

Cognitive and behavioral functions (domains) are coordinated by intersecting *large-scale neural networks* that contain interconnected cortical and subcortical components. Five anatomically defined large-scale networks are most relevant to clinical practice: (1) a perisylvian network for language, (2) a parietofrontal network for spatial orientation, (3) an occipitotemporal network for face and object recognition, (4) a limbic network for retentive memory, and (5) a prefrontal network for the executive control of cognition and comportment.

THE LEFT PERISYLVIAN NETWORK FOR APHASIAS

The areas that are critical for language make up a distributed network located along the perisylvian region of the *left* hemisphere. One hub, located in the inferior frontal gyrus, is known as Broca's area. Damage to this region impairs phonology, fluency, and the grammatical structure of sentences. The location of a second hub, known as *Wernicke's area*, is less clearly settled but is traditionally thought to include the posterior parts of the temporal lobe. Cerebrovascular accidents that damage this area interfere with the ability to understand spoken or written sentences as well as the ability to express thoughts through meaningful words and statements. These two hubs are interconnected with each other and with surrounding parts of the frontal, parietal, and temporal lobes. Damage to this network gives rise to language impairments known as aphasia. Aphasia should be diagnosed only when there are deficits in the formal aspects of language, such as word finding, word choice, comprehension, spelling, or grammar. Dysarthria and mutism do not by themselves lead to a diagnosis of aphasia. In approximately 90% of right-handers and 60% of left-handers, aphasia occurs only after lesions of the left hemisphere.

CLINICAL EXAMINATION

The clinical examination of language should include the assessment of naming, spontaneous speech, comprehension, repetition, reading, and writing. A deficit of naming (*anomia*) is the single most common finding in aphasic patients. When asked to name a common object, the patient may fail to come up with the appropriate word, may provide a circumlocutious description of the object ("the thing for writing"), or may come up with the wrong word (*paraphasia*). If the patient offers an incorrect but related word ("pen" for "pencil"), the naming error is known as a *semantic paraphasia*; if the word approximates the correct answer but is phonetically inaccurate ("plentil" for "pencil"), it is known as a *phonemic paraphasia*. In most anomias, the patient cannot retrieve the appropriate name when shown an object but can point to the appropriate object when the name is provided by the examiner. This is known as a one-way (or retrieval-based) naming deficit. A two-way (comprehension-based) naming deficit exists if the patient can neither provide nor recognize the correct name. *Spontaneous speech* is described as "fluent" if it maintains appropriate output volume, phrase length, and melody or as "nonfluent" if it is sparse and halting and average utterance length is below four words. The

examiner also should note the integrity of *grammar* as manifested by word order (syntax), tenses, suffixes, prefixes, plurals, and possessives. *Comprehension* can be tested by assessing the patient's ability to follow conversation, asking yes-no questions ("Can a dog fly?" "Does it snow in summer?"), asking the patient to point to appropriate objects ("Where is the source of illumination in this room?"), or asking for verbal definitions of single words. *Repetition* is assessed by asking the patient to repeat single words, short sentences, or strings of words such as "No ifs, ands, or buts." The testing of repetition with tongue twisters such as "hippopotamus" and "Irish constabulary" provides a better assessment of dysarthria and palilalia than of aphasia. It is important to make sure that the number of words does not exceed the patient's attention span. Otherwise, the failure of repetition becomes a reflection of the narrowed attention span (working memory) rather than an indication of an aphasic deficit. *Reading* should be assessed for deficits in reading aloud as well as comprehension. *Alexia* describes an inability to either read aloud or comprehend single words and simple sentences; *agraphia* (or dysgraphia) is used to describe an acquired deficit in spelling.

Aphasias can arise acutely in cerebrovascular accidents (CVAs) or gradually in neurodegenerative diseases. The syndromes listed in [Table 36-1](#) are most applicable to the former group, where gray matter and white matter at the lesion site are abruptly and jointly destroyed. Progressive neurodegenerative diseases can have cellular, laminar, and regional specificity, giving rise to a different set of aphasias that will be described separately. The syndromes outlined below are idealizations and rarely occur in pure form.

Wernicke's Aphasia Comprehension is impaired for spoken and written words and sentences. Language output is fluent but is highly paraphasic and circumlocutious. Paraphasic errors may lead to strings of neologisms, which lead to "jargon aphasia." Speech contains few substantive nouns. The output is therefore voluminous but uninformative. For example, a patient attempts to describe how his wife accidentally threw away something important, perhaps his dentures: "We don't need it anymore, she says. And with it when that was downstairs was my teeth-tick ... a ... den ... dentith ... my dentist. And they happened to be in that bag ... see? ... Where my two ... two little pieces of dentist that I use ... that I ... all gone. If she throws the whole thing away ... visit some friends of hers and she can't throw them away."

Gestures and pantomime do not improve communication. The patient may not realize that his or her language is incomprehensible and may appear angry and impatient when the examiner fails to decipher the meaning of a severely paraphasic statement. In some patients this type of aphasia can be associated with severe agitation and paranoia. The ability to follow commands aimed at axial musculature may be preserved. The dissociation between the failure to understand simple questions ("What is your name?") in a patient who rapidly closes his or her eyes, sits up, or rolls over when asked to do so is characteristic of Wernicke's aphasia and helps differentiate it from

TABLE 36-1 CLINICAL FEATURES OF APHASIAS AND RELATED CONDITIONS COMMONLY SEEN IN CEREBROVASCULAR ACCIDENTS

	Comprehension	Repetition of Spoken Language	Naming	Fluency
Wernicke's	Impaired	Impaired	Impaired	Preserved or increased
Broca's	Preserved (except grammar)	Impaired	Impaired	Decreased
Global	Impaired	Impaired	Impaired	Decreased
Conduction	Preserved	Impaired	Impaired	Preserved
Nonfluent (anterior) transcortical	Preserved	Preserved	Impaired	Impaired
Fluent (posterior) transcortical	Impaired	Preserved	Impaired	Preserved
Isolation	Impaired	Echolalia	Impaired	No purposeful speech
Anomic	Preserved	Preserved	Impaired	Preserved except for word-finding pauses
Pure word deafness	Impaired only for spoken language	Impaired	Preserved	Preserved
Pure alexia	Impaired only for reading	Preserved	Preserved	Preserved