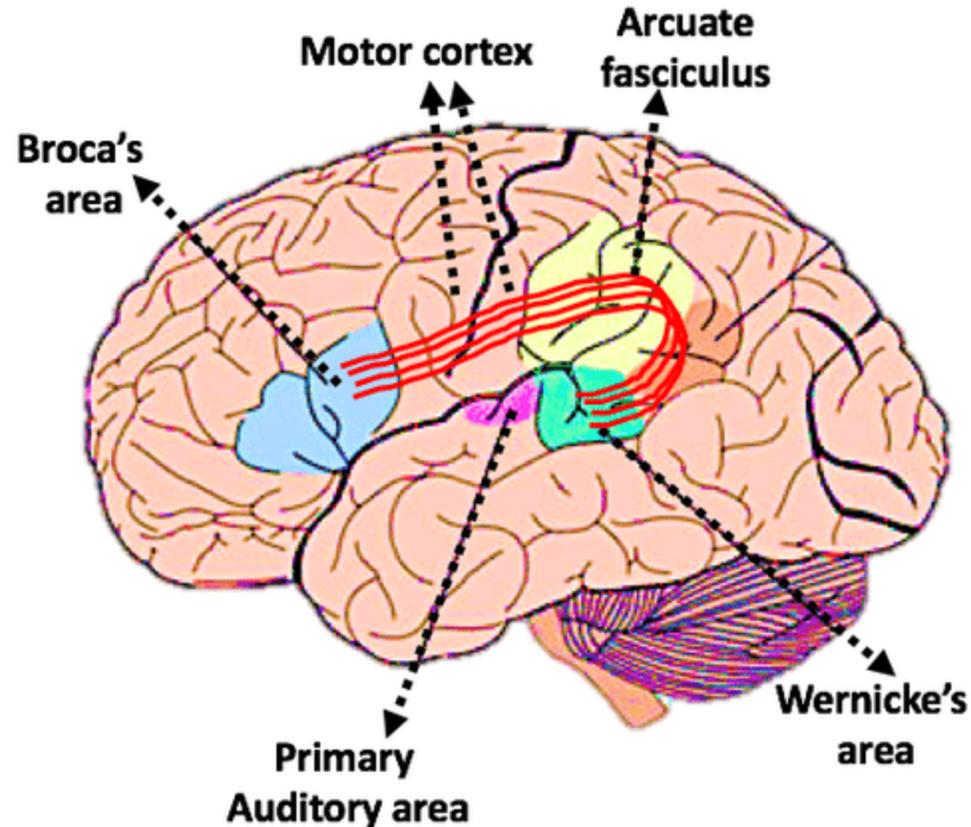


# Round 18: Language and Vision Disorders

04/15/2021

Kristy Snyder Colling, PhD

# Regions involved with Language



**Broca's area:** involved in production of speech sound

**Wernicke's area:** involved in Understanding of speech

**Motor cortex:** controls the Movements of muscles

**Arcuate fasciculus:** connects Wernicke's area to Broca's area.

- Left basal ganglia
- Thalamus
- Supplementary motor areas
- Left temporal pole and left inferotemporal cortex
  - Naming entities belonging to different conceptual categories
- Left temporal cortices
  - Tasks requiring the manipulation of concepts and related words
- Anterior and medial temporal cortex "Basal temporal language area"
  - Word processing

# Aphasia

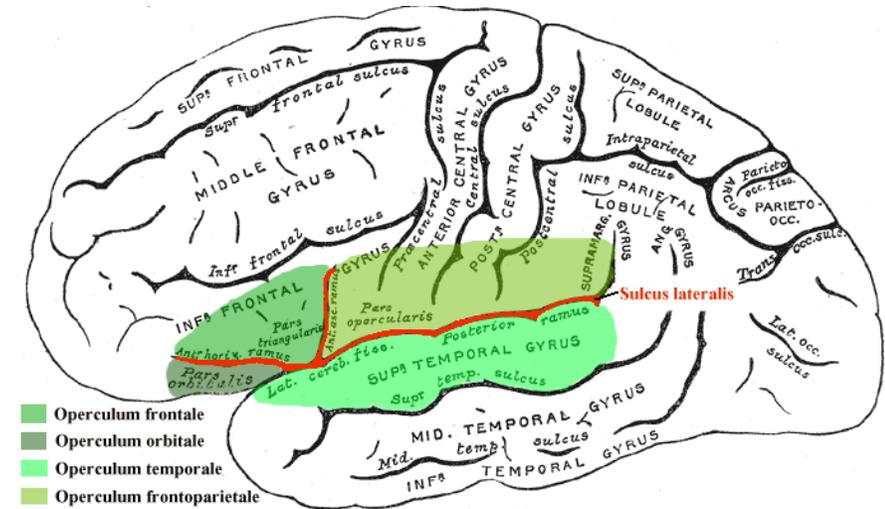
- Disturbance of language processing caused by dysfunction in specific brain regions.
- Compromise the comprehension and/or formulation of language
  - Syntax
    - Grammatical structure of sentences
  - Lexicon
    - Words available to denote specific meaning
  - Morphology
    - Individual speech sounds (i.e., phonemes) form morphemes -> the structure of words
- The structures damaged
  - Part of a neural system involved in both the assembly of phonemes into words and the assembly of words into sentences
  - The temporal ordering of linguistic components
    - System is concerned with the relational aspects of language
    - Including the grammatical structure of sentences & proper use of grammatical morphemes and verbs

# Aphasia

- Breakdown in the two-way translation process that establishes a correspondence between thoughts and language.
  - Not able to translate nonverbal images of thought into the symbols and grammatical relationships of language
  - Inverse is also defective: Once a word or sentence is heard the patient cannot construct the nonverbal images that correspond to the meaning behind the language
- Not a disorder of perception
  - Deaf people can understand language through other channels (vision, touch)
- Not a disorder of movement
  - Dysarthria – uncoordinated speech movements does not affect the formulation of language
- Not a disordered thought process
  - Schizophrenics can fluently articulate their disordered thoughts

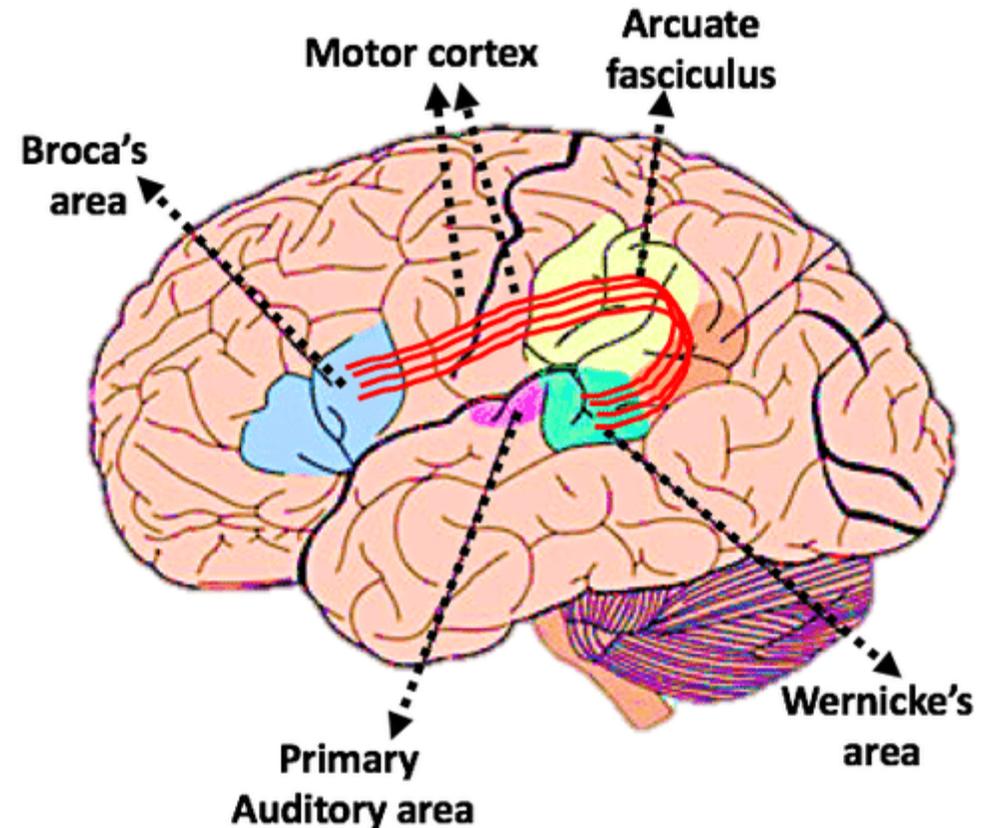
# Broca's Aphasia

- “Expressive Aphasia”
  - Speech is labored and usually slow
  - Pauses between words are more frequent than words themselves
  - Non-fluent
    - No melodic modulation that characterizes normal speech
    - Reduction in number of words
- Patients manage to communicate verbally with some success
  - Word selection is often correct -> words for entities (nouns)
  - Word selection less accurate -> words that stand for actions (verbs) & relationships (e.g., conjunctions, prepositions)
  - Defective retrieval of verbs and normal retrieval of nouns -> Lesions in the left frontal operculum, involving both prefrontal and premotor cortex and underlying white matter



# Broca's Aphasia

- Defective verbatim sentence repetition
  - They understand the sentence but can't repeat it
- Agrammatism
  - Inability to organize words in sentences according to grammatical rules
    - Canonical word order for English is violated
      - "Go I home tomorrow" instead of "I will go home tomorrow"
  - Improper use or lack of use of grammatical morphemes
    - Inflectional affixes used as verb endings to signify tense
      - (e.g., -ed, in the past tense loved; e.g., -ing in dancing)

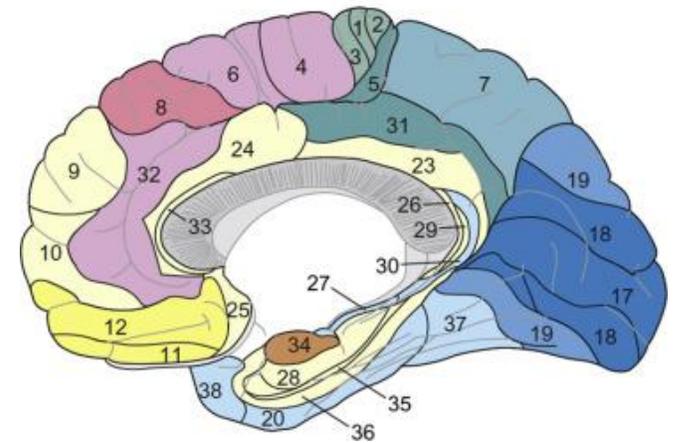
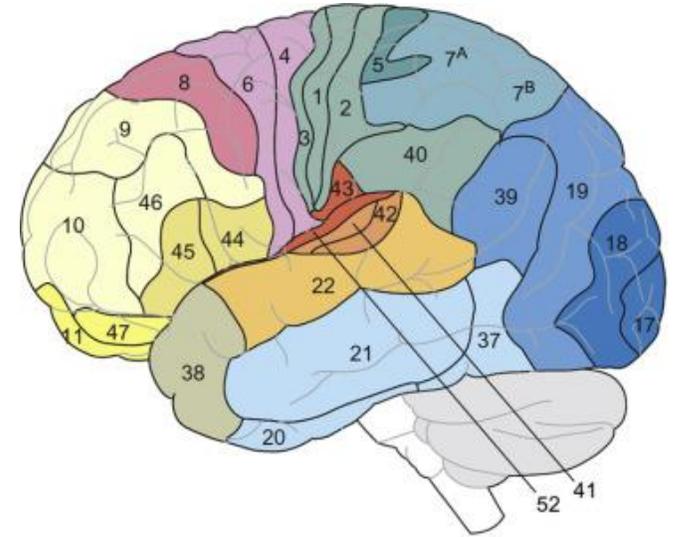
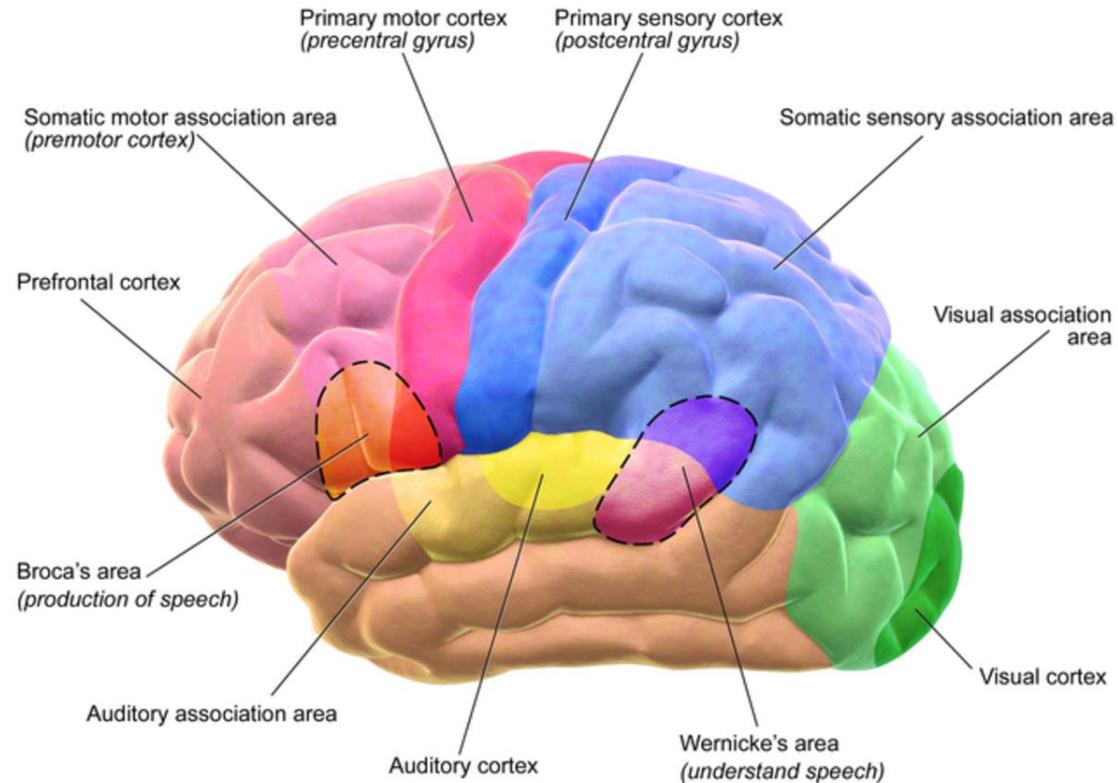


# Wernicke's Aphasia

- “Receptive Aphasia”
  - Speech is "fluent"
    - Effortless, melodic, produced at normal or faster than normal rates.
  - Content of speech is unintelligible
    - Word choice errors
  - Difficulty comprehending language
- Wernicke's area is not center of auditory comprehension
  - It is processor of speech sounds
    - Recruits auditory inputs to be mapped as words and to be used subsequently to evoke concepts
    - Auditory comprehension occurs later in a chain of events initiated in Wernicke area, when the concepts that are associated with a given word's records become activated and attended.
- Wernicke's area should also not be seen as a center for word selection
  - Once a word is selected for possible use in an utterance, Wernicke's area is part of the system needed to implement its constituent speech sounds, in the form of internal auditory and kinesthetic representations which support the upcoming vocalization

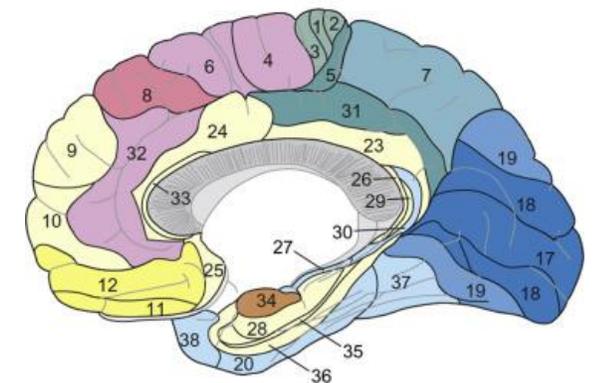
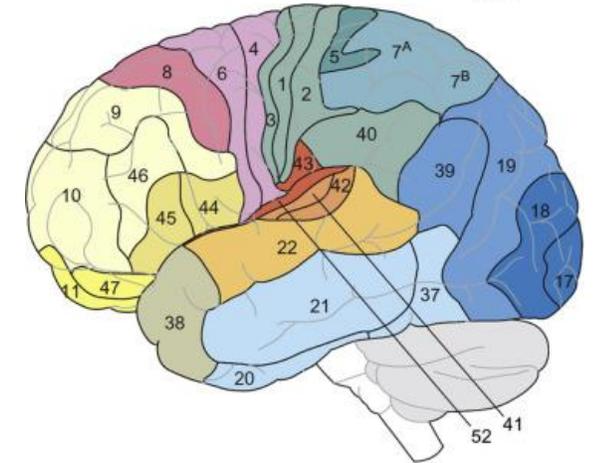
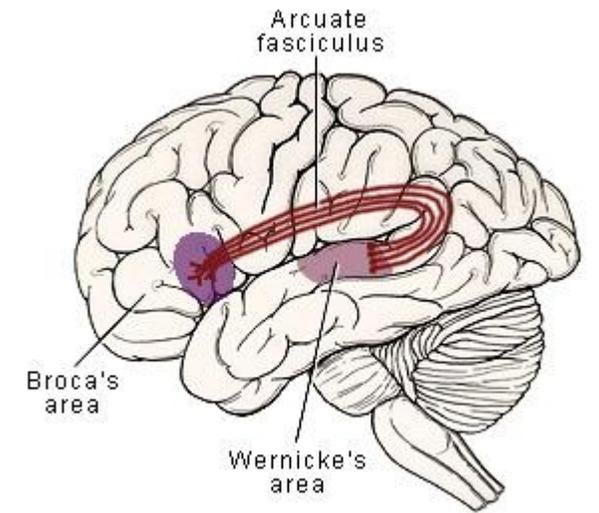
# Wernicke's Aphasia

- Usually caused by damage to the posterior sector of the left auditory association cortex (BA22).
  - Often involvement of BA 37, 39 and 40



# Conductive Aphasia

- Can
  - Comprehend simple sentences
  - Produce intelligible sentences
- Cannot
  - Repeat sentences verbatim
  - Assemble phonemes effectively
  - Name objects correctly in confrontation naming tasks
- Arcuate Fasciculus part of the system required to assemble phonemes into morphemes, an operation necessary for the vocalization of a word perceived auditorily or generated internally, in the mind's ear
- Damage in one of two regions:
  - Left BA 40 (supramarginal gyrus), with or without extension to the white matter underneath the posterior insula
  - Left primary auditory cortices (BA41 and 42), the insula, and the underlying white matter

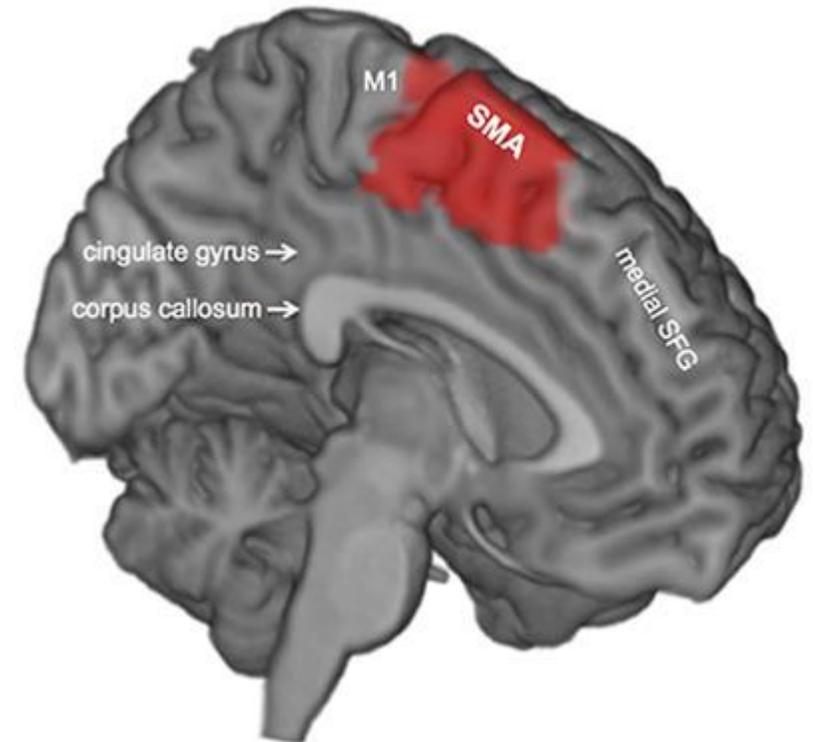


# Global Aphasia

- Almost complete loss of the ability to comprehend language or formulate speech
  - Combination of the features of Broca's and Wernicke's aphasias
- Deliberate speech, also known as "prepositional" speech, is reduced to a few words and sentences
  - Only effective aspect of verbal communication consists of stock expletives
    - Example: "Goddamn it"—used appropriately and with normal phonemic, phonetic, and inflectional structures
  - “Automatic” speech routines also intact
    - Examples: Counting or reciting the days of the week and singing parts of previously learned melodies and their lyrics
- Damage
  - Anterior language region (i.e., Broca’s area)
  - Basal ganglia region
  - Insula and auditory cortices (i.e., conduction aphasia)
  - Posterior language region (i.e., Wernicke’s area)
- This large degree of damage is caused by a large infarct in the region supplied by the middle cerebral artery

# Akinesia

- Loss of the ability to move muscles voluntarily
- Damage to left supplementary motor area & anterior cingulate
- Role in the initiation & maintenance of speech, as well as attention & emotion
- Akinetic-mutism
  - Failure to communicate by spoken word, gestures, or facial expressions
  - Loss of drive to communicate
  - If they recover, they report a reduction in range and resonance of thought processes and will to speak



# Non-Dominate Hemisphere

- Right hemisphere (typically)
  - Discourse
    - Ability to tell or comprehend a story or joke
  - Kinesics
    - Limb, body, and facial movements that accompany discourse and modulate the verbal message
      - Pantomime
        - Movements that are used to express mutually agreed-upon symbols that convey semantic information (e.g., the peace sign)
        - May be mostly mediated by left structures
      - Gestures
        - Movements that color, emphasize, and embellish speech
        - May be mostly mediated by right structures
  - Prosody
    - Pitch, intonation, inflections, stresses, melody, cadence, tempo, accent, pause timing of speech that give language meaning beyond the literal dictionary definitions

# Prosody

- Intrinsic
  - Used to clarify meaning
  - Equivalent to commas, colons, semicolons, periods, and question marks in written language
- Dialectal/Idiosyncratic
  - Regional and individual differences in enunciation, pronunciation, stresses, and pause patterns
- Intellectual
  - Imparts attitudinal information and may drastically influence meaning
    - “He is clever”
      - if **is** is stressed it denotes an acknowledgement of ability
      - If **clever** is emphasized it denotes sarcasm
- Emotional
  - Inserts moods and emotions (e.g., happiness, sadness, fear, and anger)
  - If a statement contains an affective-prosodic intent that is at variance with its literal meaning, the former usually takes precedence in the interpretation of the message
  - The paralinguistic features of language may play an even more important role in human communication than the exact choice of words

# Aprosodia

- Focal damage to the right hemisphere selectively impairs the production, comprehension, and repetition of affective prosody without disrupting the prepositional elements of language.

Damage to ...	Impairs
Right hemisphere	Ability to insert affective variation into verbally neutral sentences
Posterior-inferior frontal lobe, including pars opercularis and triangularis (homolog to Broca's area)	Spontaneous (production) of affective prosody
Posterior-superior temporal lobe (homolog to Wernicke's area) & right posterior temporoparietal operculum	Comprehension of affective prosody

- Damage may be in left or in corpus collosum
  - Speech production requires interhemispheric interaction to ensure that the articulatory-verbal and affective-prosodic elements achieve behavioral unification and temporal coherence
    - The right hemisphere must be appraised by the left hemisphere of which words to say and their cadence so that it can correctly insert the intended affective-prosodic intonation

# Aprosodia

- Speakers of tone languages use different acoustical strategies to signal affect in speech because of the need to preserve tone contrasts that are essential for word meaning.
- The acoustic profiles of Taiwanese patients with right hemisphere lesions and motor types of aprosodias are distinctly different from English-speaking patients with similar types of aprosodias
- Suggests that it is the behavioral goal rather than the innate ability of each hemisphere to control a certain set of acoustical features that drives the lateralization of communicative functions.

<b>Mandarin Character</b>	<b>Phoneme/Tone</b>	<b>English Meaning</b>
媽	ma —	mother
麻	ma /	numb(ness)
馬	ma ✓	horse
罵	ma \	[curse]

# Agnosia

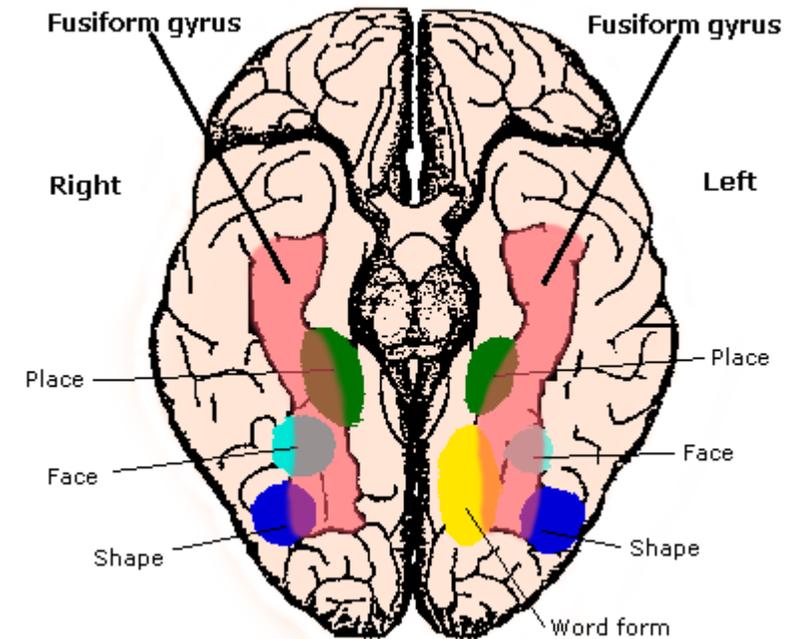
- “A normal percept stripped of its meanings”
- A visual disorder of cognition -> alert, attentive, & intelligent patient with normal visual perception does not know the meaning of visual stimuli (i.e., cannot recognize)
- Distinction b/t perception & recognition
  - Perception -> Object is seen
    - Report accurate description of stimuli (e.g., shapes, number, position, and distribution in space)
    - Copy a drawing of an object or match an actual object with the appropriate drawing or photograph of a similar object
- Distinction b/t naming & recognition
  - Naming deficit -> Pt knows what the object is and what it is used for
    - Tested by inquiring about the use and functional category of the object
    - Have the patient produce responses pertinent to the object both by manipulating it or by choosing logically connected items from a multiple choice display.

# Prosopagnosia

- From the Greek “Prosopon” -> face & “Gnosis” -> knowledge
- Inability to recognize previously known faces (the retrograde defect)/ learn new ones (the anterograde defect)
  - Face appears unfamiliar but voice and other clues (e.g., body build, attire, movements, and posture) are recognized
- Not specific to human faces
  - Examples:
    - Farmer will no longer be able to recognize his cows individually
    - Bird-watcher will no longer identify different species of birds
- Failure to recognize stimuli that belong to a group containing numerous, visually "ambiguous" stimuli
  - Stimuli that share the same type of subcomponents, that are arranged in the same way, and that can be distinguished only by relatively minor differences of shape or size of subcomponents
- Defect of visually triggered memory -> memories of visual stimulus fail to be evoked, which blocks the activation of the multimodal memory traces on which the matrix of recognition is built
  - dysfunction responsible for prosopagnosia
    - Interferes with activation of records pertinent to the face
    - destroys the records

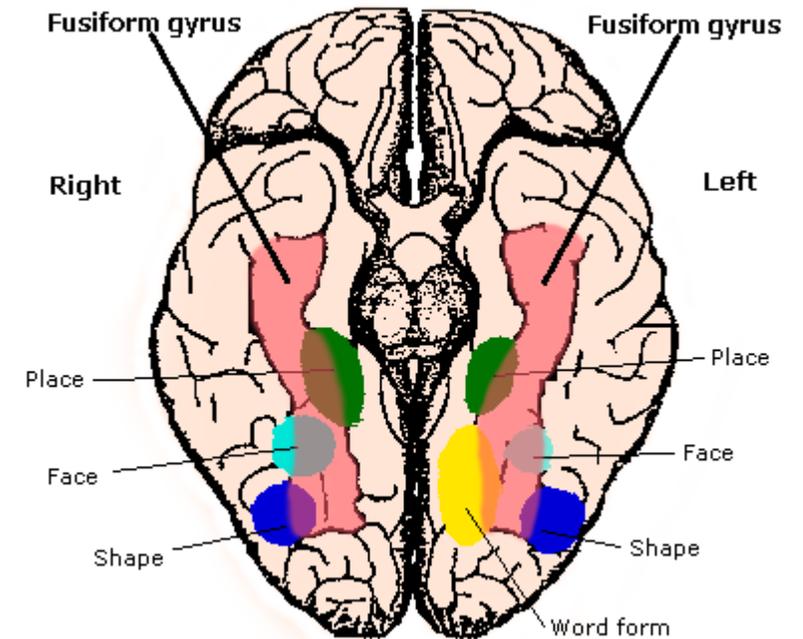
# Recognition Deficits

- Prosopagnosia related to damage in the fusiform face area
  - Decoding emotion/ mood from facial expressions is usually intact
    - Deficits due to Amygdala damage
      - Amygdala also involved in making social judgments of a person (e.g., whether they are trustworthy)
- Visual Object Agnosia aka "general" or "category-specific"
  - Behaviorally and anatomically distinct from prosopagnosia
    - Unable to recognize the generic class of an object
      - E.g., Do not know that a face is a face or that a car is a car
    - May also have visual naming defect with intact auditory & tactile naming
    - May suddenly "unblock" their agnosia to name or describe the use of an object when it is moved or rotated



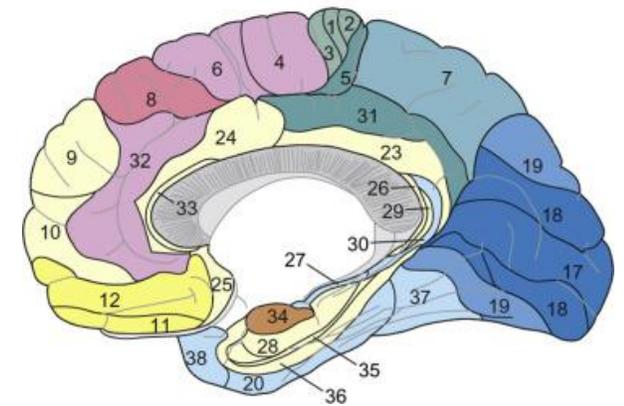
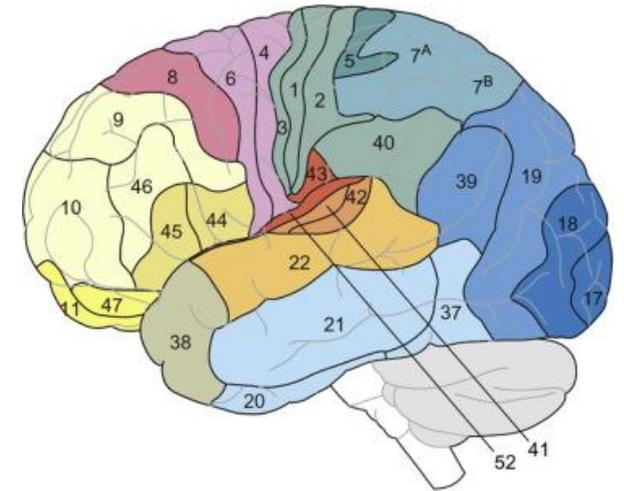
# Recognition Deficits

- Alexia aka “Word Blindness”
  - Perceive words/ sentences but cannot do the pattern recognition necessary to read it
    - They can copy text but not comprehend it
- Disorders of Topographic/Spatial Orientation
  - Inability to locate a public building, one’s room, and to describe either verbally or by map how to get to a specific place
  - Cannot access previously stored memories that would assist in establishing bearings and plan a route
  - Parahippocampal place area (PPA) -> perceiving the local visual environment, an essential component of navigation
    - PPA represents places by encoding the geometry of the local environment



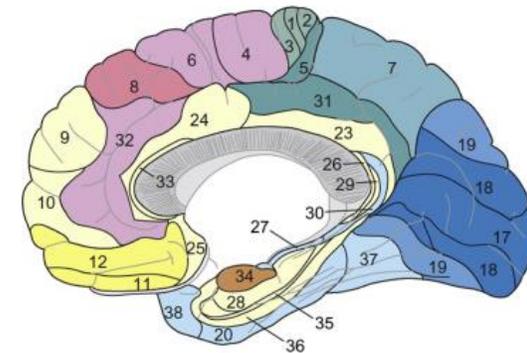
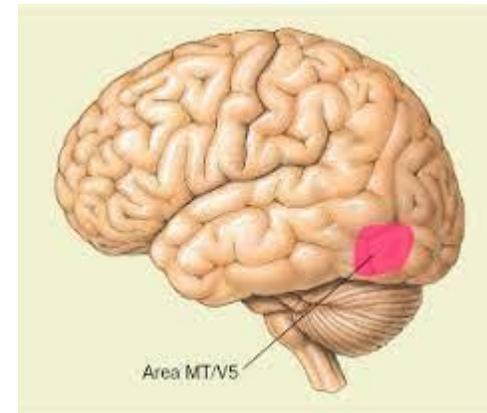
# Balint's Syndrome

- Acquired disturbance of the ability to perceive the visual field as a whole
- Simultanagnosia
  - Unpredictable perception and recognition of only parts of it
- Optic Ataxia
  - Impairment of target pointing under visual guidance
- Ocular Apraxia
  - Inability to shift gaze at will toward new visual stimuli
- Damage to bilateral dorsal occipitoparietal region
- Usually areas 7, 19, and 39
- Infarctions in the border zone (watershed) between the anterior and posterior cerebral artery territories
- Elderly individuals with low blood pressure



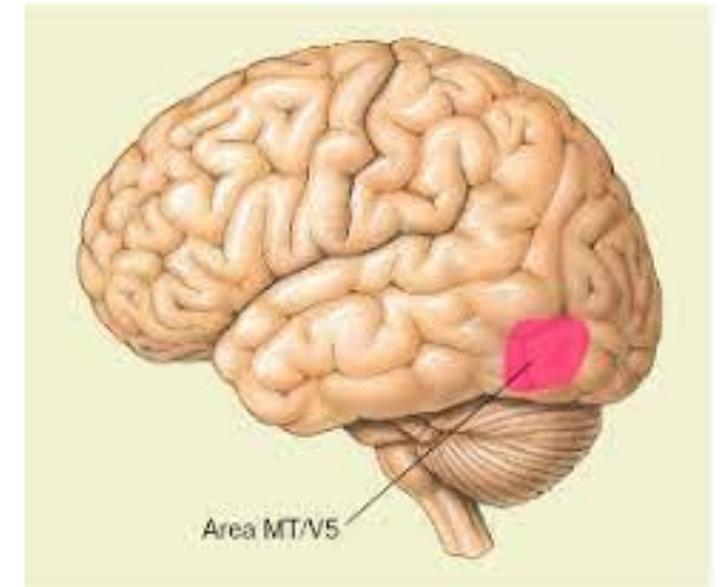
# Cerebral Akinetopsia

- Acquired defect of motion processing caused by cerebral lesions
  - May result from defective smooth-pursuit eye movements or trouble perceiving motion-defined objects (structure-from-motion or kinetic depth)
  - Damage around the angular gyrus, parietal-temporo-occipital, and parieto-occipital regions and may be part of a more pervasive disturbance (as in Balint's syndrome or Alzheimer's disease).
- Pt L. M.
  - Could see movement in slowly moving targets, but targets moving at greater than 10 to 14° per second seemed to materialize at successive positions with no movement in between.
  - Smooth ocular pursuit of moving targets broke down at 8° per second
  - Reduced perception of motion aftereffects, the spiral aftereffect elicited no sense of motion-in-depth, and she reported seeing changes in position but not movement in depth when a target was moved toward and away from her
- Damage to occipito-temporoparietal and a parieto-occipital location
  - Dorsolateral lesions overlap the localizations provided by functional neuroimaging studies for a human motion processing region.
  - BA 19 & 37



# Area MT

- Contains a large proportion of neurons that are sensitive to stimulus direction, speed, orientation, and binocular disparity
- Active during perceptual decisions on these properties
- Contributes to motion direction and even shape-from motion perception
- Processes different types of motion
  - First-order motion - change in luminance over space and time (e.g., when a shadow passes over the ground).
  - Second order motion - absolute change in contrast, not just luminance
  - Third order motion - pattern-tracking motion that is attention dependent
- Role in extracting salient information from noise
- Lesions of the dorsolateral pathways (as seen in pt LM) can affect object recognition whether the cues that define the object are moving or static
  - Incompatible with the hypothesis that shape and object perception/recognition are exclusive of ventral “what” pathway



# Constructional Apraxia

- Impairments in the ability to construct a copy of a visually presented model by means of assembling blocks or by drawing
- Construction tasks performance presupposes normal visual acuity, the ability to perceive the several elements of the model as well as their spatial relationship, and adequate motor ability.
- Usually related to right parietal regions
- Language defect can contribute to the disturbance
  - Lesions may be located closer to the language cortices of the left hemisphere
  - Association of symptoms on the basis of anatomic contiguity

Thank You