

# White matter matters!

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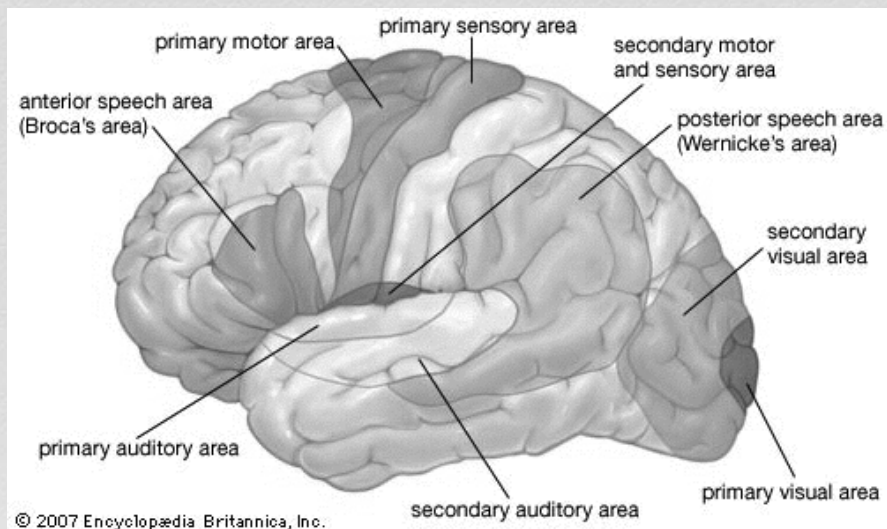
## disclosure

- ✿ *Dr. Howland is receiving an honorarium for this talk*
- ✿ *Dr. Howland wrote a course for [speechpathology.com](http://speechpathology.com) called 'A neuroscience primer for SLPs' and 'Music based interventions with autism'. She was paid for these talks but does not receive subsequent fees for viewership*
- ✿ *There are no other relevant financial or non-financial relationships to disclose*

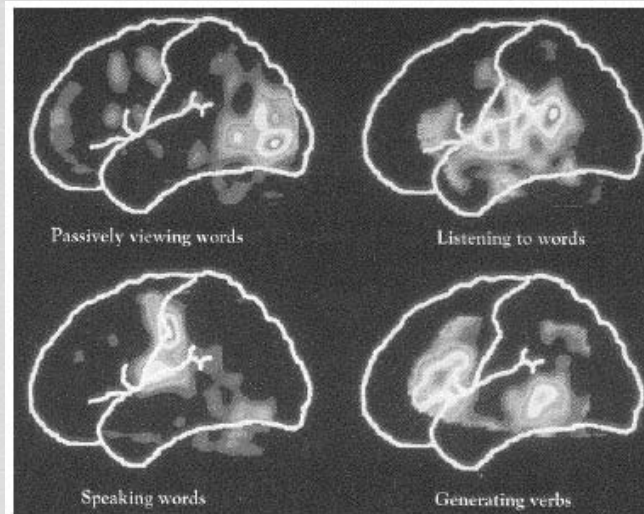
# agenda

- ✿ *distinguish grey/white matter*
- ✿ *identify neuroimaging technology advancements*
- ✿ *arcuate fasciculus and its role in speech/language*
- ✿ *consider the advantages of singing*

# neuroanatomy



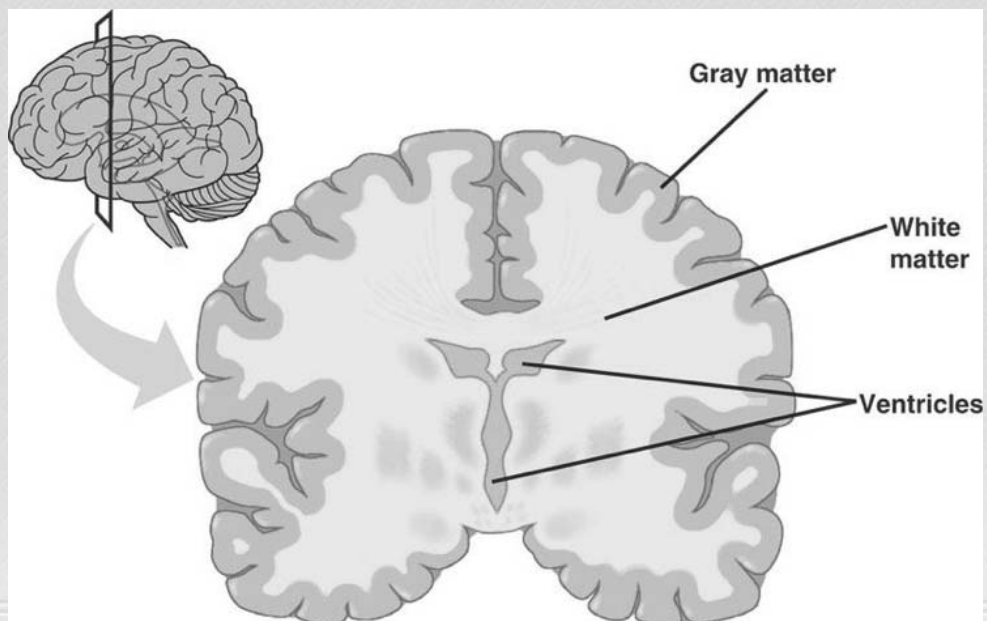
# PET scan of speech/language



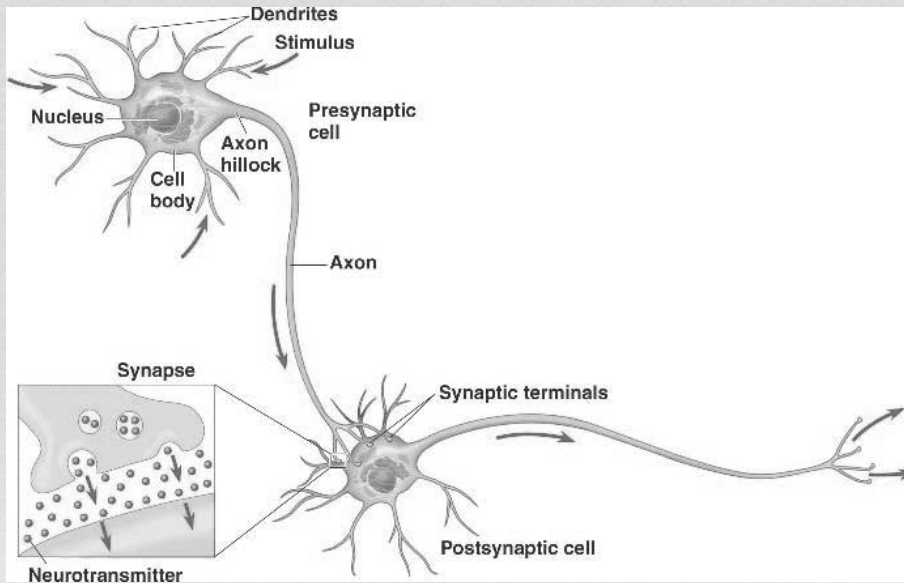
(from Posner & Raichle, 1994, p. 115)

**Fig. 3**

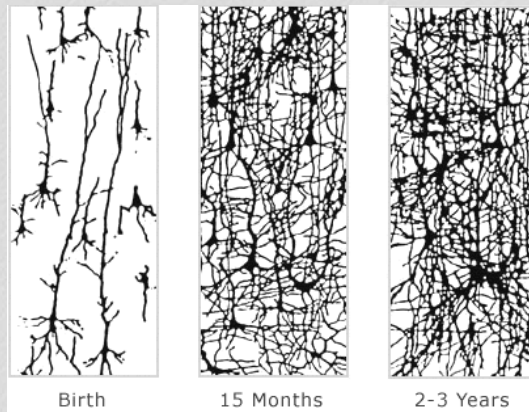
# grey and white matter



# the neuron



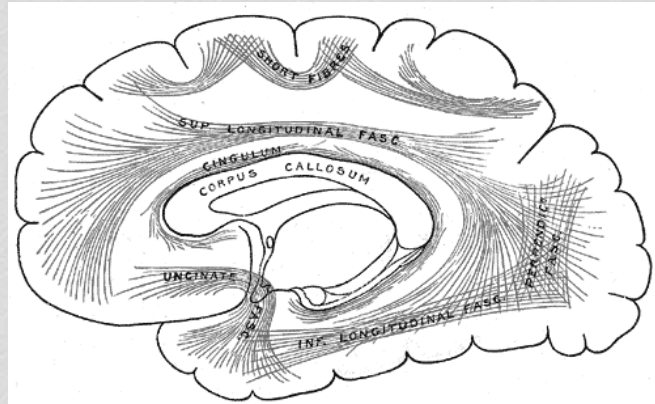
# dendritic arborization





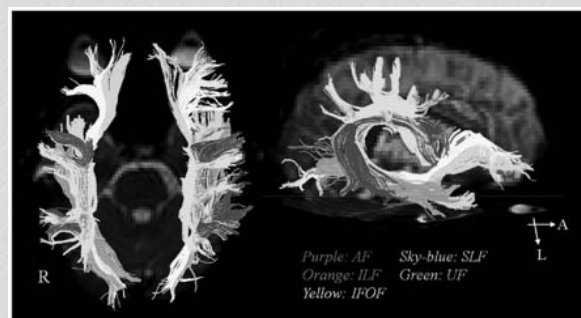
# white matter

- *intrahemispheric*
  - *arcuate fasciculus*
- *interhemispheric*
  - *corpus callosum*



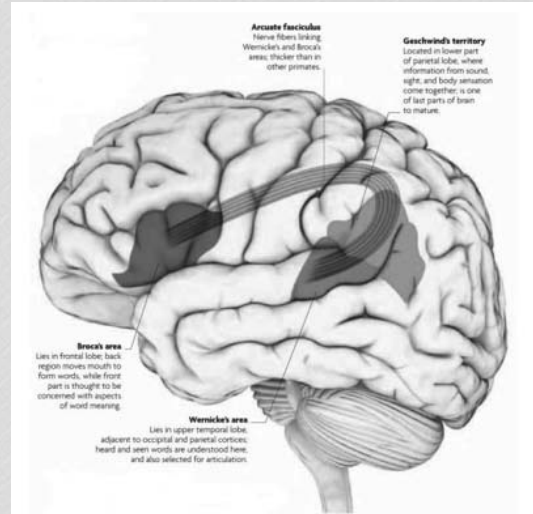
# neuroimaging of white matter

- *diffuse tensor imaging*
  - *provides information about ischemia, myelination, axonal damage, inflammation, and edema*



# arcuate fasciculus

- ✿ *plays an important role in auditory-motor mapping*
- ✿ *the left AF underlies language processing*



# purpose of interventions

- ✿ *to drive behavioral outcomes*
  - ✿ *functional speech and language*
- ✿ *to drive neural changes*



# what drives neural changes?

- *neuroplasticity*
  - *meaningful engagement*
  - *complexity*
  - *repetition*
  - *novelty*
  - *positive emotions*



## Neuroplasticity

Our routines make routes in our brain. It's empowering to know that we can re-route our brains with mindfulness, to make better habits and more helpful thought patterns.

### 1 MENTAL ACTIVITY

This can be a thought, feeling, or action.

### 2 CREATION OF NEW NEURAL STRUCTURES

Neurons fire together, forming a brief connection by communicating through gaps called synapses.

### 3 REPETITION OF MENTAL ACTIVITY

### 4 STRENGTHENING OF NEURAL CONNECTION

Neurons wire together to make more lasting circuits.

With attention, we can direct how this neural substrate is built - & rebuilt!

We can strengthen the pathways we want by thinking in the way we want to be.

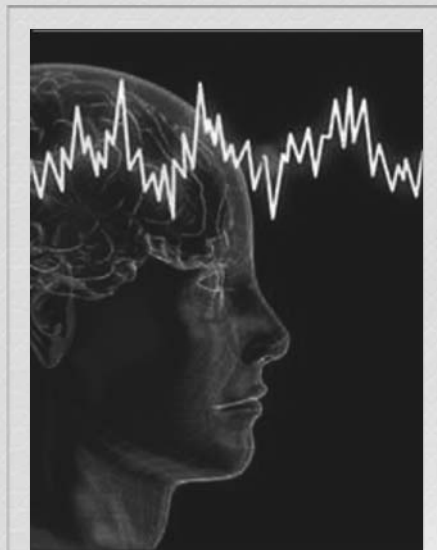
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# why music?

- *music is nearly universal*
- *shared and distinct networks with speech*
- *leverages one's strengths against their deficits*
- *repetition in music is more favorable than repetition in speech*
- *spectrum of simple to complex*
- *endless opportunities*
- *multimodal activity that integrates sensorimotor systems*
  - *strong coupling of perception and action*

# targeted populations for singing

- *Parkinson's disease*
- *aphasia*
- *autism*
- *stuttering*





# MIT

- ✿ *criteria for intervention*
  - ✿ *nonfluent aphasic patients can sing and struggle to talk*
  - ✿ *comparatively intact comprehension skills*
- ✿ *repetition of functional phrases with 2 tones, continuous voicing and left hand tapping*
- ✿ *studies have shown MIT transfers to untrained contexts after 40 sessions (Schlaug, et al. 2008)*

## Melodic Intonation Therapy

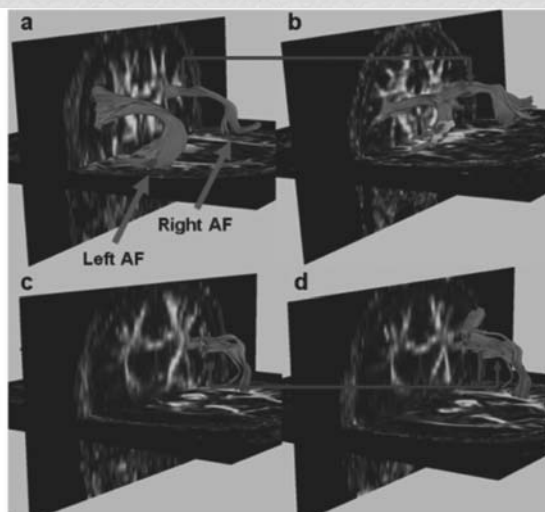


FIGURE 1. The arcuate fasciculus (AF) fiber bundles of: a healthy nonmusician (a); a healthy professional singer (b); a patient with Broca's aphasia before (c) and after (d) intensive melodic intonation therapy. This patient has no left AF due to his left hemispheric stroke.

(Wan et al, 2010)

# singing

- ✿ *the right AF is more developed in singers than nonsingers and non musicians*
  - ✿ *presumably due to training*
- ✿ *singing engages auditory-motor regions of the right hemisphere, and intense therapy over a long period of time may lead to structural adaptations in gray and white matter (Schlaug et al., 2008 and 2009)*



# what to sing?

- ✿ *'warm-up' exercises*
- ✿ *known, familiar songs*
- ✿ *unknown, unfamiliar songs*
- ✿ *songwriting, improvisation*



## summary

- ✿ *white matter matters and is on the forefront of being studied and better understood*
- ✿ *white matter has a key role in effective communication*
- ✿ *white matter tracts can change with music-based intervention*
- ✿ *improve timing of outcomes with more music*

## web resources

- ✿ *Music and Brain Lab at Beth Israel Hospital, Boston*
  - ✿ [www.musicianbrain.com](http://www.musicianbrain.com)
- ✿ *Auditory Neuroscience Lab at Northwestern University*
  - ✿ [www.brainvolts.com](http://www.brainvolts.com)
- ✿ *my website- I welcome questions and comments!*
  - ✿ [www.kathleenhowland.com](http://www.kathleenhowland.com)