Speech and Language Disorders

BROCA'S, WERNICKE'S… ETC.

DEX ARNOLD
PGY-2 UNIVERSITY OF CALGARY NEUROLOGY
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SEVERAL GRAPHICAL SLIDES ADAPTED FROM DR. DARYL WILE'S 2011 PRESENTATION

Basic Concepts

- Language ≠ Speech
- Speech is merely the auditory expression of language
- Language encompasses reading, writing, speech, and motor gestures, and is a means of transmitting ideas or feelings through symbols
- The production of sounds and articulation are the result of vocal cord, tongue, and pharyngeal/ laryngeal muscle activity. These are controlled chiefly by the brainstem and upper cervical spine.
- Language is the domain of the cerebral cortex.

Basic Concepts

- Two major neurologic disorders covered here:
  1. Dysarthria (and Dysphonia)
  2. Aphasia
- Differentiating between them is critical!

Dysarthria and Dysphonia

THE CONTENT IS RIGHT. THE DELIVERY IS OFF.

Localizing

- Muscle
- Neuromuscular Junction
- Lower Motor Neuron (cranial nerves or upper cervical nerves)
- Brainstem nuclei
- Cerebellum
- Basal Ganglia
- Cortex/Subcortex

- Generally, dysarthria is difficult to localize.

Brainstem Innervation

- CN V: muscles of mastication, opening and closing the mouth
- CN VII: controls facial expression and adjusts lip shape via orbicularis oris and other facial muscles
- CN IX & X: movement of the soft palate, pharynx and larynx
- CN XII: tongue movement

The Brainstem's Contribution

- Vocalization is the result of coordinated respiratory muscle activity, the tension and length of the vocal cords, the size and shape of the glottis, pharynx, and mouth, and the positioning of the tongue, palate, and lips.
- In trached patients, speech is still possible due to the esophagus.
  - Swallowed air is slowly released through the GE junction, and resonates in the esophagus and pharynx to be molded by the mouth and lips into words.

Exam Pearls

- Labial (lip) sounds - CN VII: b, p, m
- Lingual (tongue) sounds - CN XII: t,d,l,n
- Velar (pharyngeal) sounds – CN IX/X: k, g
- Combine with "pataka"
- Test for dysarthria with consonant-loaded phrases
  - E.g. "baby hippopotamus", "third riding artillery brigade", and "voluntary retribution"

- Conditions like myaesthenia – fatigable speech. Ask the patient to count to 100
- Cerebellar dysfunction – ataxic speech – lurching, breaking, wavering, explosive speech
- Hoarse or weak voice – think about recurrent laryngeal nerve, larynx mass or pathology, vocal cord paralysis, injury, or dysfunction
- Nasal-sounding voice – pharyngeal muscle dysfunction or CN X lesion – the nasopharynx cannot be sealed off
- Vocal tremor may be seen with cerebellar disorders, essential tremor, and Parkinsonism. Hypophonia (soft, monotonous speech) is a hallmark of Parkinson's

- Note that pronunciation is influenced by level of education, cultural background, first language, and individual factors. Ask family what is normal.

Table 12B.1 Classification of the Dysarthrias

Type	Localization	Auditory Signs	Characteristic Disease(s)
Flaccid	Lower motor neuron	Breathy, nasal voice, imprecise consonants	Stroke, myasthenia gravis
Spastic	Bilateral motor neuron	Strain-strangle, harsh voice; slow rate; imprecise consonants	Bilateral strokes, tumors, primary lateral sclerosis
	Unilateral upper motor neuron	Consonant imprecision, slow rate, harsh voice quality	Stroke, tumor
Ataxic	Cerebellum	Irregular articulatory breakdowns, excessive and equal stress	Stroke, degenerative disease
Hypokinetic	Extrapyramidal	Rapid rate, reduced loudness, monopitch and monoloudness	PD
Hyperkinetic	Extrapyramidal	Prolonged phonemes, variable rate, inappropriate silences, voice stoppages	Dystonia, HD
Spastic and flaccid	Upper and lower motor neuron	Hypernasality, strain-strangle, harsh voice, slow rate, imprecise consonants	ALS, multiple strokes

Adapted from Duffy, J.R., 1995. Motor Speech Disorders: Substrates, Differential Diagnosis, and Management. Mosby, St. Louis; and from Kirshner, H.S., 2002. Behavioral Neurology: Practical Science of Mind and Brain. Butterworth Heinemann, Boston.

ALS, Amyotrophic lateral sclerosis; *HD*, Huntington disease; *PD*, Parkinson disease.

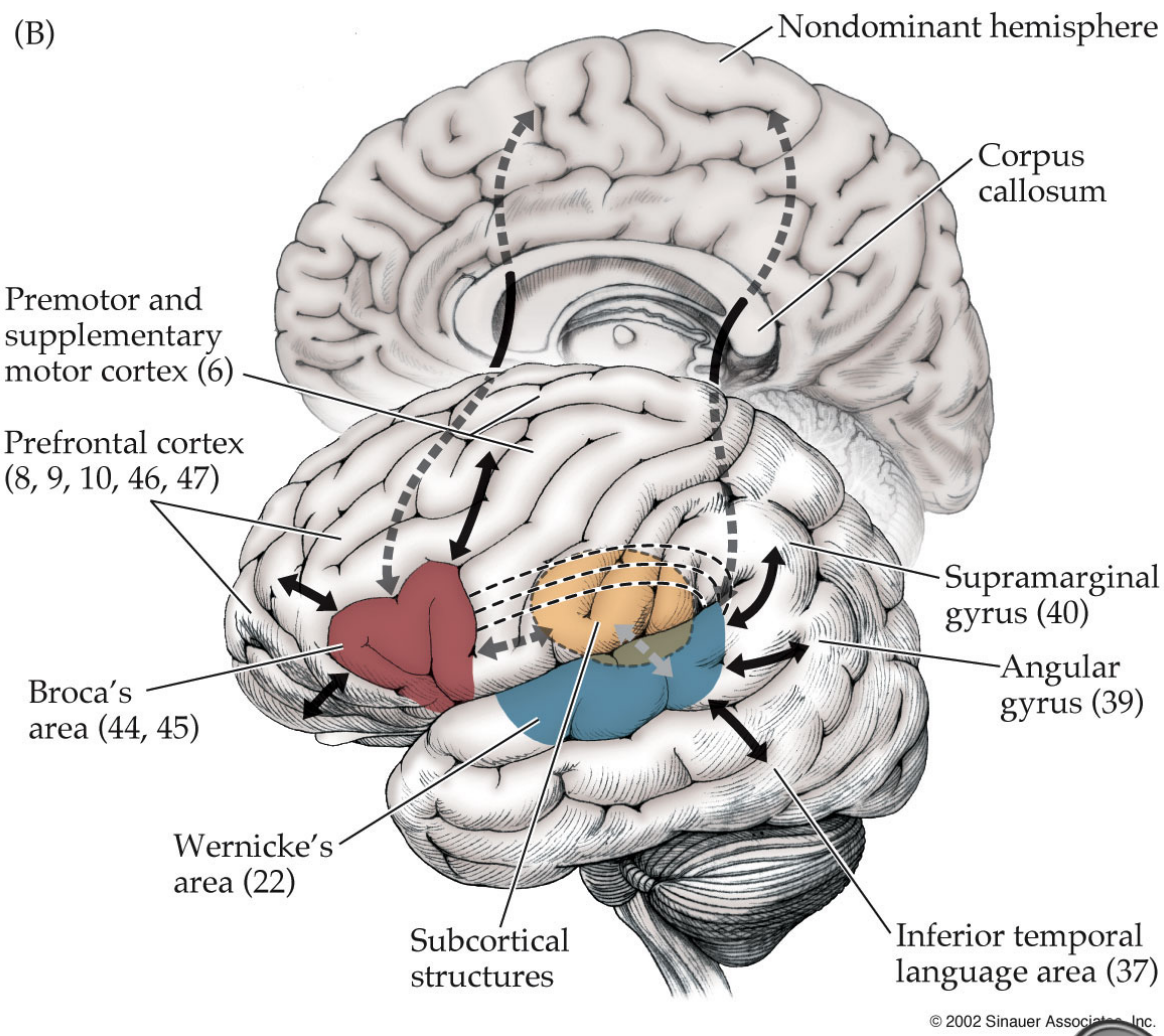
Source: Bradley's Neurology in Clinical Practice

Aphasia

DOMAINS OF LANGUAGE, ANATOMY, A HOUSE AROUND WHICH TO BUILD AN UNDERSTANDING, AND PATTERNS

Anatomy

- Usually in the left hemisphere
- The main circuit consists of Wernicke's area on the superior temporal gyrus, the arcuate fasciculus, and Broca's area in the inferior frontal lobe.
- In essence, a C-shaped area of brain around the sylvian fissure.

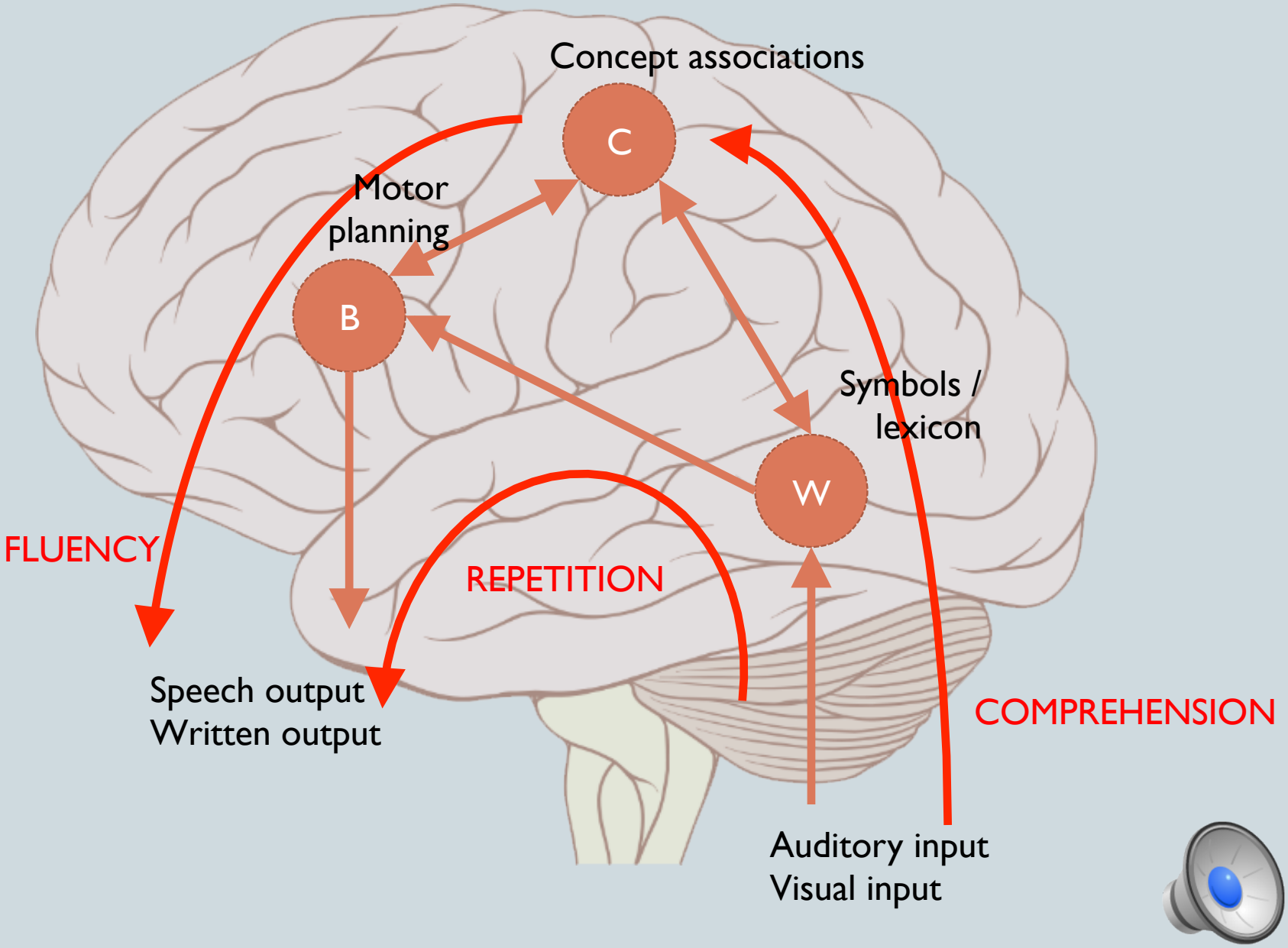


Source: Blumenfeld's Neuroanatomy through Clinical Cases

HANDEDNESS

LEFT	RIGHT
60-70% LH dominance	>95% LH dominance
May be co-dominant	

Lichtheim's House (1885)

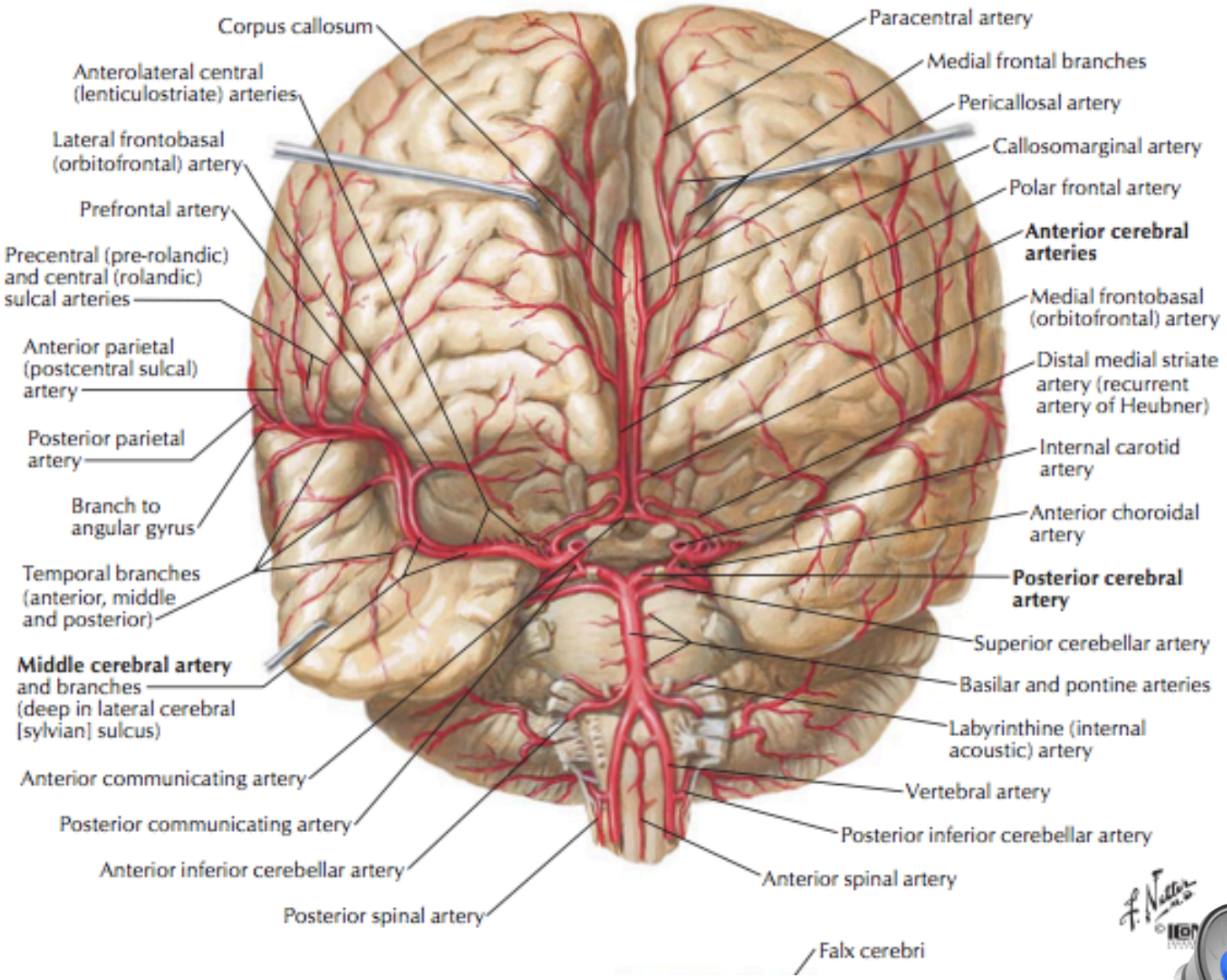


Vascular Anatomy

- Perisylvian language areas perfused by the MCA
- Broca's area = superior division
- Wernicke's area = inferior division
- Proximal MCA occlusions = more global aphasia

- Exact localization, matching of symptoms to anatomy is difficult. Inter-individual variability is significant. Generally, the bigger the lesion, the more global the problem.

- Key Point: The most important and common cause of aphasia is left MCA ischemia!



Source: Netter's Neuroanatomy

The Exam

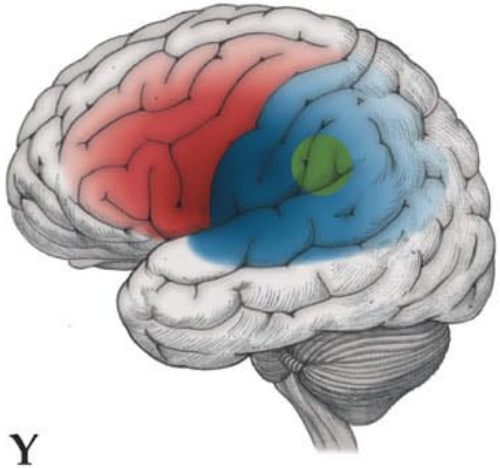
- Demographics (including handedness)
- Assess the remainder of the mental status
- Full language exam involves assessing the following domains:
  1. Fluency
  2. Naming
  3. Comprehension
  4. Repetition
  5. Reading
  6. Writing

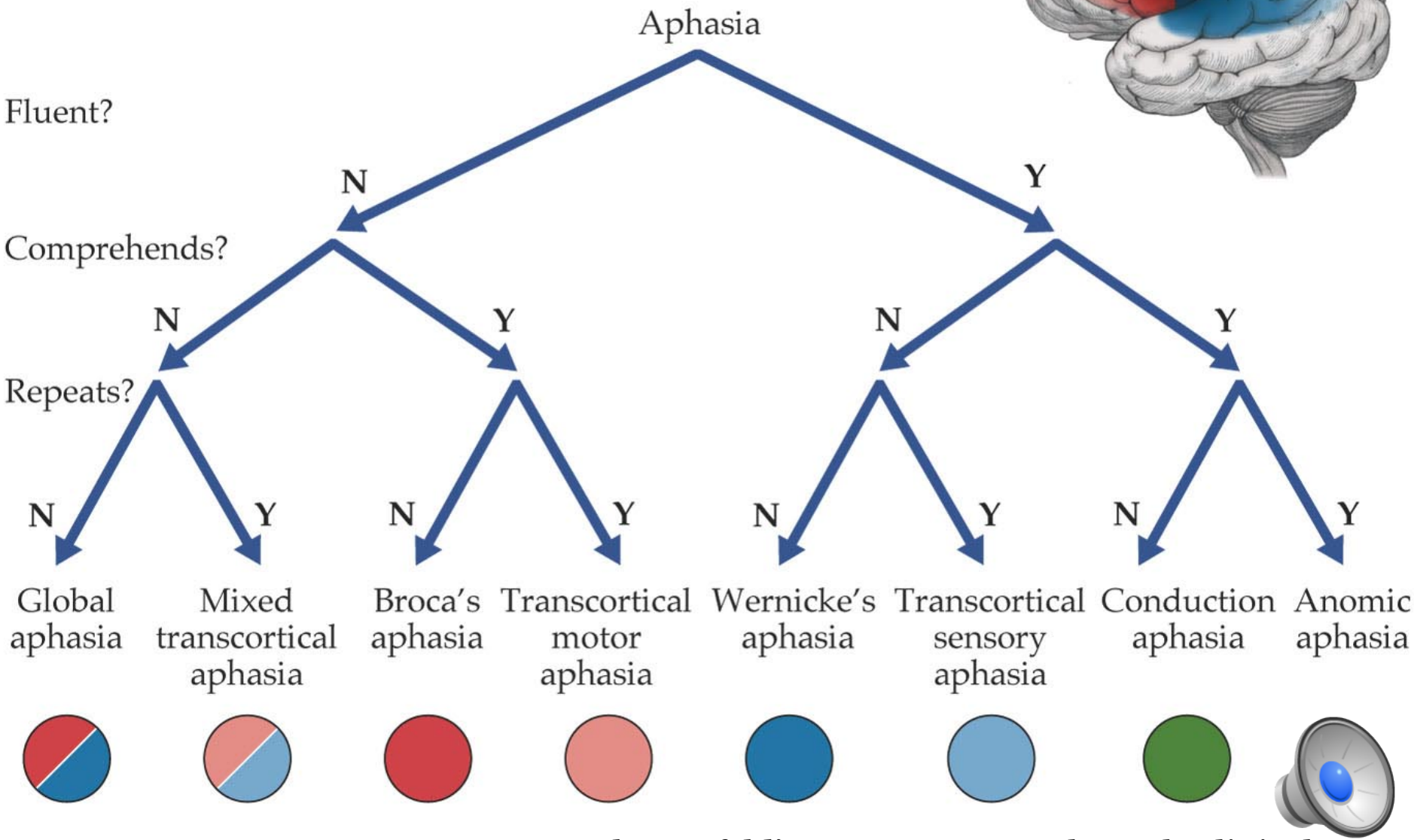
Types of Aphasias

Classifying Aphasias

- Expressive and receptive terms, while learned in medical school, are tough as all aphasic patients have trouble expressing themselves
- DeJong's proposes Fluent and Nonfluent as a general approach (helps to classify 60-80% of acute aphasias)

Aphasia syndromes





Source: Blumenfeld's Neuroanatomy through Clinical Cases

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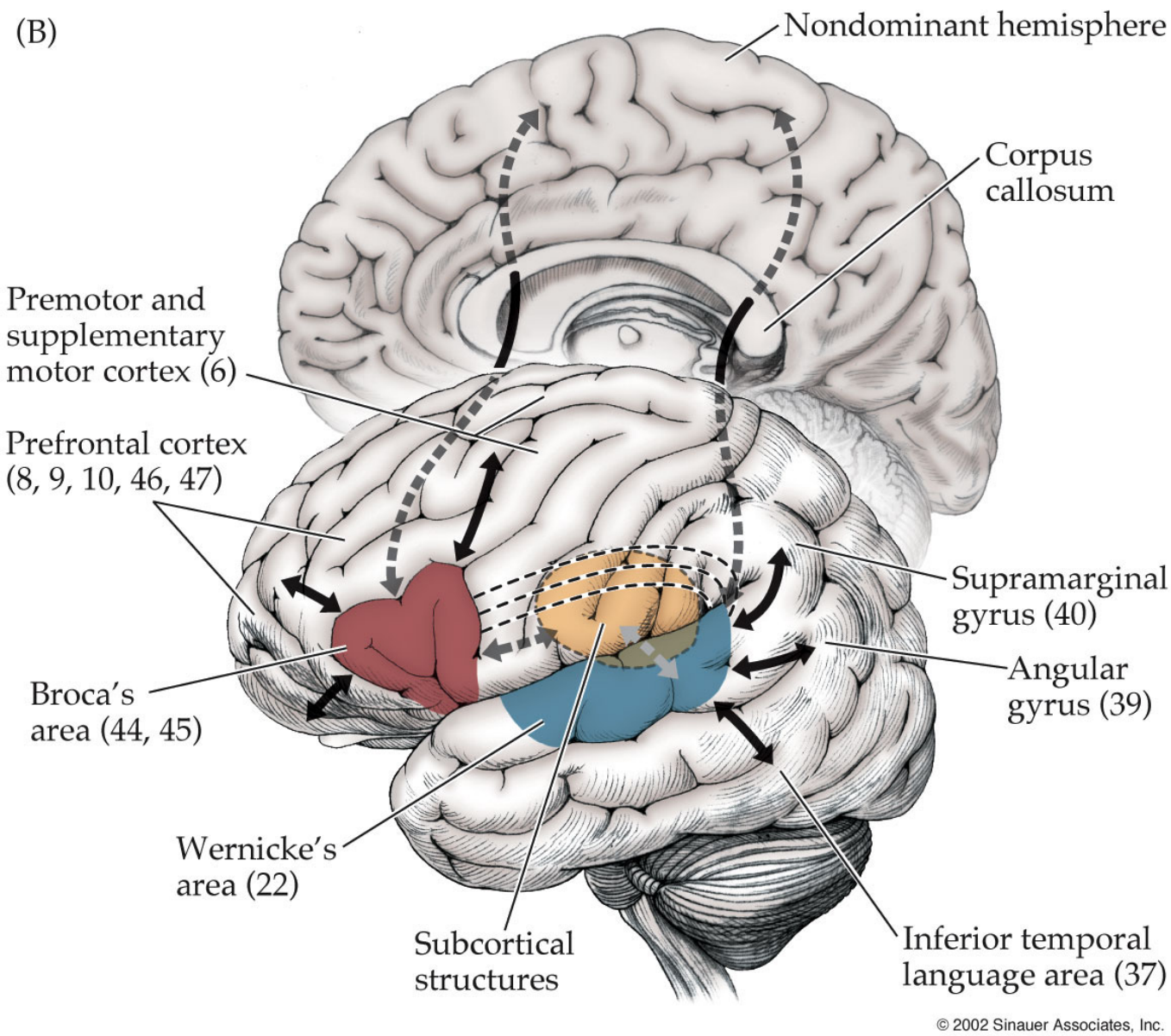
Broca's

- The most common non-fluent aphasia
- Decreased linguistic output, with relatively preserved comprehension
- Speech may consist of nouns and major verbs produced with great effort
- Patient are aware and frustrated
- Impaired repetition, reading aloud, naming
- Superior MCA occlusion

Wernicke's

- Impaired comprehension, but fluent speech
- Speech, while of normal or increased rate, is devoid of meaningful content – flowing gibberish
- Agrammatism, neologisms, and paraphasias abound
- Patient is often unaware of the deficit
- Hearing intact, and patients will recognize voices, but content is incomprehensible
- Inferior MCA occlusion



Source: Blumenfeld's Neuroanatomy through Clinical Cases

Global

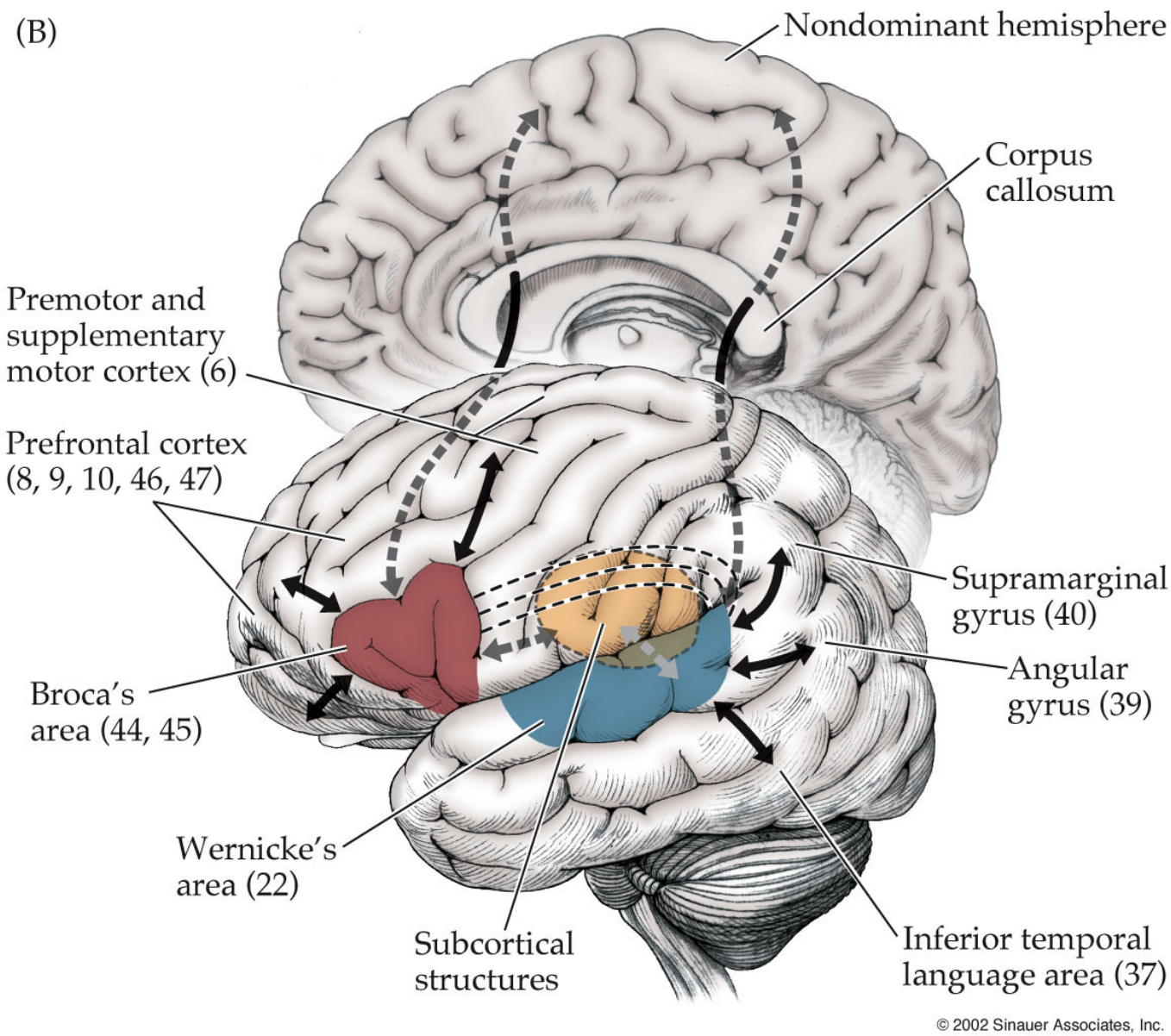
- Exactly as it sounds. Nonfluent as well as severe comprehension impairment.
- In vascular etiologies, cause is usually proximal MCA occlusion or ICA occlusion.

Conduction

- Lesion is in the supramarginal gyrus, usually involving the arcuate fasciculus, the white matter highway connecting Wernicke's to Broca's
- Clinically, intact fluency and comprehension, but with impaired repetition
- May see word-finding difficulty
- Vascular cause is usually an MCA terminal branch occlusion

Anomic

- Pretty much all aphasias come with naming difficulty, or recover to a point of mild naming impairment
- If naming is the chief issue throughout the course, dubbed anomic aphasia
- Localizes to the lower temporal lobe
- If accompanied by Gerstmann syndrome (dysgraphia, dyscalculia, finger agnosia, left-right disorientation), lesion localizes to the dominant angular gyrus (temporal-parietal junction)



Source: Blumenfeld's Neuroanatomy through Clinical Cases

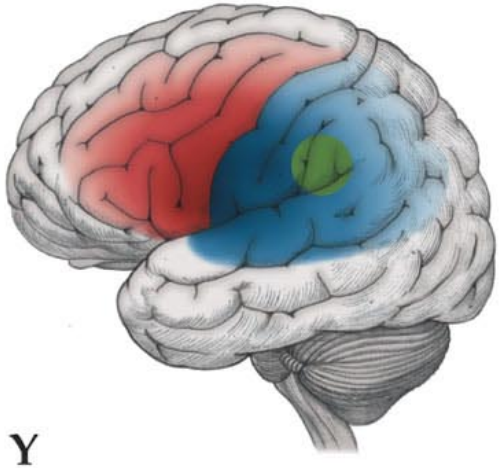
Transcortical Aphasia

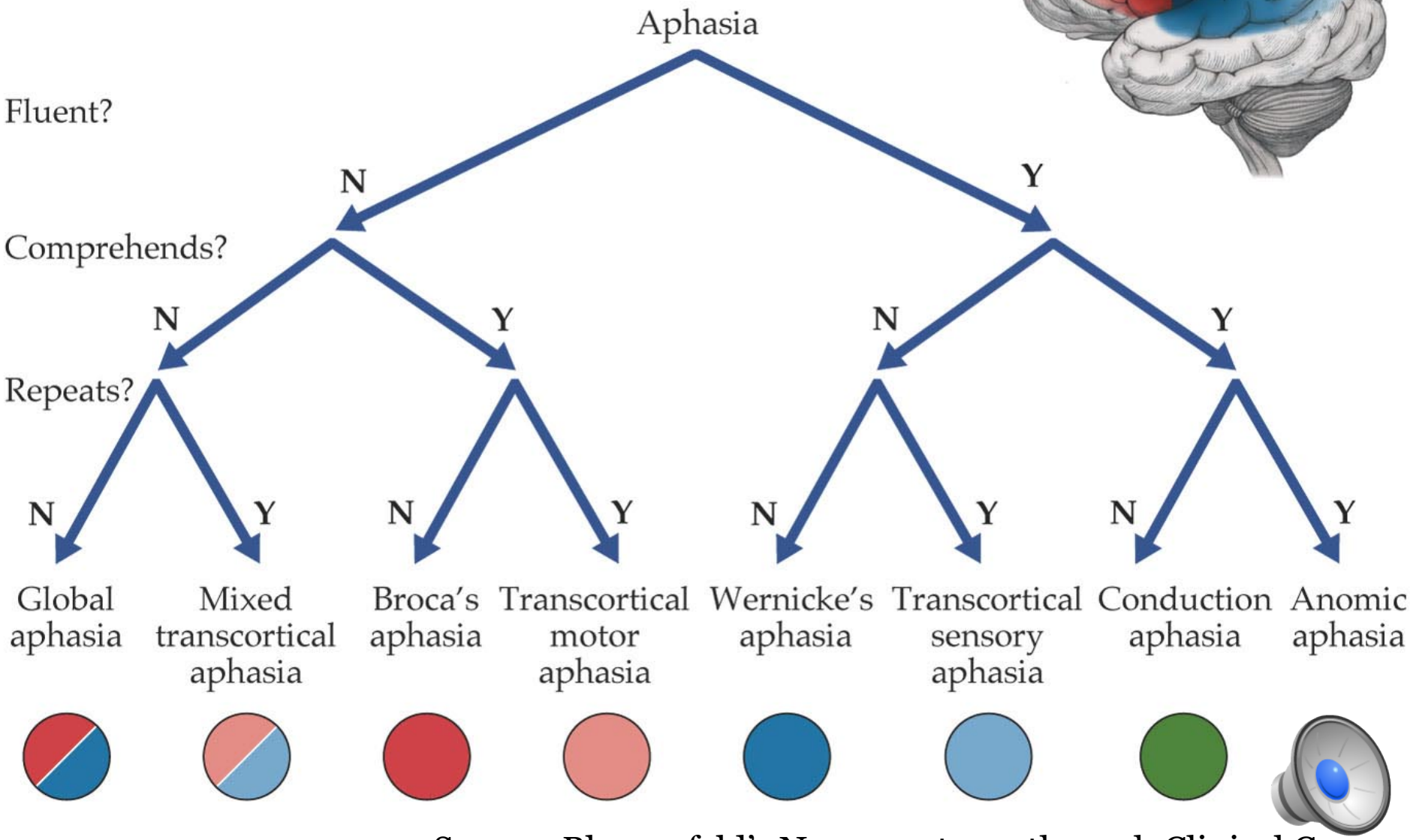
- Perisylvian language areas are intact, but they become an island cut off from the rest of the brain
- Usual etiology is watershed infarct
- Repetition is intact (the hallmark) as the arcuate fasciculus connects intact Broca's and Wernicke's areas
- Transcortical motor aphasia is like Broca's, but with repetition > spontaneous speech
- Transcortical sensory is similar to Wernicke's, but with repetition > comprehension

Other Aphasias

- Subcortical aphasias – often resemble transcortical aphasias
- Non-dominant lesions – the usual of domains of language will be intact, but patients may lose an understanding for the emotional undertones of speech, or lose the ability to instill emotion (prosody) into their own speech

Aphasia syndromes





Source: Blumenfeld's Neuroanatomy through Clinical Cases

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	Broca's	Wernicke's	Trans cortical motor	Trans cortical Sensory	Conduction	Global	Anomic
Fluency	non-fluent	fluent	non-fluent	fluent	fluent	non-fluent	fluent
Naming	poor	poor	poor	poor	poor	poor	poor
Repetition	poor	poor	intact	intact	poor	poor	intact
Compre-hension	intact	poor	good	absent	intact	poor	intact

Video Links

- Broca's Aphasia
  - https://www.youtube.com/watch?v=f2IiMEbMnPM
- Wernicke's Aphasia
  - https://www.youtube.com/watch?v=3oef68YabD0

Differential Diagnosis

- Broadly:
  1. Aphasia – think vascular, isolated language deficit +/- hemiparesis and other stroke syndrome features
  2. Dysarthria – slurred speech, but normal syntax/idea construction, and no other language domains affected
  3. Delirium – fluctuating inattention/level of consciousness
  4. Dementia – progressive over time, affects memory, visuospatial function (other cognitive domains)
  5. Psychosis – usually, sentence structure and word form is intact. Associated with agitation, hallucinations, delusions, etc.

Etiologies

1. Vascular, Vascular, Vascular (hemorrhagic and ischemic)
2. Trauma (particularly to the left hemisphere)
3. Tumours
4. Abscesses
5. Focal dyscognitive seizures
6. CNS infections – particularly HSV, HIV, syphilis, tuberculosis
7. Degenerative – Primary Progressive Aphasia. Also seen in FTD, AD, and PD.

Cases

TIME TO PRACTICE

Case 1

- 81 yo RHD female, history of HTN. Sudden onset of nonsensical speech. On exam, irregular S1/S2. Rest of general exam normal. Language exam – fluent, normal prosody and grammatical constructs, however meaningless content with frequent paraphasic errors and repetition. Unable to follow commands other than “close your eyes”. Unable to repeat simple words and called a pen “red rains” and a watch “round thing”. Nonsensical writing and unable to read. Oblivious to deficits.

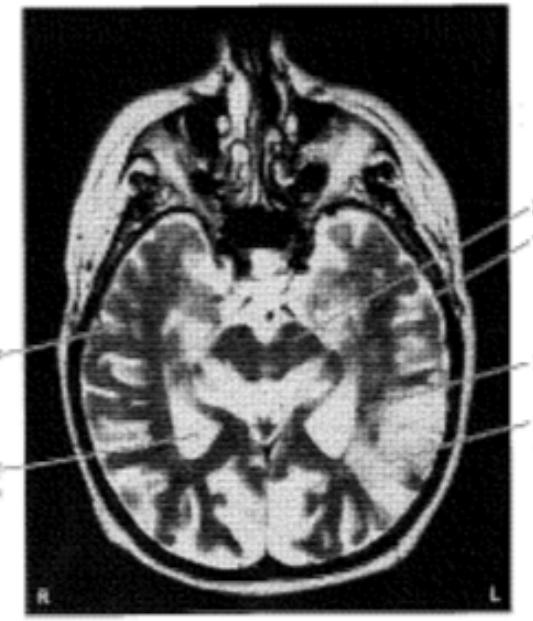
Source: Blumenfeld’s Neuroanatomy through Clinical Cases

Case 1

- Fluent aphasia. Not comprehending. Impaired repetition. Oblivious to deficits.

- Localization?
  - Wernicke's Aphasia in the posterior/superior temporal region and inferior parietal region. As RHD, most likely in left hemisphere.
- Etiology?
  - Vascular

(A)



Source: Blumenfeld's Neuroanatomy through Clinical Cases

Case 2

- 64 yo RHD female with one week progressive issues with vision and reading. History of colon cancer with liver metastases. Exam normal except unable to read written words, mild short-term verbal memory impairment, and right homonymous hemianopia. Writing intact. Mild dysnomia.

Source: Blumenfeld's Neuroanatomy through Clinical Cases

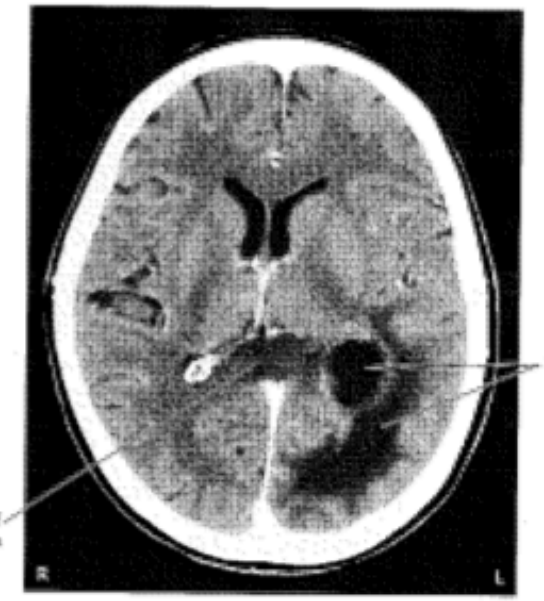
Case 2

- Localization
  - Patient has alexia without agraphia. Mild language dysfunction, but mostly intact. Mainly thinking about damaged connections between the primary visual cortex in the occipital lobe and the language circuits in the perisylvian area. With right homonomyous hemianopia, left optic radiation affected.
- Etiology?
  - With history of cancer and progressive course, consider metastasis. Also on DDx would be slowly evolving PCA infarct or ICH, abscess, or primary CNS neoplasm

Source: Blumenfeld's Neuroanatomy through Clinical Cases

(A)

(B)



Source: Blumenfeld's Neuroanatomy through Clinical Cases

Summary

- Language is not the same as dysarthria
- Language is housed chiefly in the inferior frontal lobe and superior temporal lobe (Broca's and Wernicke's areas), usually on the left
- Left MCA occlusions or hemorrhages in this territory are clinically **very** important causes of aphasia
- Aphasias can be broadly clumped into fluent and nonfluent categories. Think about the anatomy and correlate it with the patient's symptoms to localize the lesion.

References

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   - Kirshner, H. Chapter 12A: Language and Speech Disorders, Aphasia and Aphasic Syndromes. 131-148.
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