s area</td>
</tr>
<tr>
<td>Transcortical sensory aphasia:</td>
<td>Posterior parietal lobe</td>
</tr>
<tr>
<td>Conduction aphasia:</td>
<td>Often deep lesion between Wernicke’s and Broca’s areas, including white fiber bundles (the arcuate fasciculus)</td>
</tr>
<tr>
<td>Transcortical motor aphasia:</td>
<td>Area in front of the Rolandic fissure (the supplementary motor area)</td>
</tr>
<tr>
<td>Broca’s aphasia:</td>
<td>Broca’s area</td>
</tr>
<tr>
<td>Global aphasia:</td>
<td>Large cortical and subcortical areas around the Sylvian fissure</td>
</tr>
<tr>
<td>Anomic aphasia:</td>
<td>Often impossible to localize, traditionally said to be present with lesions affecting the angular gyrus</td>
</tr>
<tr>
<td>Isolated speech area:</td>
<td>Like transcortical sensory + transcortical motor aphasia, in so called “watershed areas” (borders between the areas of supply for the different arteries).</td>
</tr>
</tbody>
</table>
Luria’s framework

• Luria sees the brain as a functionally connected system, where a task can be performed by different mechanisms with the same result. The activity is complex and demands cooperation between several zones. It is thus not possible to localize a language function to a certain area because the function is lost when that area is damaged. On the other hand, different cortical and subcortical areas give specific contributions to every complex system of activity, which is why antilocalism can not be accepted.
Block I

- Block I, subcortical structures (including the limbic system) and the brain stem (including the reticular formation), has the function of regulating tone (=tension) or degree of awareness. According to Pavlov, organized goal directed activity requires sustained optimal cortical tone. This is attained from three sources: 1) metabolic processes, 2) stimuli from the external world, and 3) intentions and plans which are formed consciously with the help of speech, in block III (see below).

- Damage to Block I causes a non-specific reduction of cortical tone, which reduces the selectivity in psychological processes.
Block II

- Block II, the post-central cortex (including visual, auditory and sensory areas in the parietal, occipital and temporal lobes, receive, analyze and store information.

- Primary zones are highly modality specific (e.g. the auditory center) and handle perception. Secondary zones handle the analysis within each modality and tertiary zones coordinate the analyses from the different modalities. The tertiary zones are in the border area between cortex of the occipital, temporal and parietal lobes and are seen as specifically human.

- Block II is said to be responsible for the paradigmatic organization of verbal communication, i.e., the organization of phonematic, lexical, morphological, syntactic and semantic units in the linguistic code.
Block III

- Block III, the pre-central cortex (the frontal lobes) programs, regulates and controls mental activity. Primary, modality specific zones are in the motor cortex, secondary zones in the pre-motor cortex and tertiary zones in the prefrontal parts of the frontal lobes. The tertiary zones form intentions and programs and are seen as superordinate to all other parts of the cerebral cortex, monitoring behavior.

- Block III is responsible for syntagmatic organization of verbal communication, i.e., the organization of connected utterances
Laws

• Three different laws apply to the blocks:
• 1) The law of hierarchical structure of cortical zones (primary – secondary – tertiary): Tertiary zones are superordinae to secondary zones, which are superordinate to primary zones.
• 2) The law of diminishing specificity in the hierarchically ordered cortical zones: most in the primary zones, least in the tertiary zones.
• 3) The law of progressive lateralization of function: least in primary zones, most in tertiary zones
Block II

- **Afferent motor aphasia**
- **Lesion:** Block II, sensory secondary zone
- **Symptoms:** Phoneme exchanges (= phonological paraphasias), which the patients attempts but is not able to correct, because of a lack of kinesthetic feedback about the articulatory movements to the secondary zones in Block II.
Block II

- **Acoustic aphasia** (= Sensory aphasia)
- Lesion: Block II, auditory secondary zone (including Wernicke’s area)
- Symptoms: Problems recognizing and discriminating phonemes. The patient speaks with severe phoneme paraphasias (=substitutions ) and does not react to this. The syntactic and prosodic pattern remains and speech is fluent. In language comprehension the patient can with the help of these patterns interpret part of what is said.
Block II

• Acoustic-mnestic aphasia
• Lesion: Block II, medial zones, deep in the left temporal lobe.
• Symptoms: Problems in keeping series of audio-verbal traces long enough, which lead to paraphasias (exchanges of phonemes and words) in naming and spontaneous speech. Syntax and prosody remain also in this case.
Block II

- **Amnestic aphasia (= Semantic aphasia)**
- Lesion: Block II, posterior tertiary zone (posterior and inferior parietal lobe or the border between the parietal and occipital lobes)
- Symptoms: 1. Disturbances in the semantic network of words, which lead to semantic paraphasias (=substitutions of words), searching for words and circumlocutions (paraphrases). 2. Difficulties handling complex grammatical relations.
Block III

- **Dynamic aphasia**
- **Lesion:** Block III, tertiary zone
- **Symptom:** Inability to transform a semantic plan into linearly ordered speech via “inner speech”, no spontaneous speech. The patient repeats and names correctly.
Block III

- **Efferent motor aphasia**
- Lesion: Block III, motor secondary zone (including Broca’s area)
- Symptoms: Difficulties changing from one phoneme to another, perseveration (= pathological inertia, repetition). (A non-specific disturbance which affects also other movements.)
# Speech comprehension

<table>
<thead>
<tr>
<th>Linguistic process</th>
<th>Brain area</th>
<th>Type of aphasia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. Comprehension of a word</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Isolation of phonemes (acoustic analysis)</td>
<td>secondary auditory zone, LH</td>
<td>acoustic aphasia</td>
</tr>
<tr>
<td>2. Identification of meaning (“image”)</td>
<td>tertiary, posterior zone, LH</td>
<td>amnestic aphasia</td>
</tr>
<tr>
<td><strong>II. Comprehension of meaning in a phrase as a whole</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1) Keeping elements in memory</td>
<td>secondary, auditory zone + deep medial-temporal zone, LH</td>
<td>acoustic-mnestic aphasia</td>
</tr>
<tr>
<td>2) Simultaneous synthesis and logical plans</td>
<td>tertiary, posterior zone, LH</td>
<td>amnestic aphasia</td>
</tr>
<tr>
<td>3) Active analysis of the most significant elements</td>
<td>frontal zones</td>
<td></td>
</tr>
</tbody>
</table>
Spontaneous speech production

<table>
<thead>
<tr>
<th>Linguistic process</th>
<th>Brain area</th>
<th>Type of aphasia</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Intention, plan</td>
<td>frontal lobes</td>
<td>general lack of initiative</td>
</tr>
<tr>
<td>2. Inner speech with predicative structure (linear plan)</td>
<td>frontal lobes</td>
<td>dynamic aphasia</td>
</tr>
</tbody>
</table>
Pragmatics/Communication

• Theories about speech acts and language games, theories about context, activity, conversational principles, conversation patterns and about body communication, gesture and picture communication. One approach used for interaction analysis is Conversation Analysis, i.e. microanalysis of recorded interaction sequences. The social approach to therapy has also led to a number of suggested procedures for handling aphasia.
Cognitive neuropsychology

- It involves working from models of linguistic processes and hypotheses about disturbances and therapy related to these models. It has a strong clinical tradition by now, including, for example, the PALPA investigation (Kay et al. 1992, Whitworth et al. 2005), the Pyramids and Palm Trees test (Howard and Patterson 1992) and the documentation of model based clinical work (Byng et al. 2001). Examples of research areas studied extensively in this framework are lexical semantics and reading.
Assignments

- Assignments
- Below are four descriptions of typical linguistic symptoms or combinations of symptoms (=syndromes) in aphasia.
  - Anomia, i.e. word finding problems in language production
  - Severe language comprehension problems
  - Inability to repeat words or sentences
  - Perseveration, i.e., "getting stuck" in what you have just said and repeating it when you want to move on to something new
- Try to apply to each one of them what you know about:
  - Dynamic localization of function (Luria)
  - The classical-neoclassical model (Wenicke-Geschwind-Boston)
  - Cognitive neuropsychology, i.e., the model in Figure 3.5, after reading this chapter.
- Try to describe and explain, according to each one the symptom-syndrome and the type of aphasia. Apply the figures, tables and schemas used by the different frameworks.