Measurement of higher brain function in humans

Michael S. Beauchamp, Ph.D.

Assistant Professor
Department of Neurobiology and Anatomy

Adjunct Assistant Professor
Departments of Psychology and Bioengineering

Adjunct Assistant Professor
Department of Neuroscience

Michael.S.Beauchamp@uth.tmc.edu

Higher Brain Functions, Mariella De Biasi, Course Director
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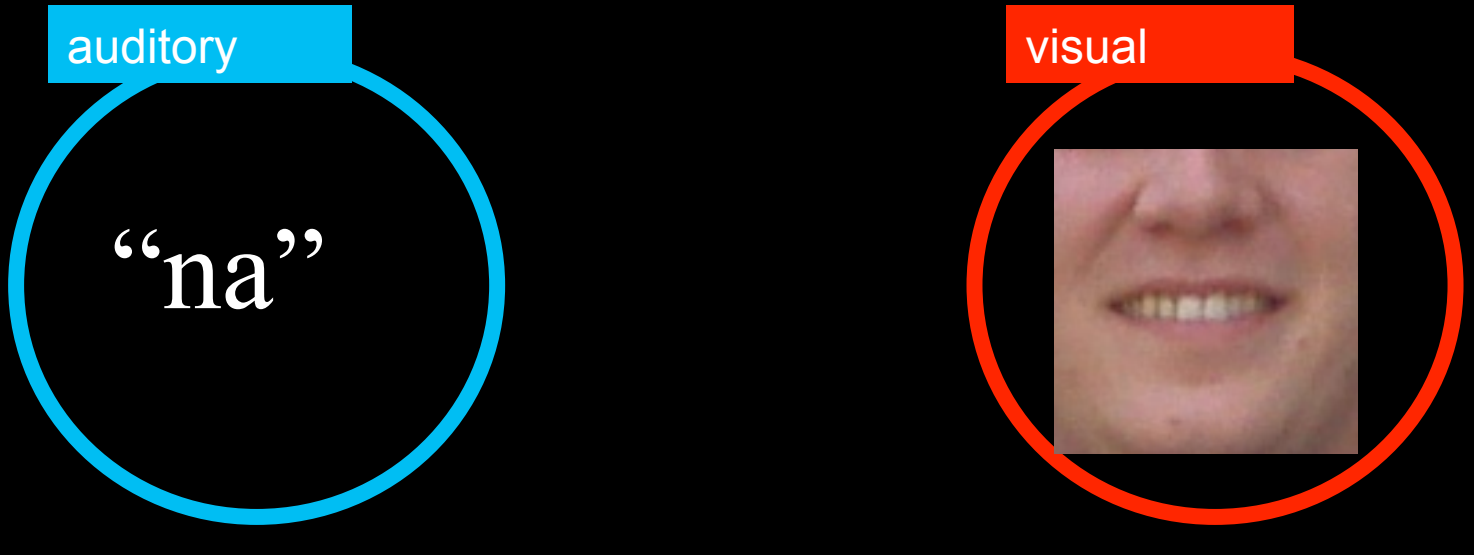
General utility of multisensory integration

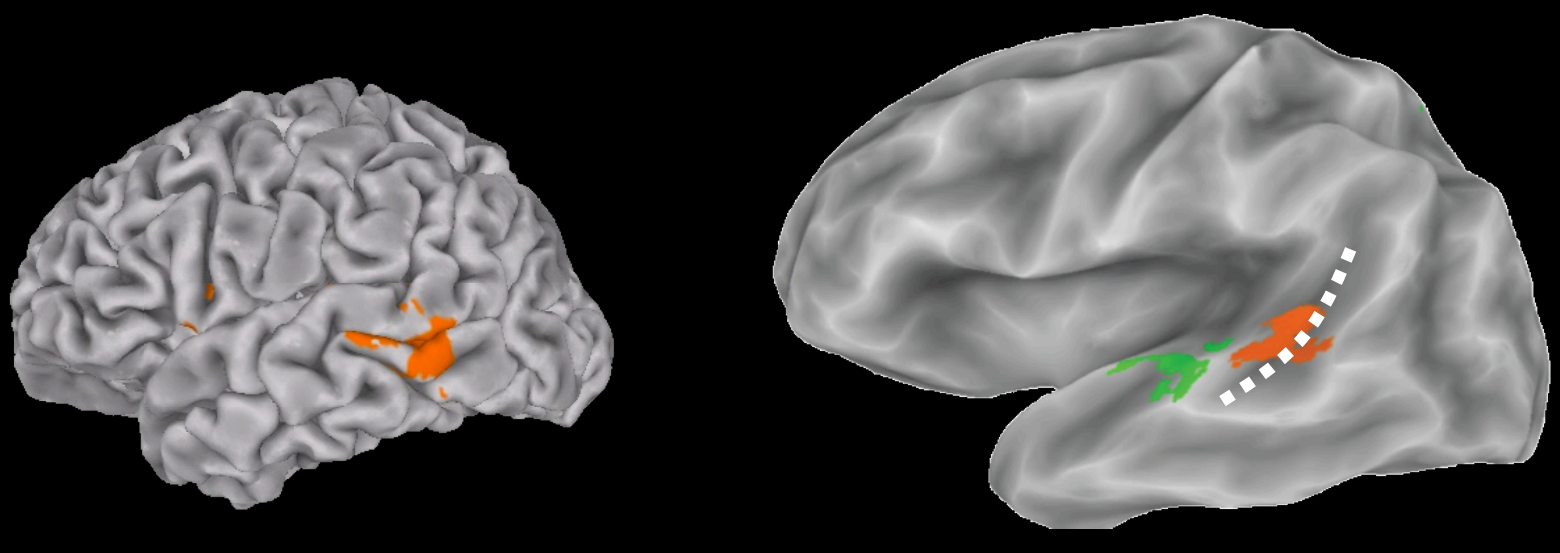
- Independent sources of information about the world



Fascinating—but what are the neural mechanisms?

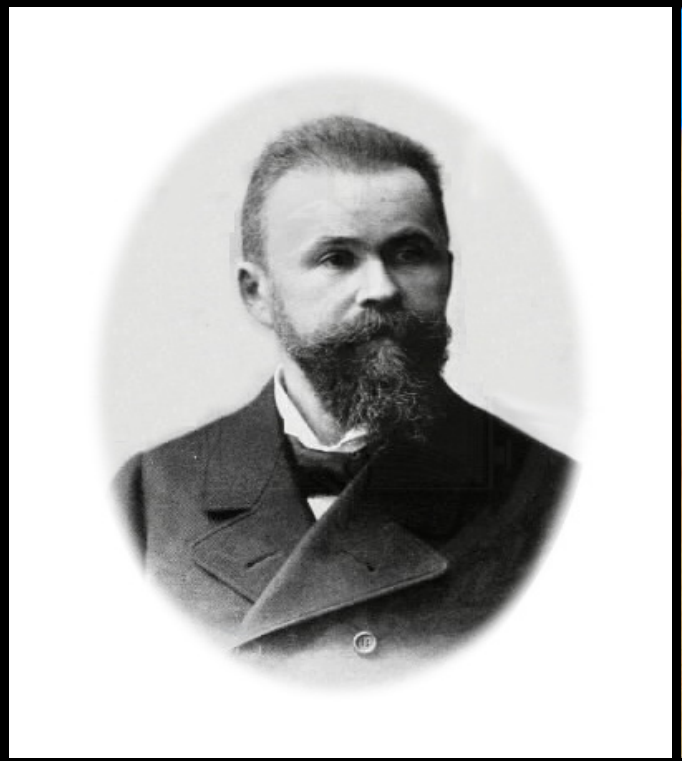
The Superior Temporal Sulcus

A brain hub for multisensory integration and biological motion perception



Beauchamp et al., *Neuron,* 2002; *Journal of Cognitive Neuroscience,* 2003, *Neuron,* 2004; *Nature Neuroscience,* 2004; *Neuroimage,* 2008; *Journal of Neuroscience,* 2010, *Journal of Neuroscience,* 2011

Speech perception



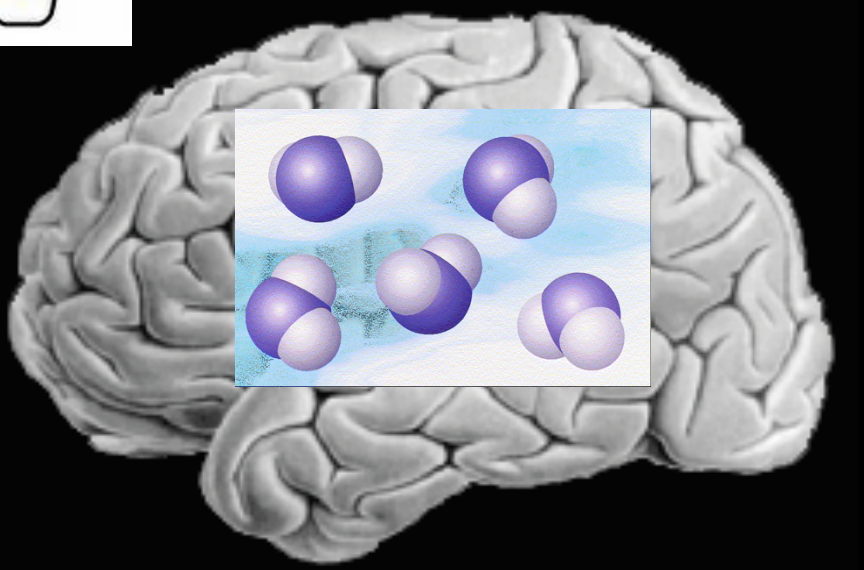
Wernicke's Area: Carl Wernicke, 1874

+ a network of areas (e.g. Scott & Johnsrude, 2003)

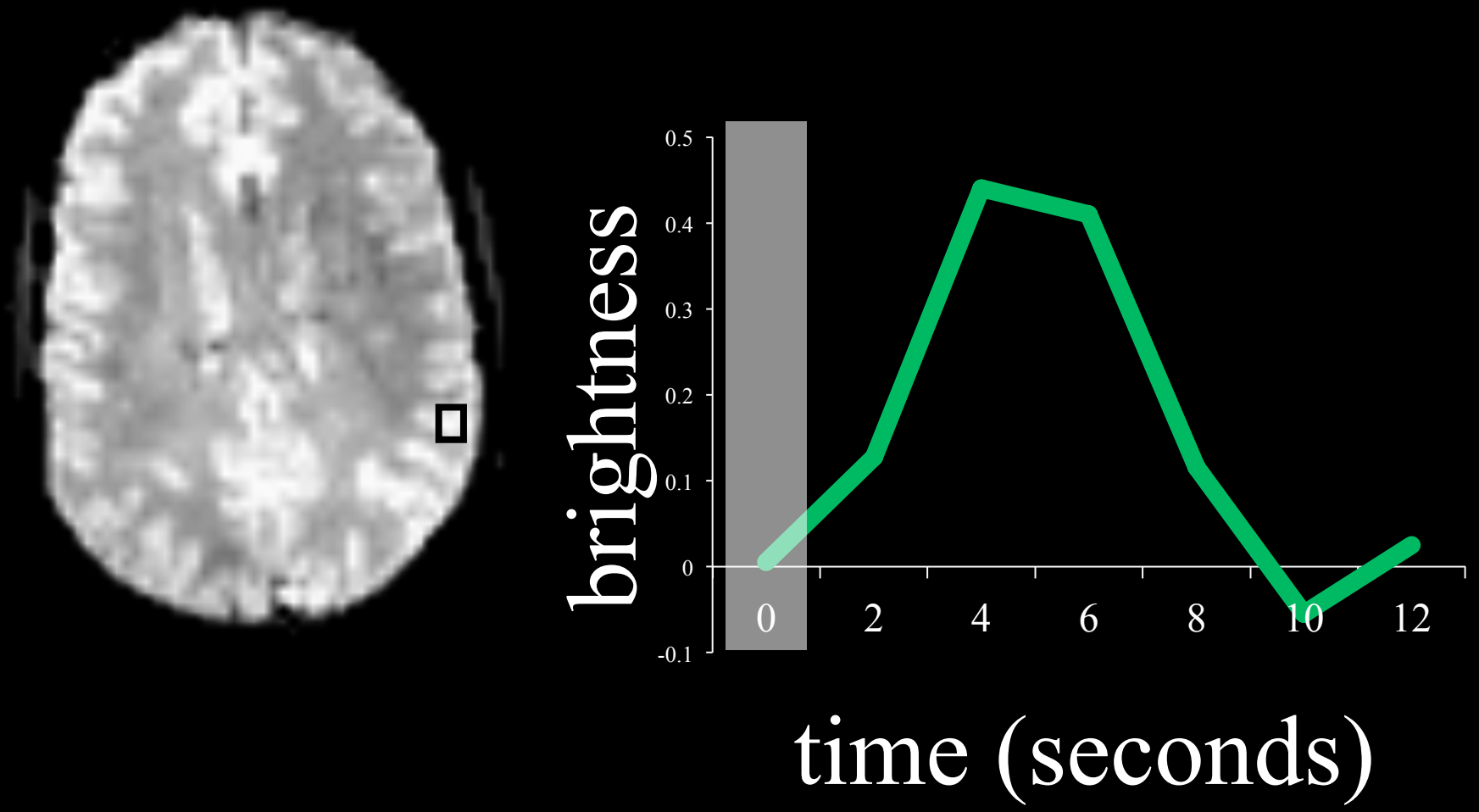
fMRI (functional Magnetic Resonance Imaging)

Basic principle: uses radio waves to interrogate protons in water molecules in the brain

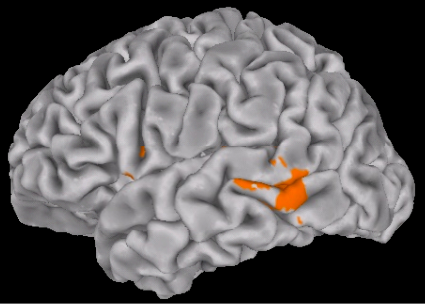
Discoverer: Seiji Ogawa, *PNAS*, 1990

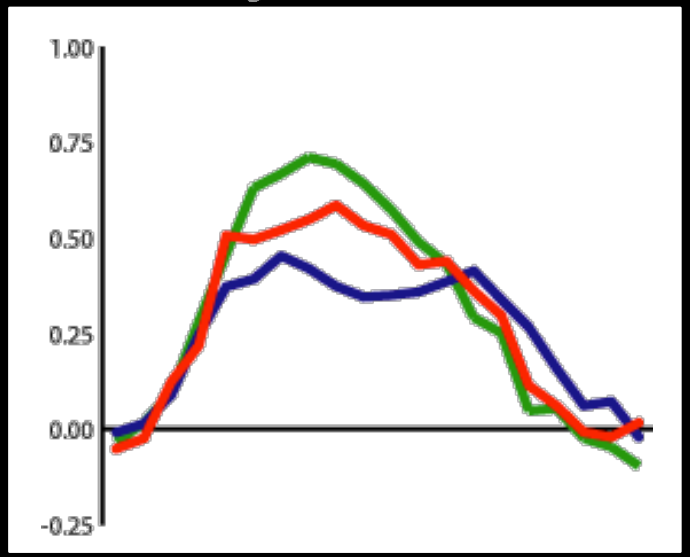


Basic fMRI experiment

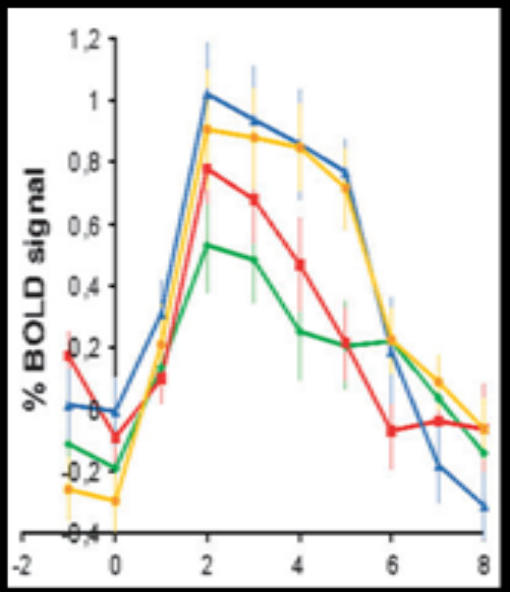


fMRI of multisensory integration in the STS

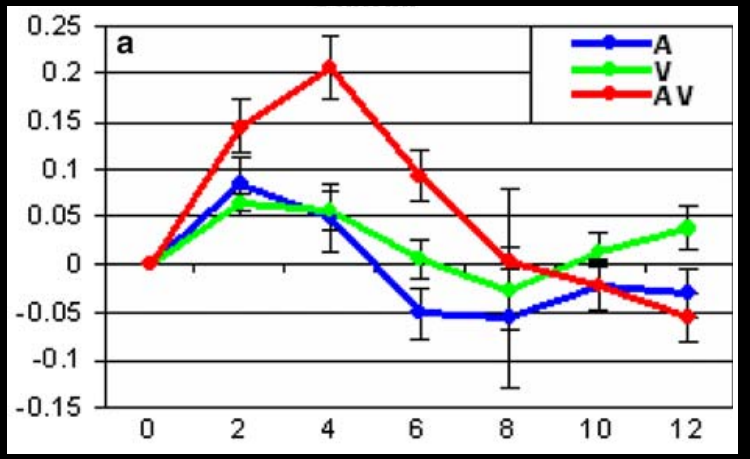




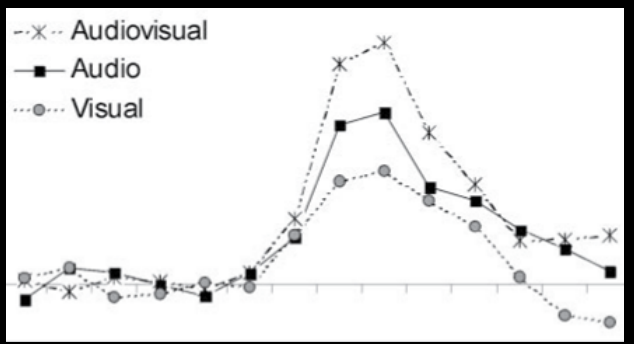
Beauchamp et al., *Neuron,* 2004



van Atteveldt et al., 2007



Stevenson et al., 2007

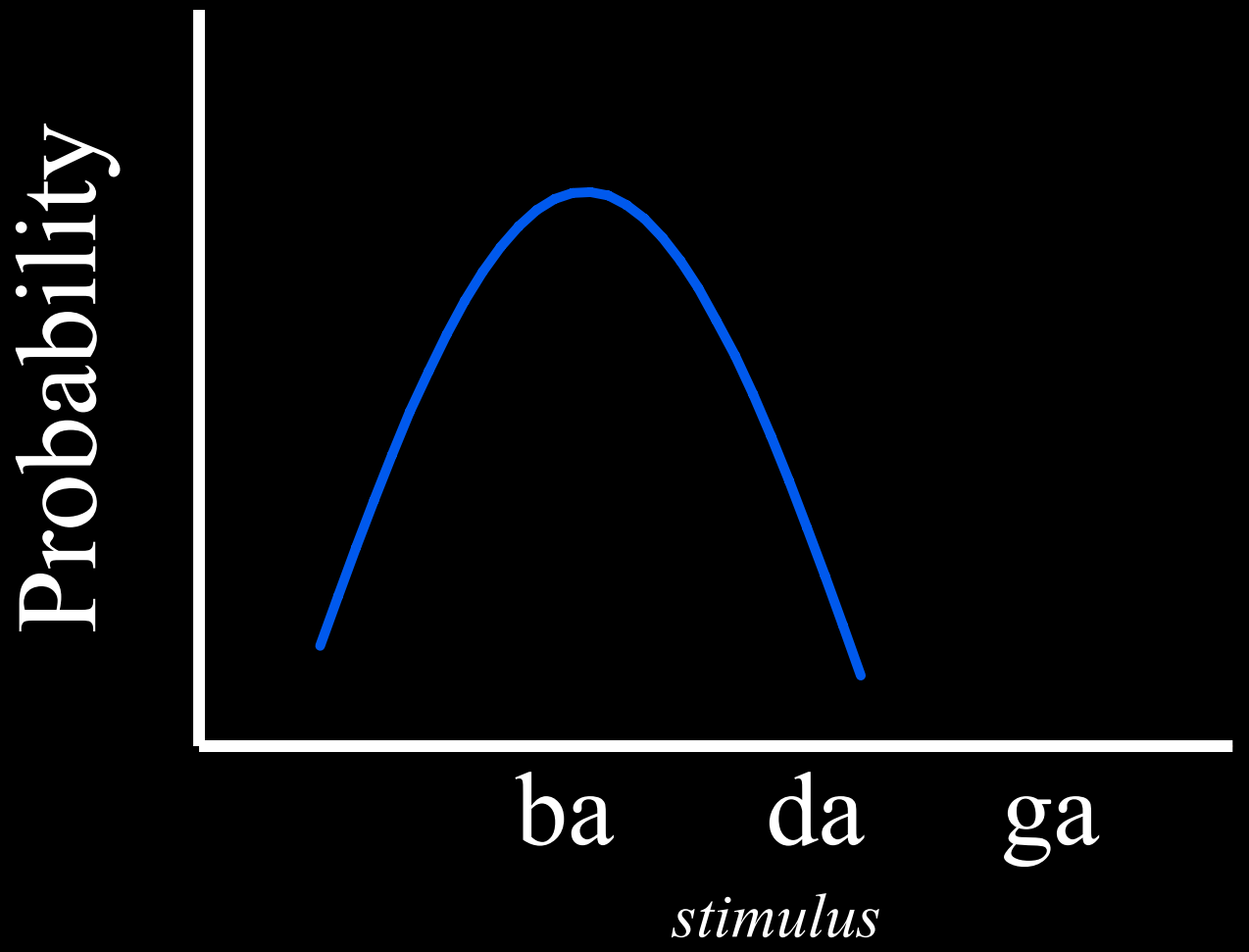


Wright et al., 2003

Linking the STS to Speech Perception

McGurk and McDonald, *Nature*, 1976

Demonstration of the McGurk Effect

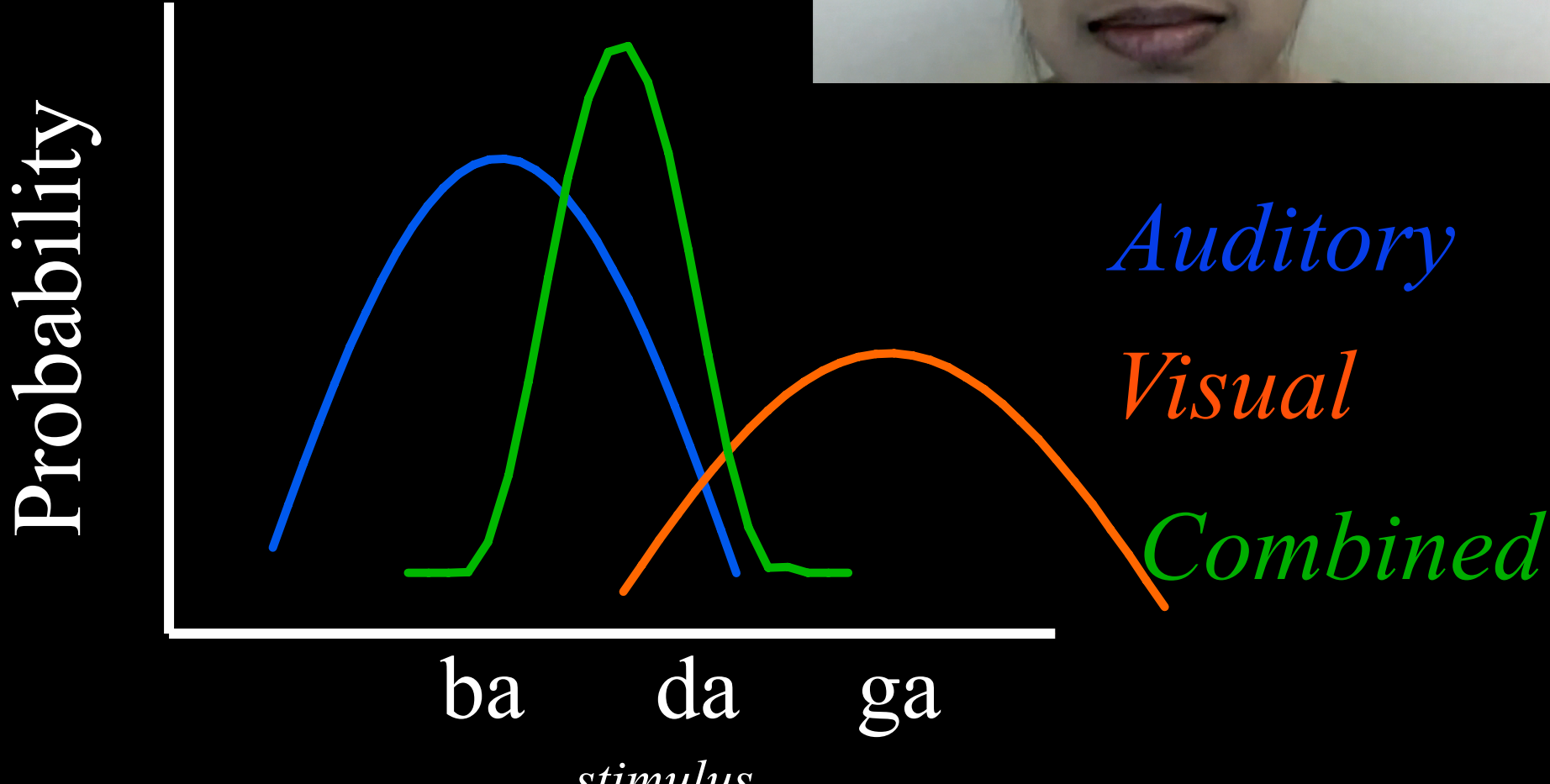

Probability
ba
da
ga
stimulus
Auditory

Probability

Visual

ba da ga

stimulus


Probability
ba
da
ga
stimulus
Auditory
Visual
Combined

Hearing lips and seeing voices

HARRY MCGURK
JOHN MACDONALD

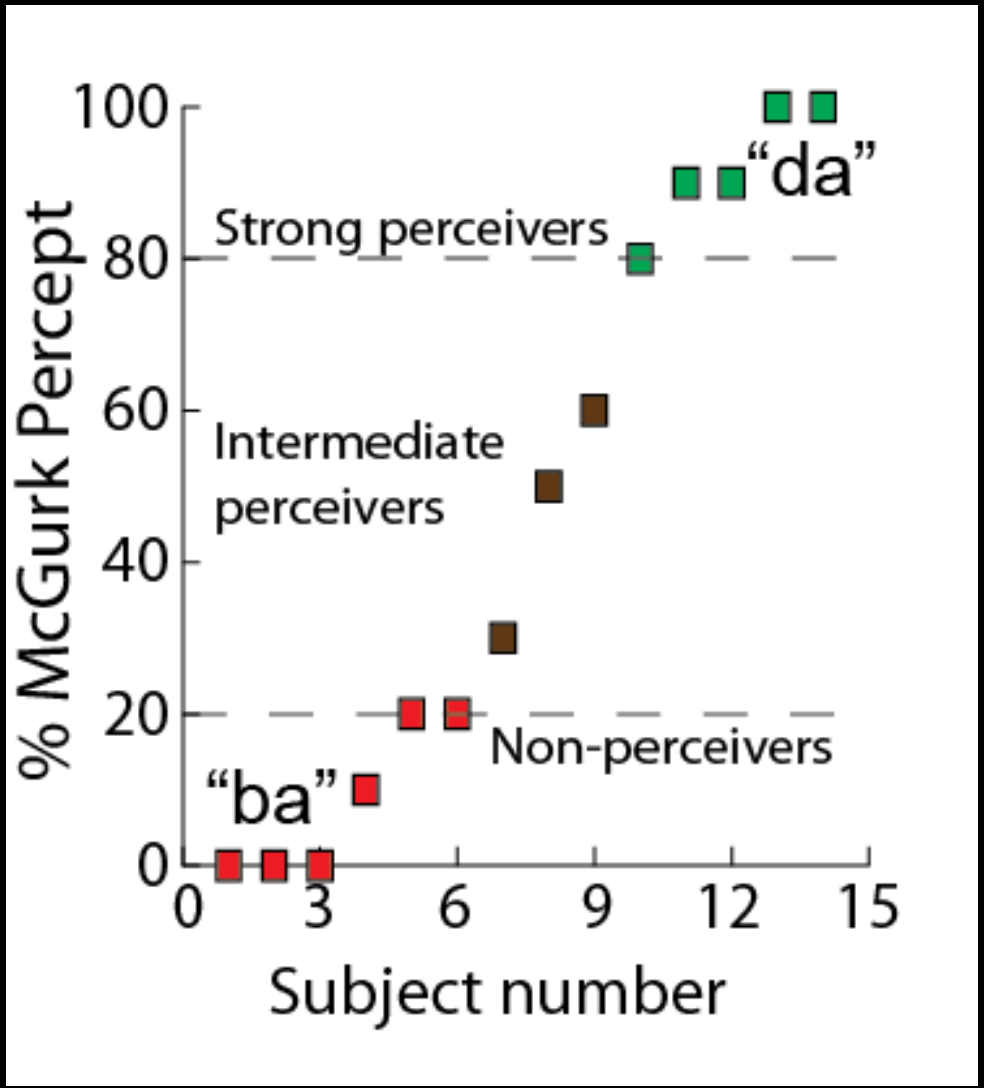
Stimuli					
Auditory	Visual	Subjects	Auditory	Visual	Responses Fused
ba-ba	ga-ga	18–40 yr ($n = 54$)	2	0	98

Table 2

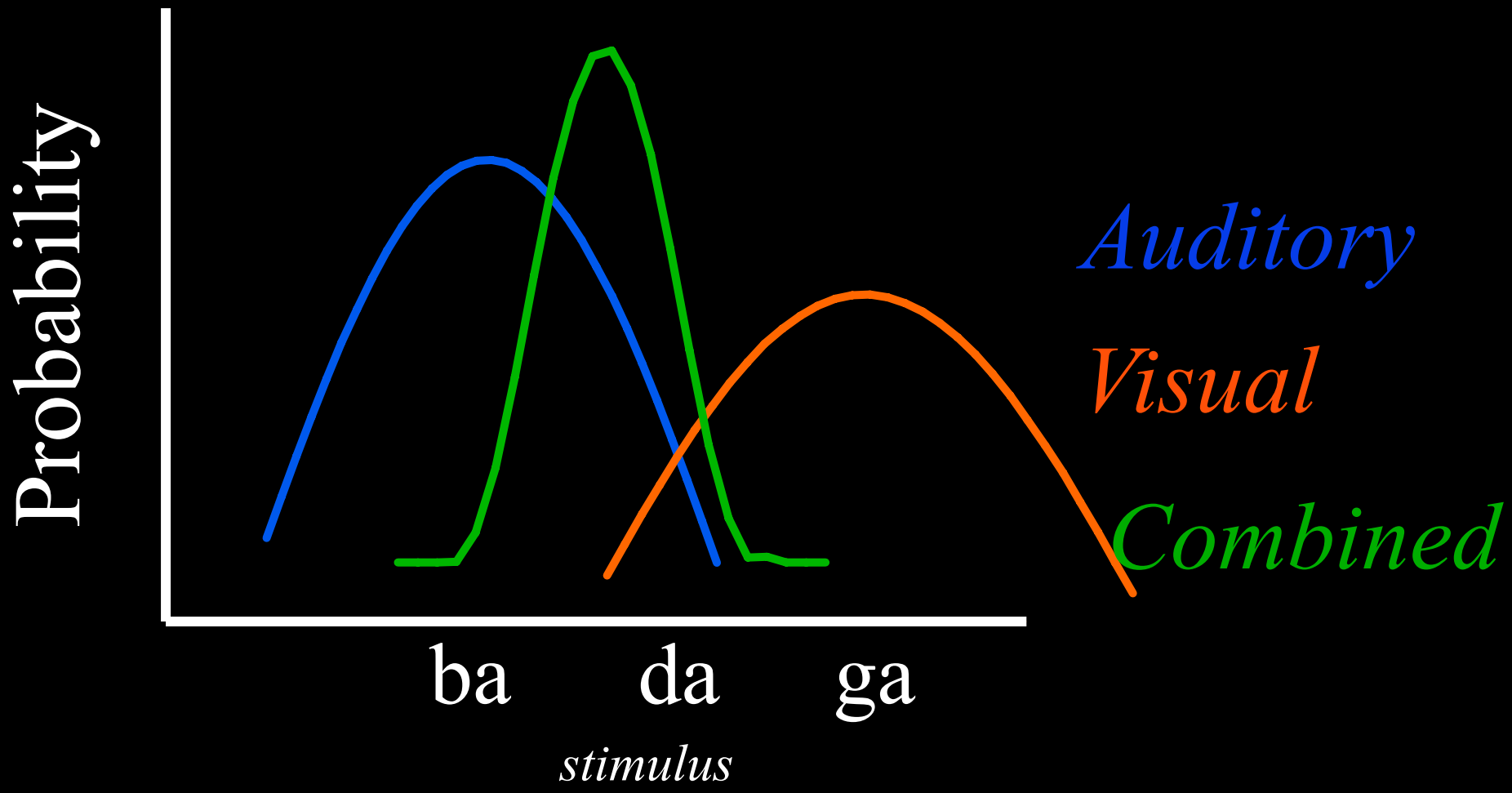
Nature Vol. 264 December 23/30 1976

What about in this audience?

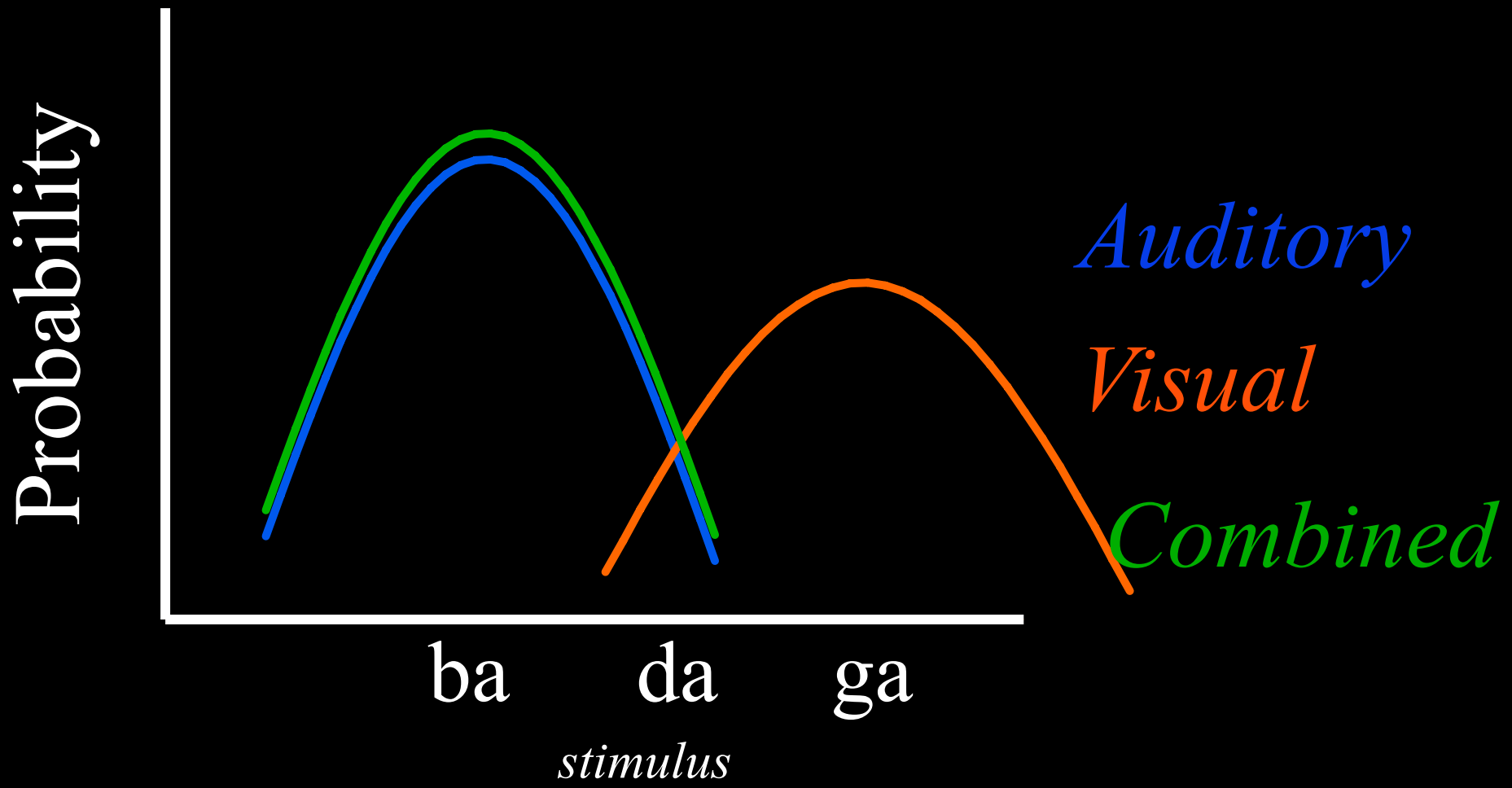
Intersubject Variability



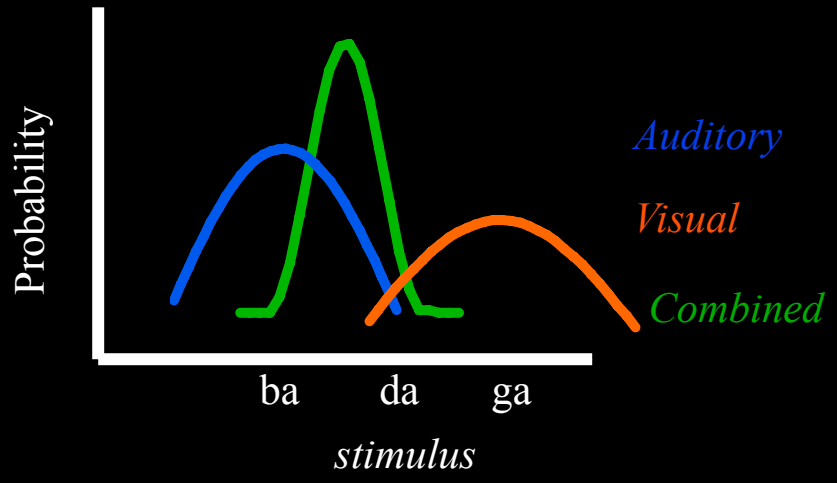
Strong Perceivers



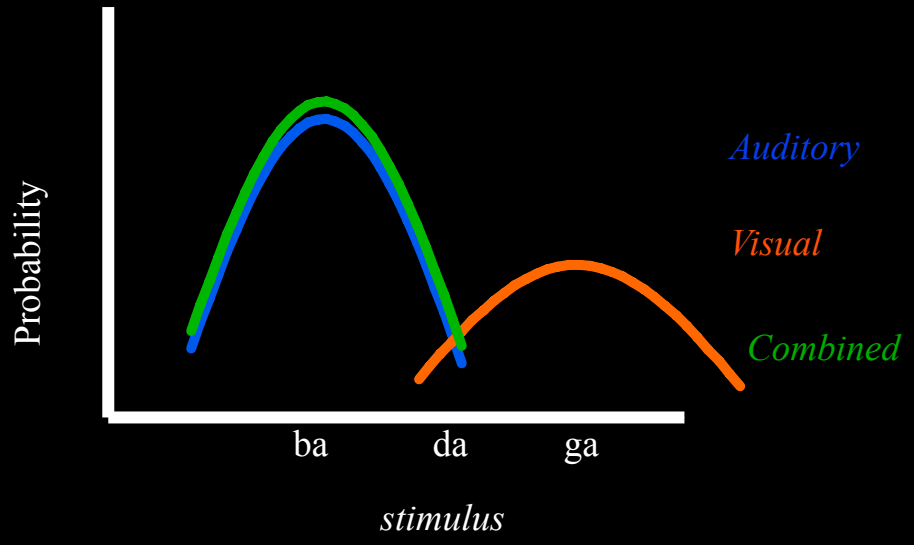
Non-perceivers



Perceivers

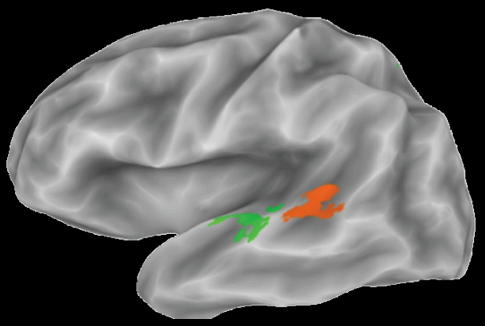


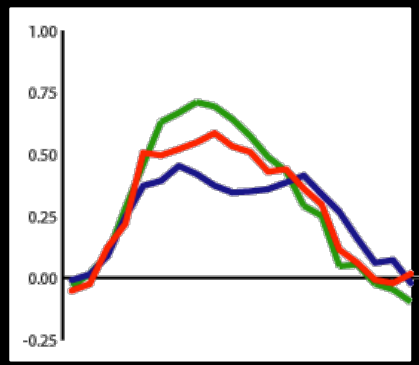
Non-perceivers



Hypothesis: perceivers integrate incongruent audiovisual speech, non-perceivers do not.

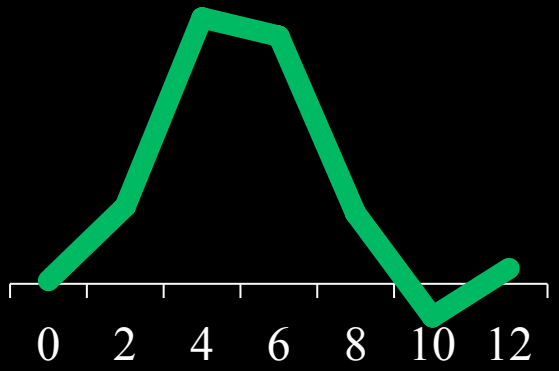
Test hypothesis with fMRI of the STS



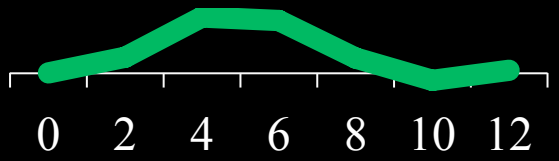


Beauchamp et al., *Neuron,* 2004

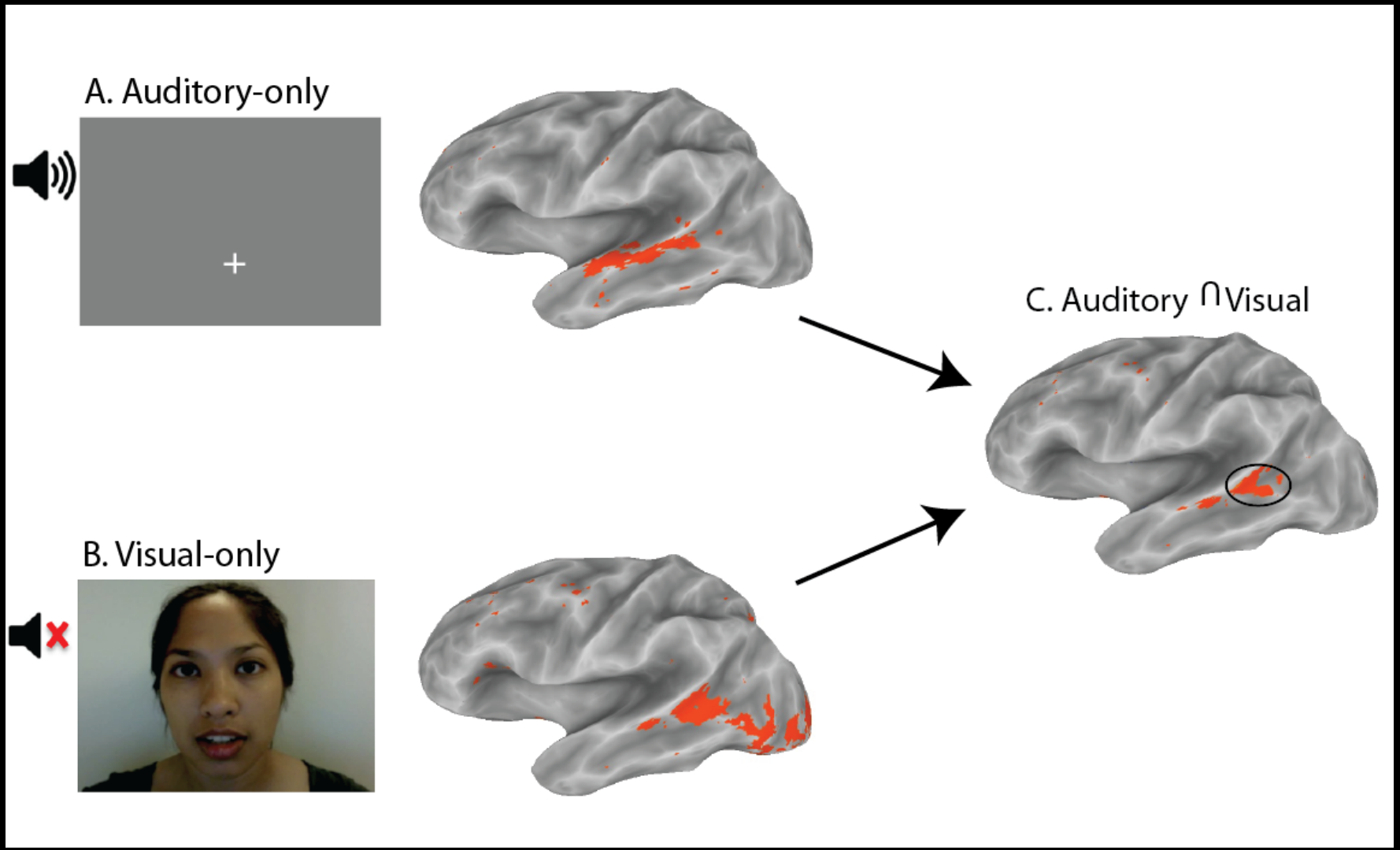
Perceivers



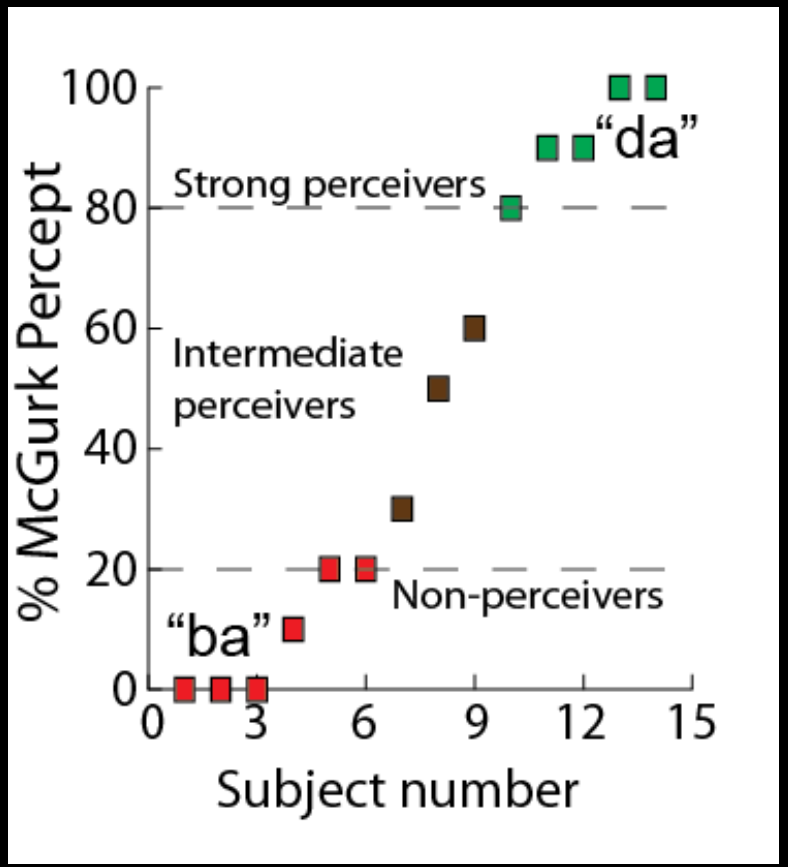
Non-perceivers

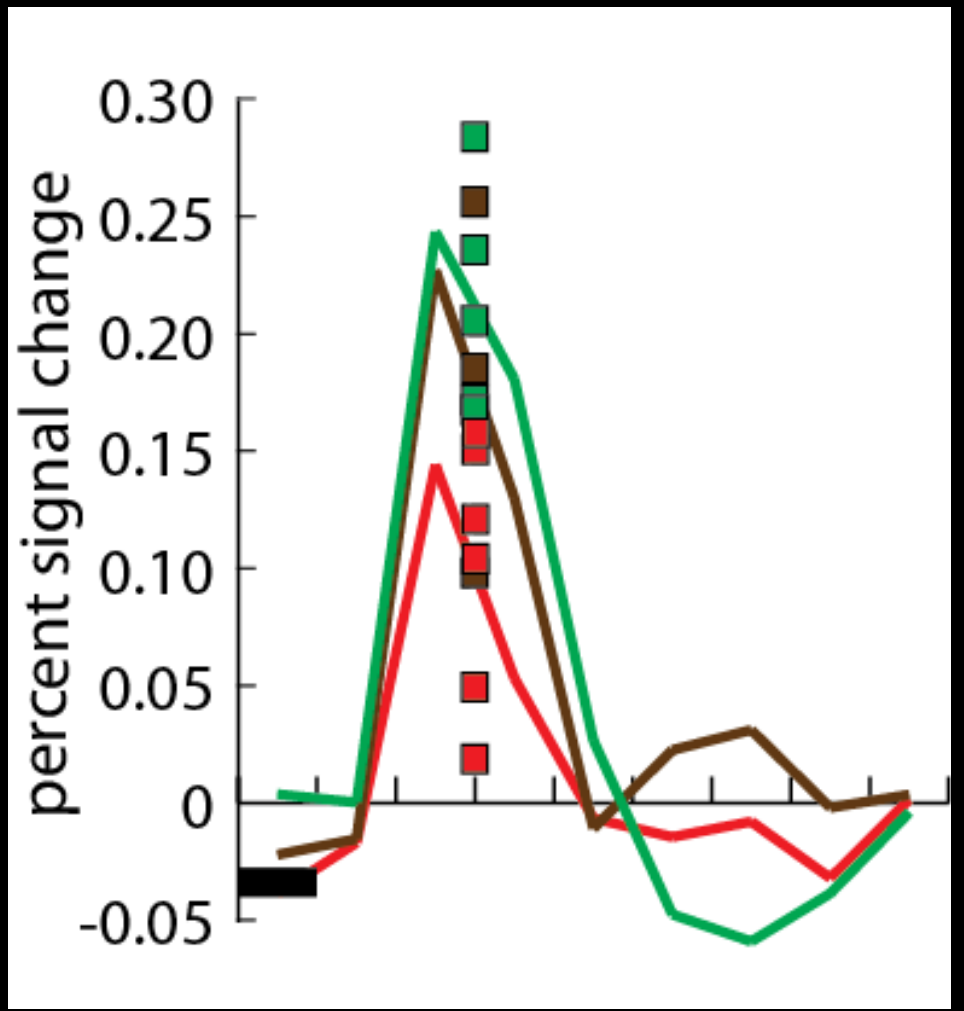


Independent Functional Localizers to identify the STS in each subject

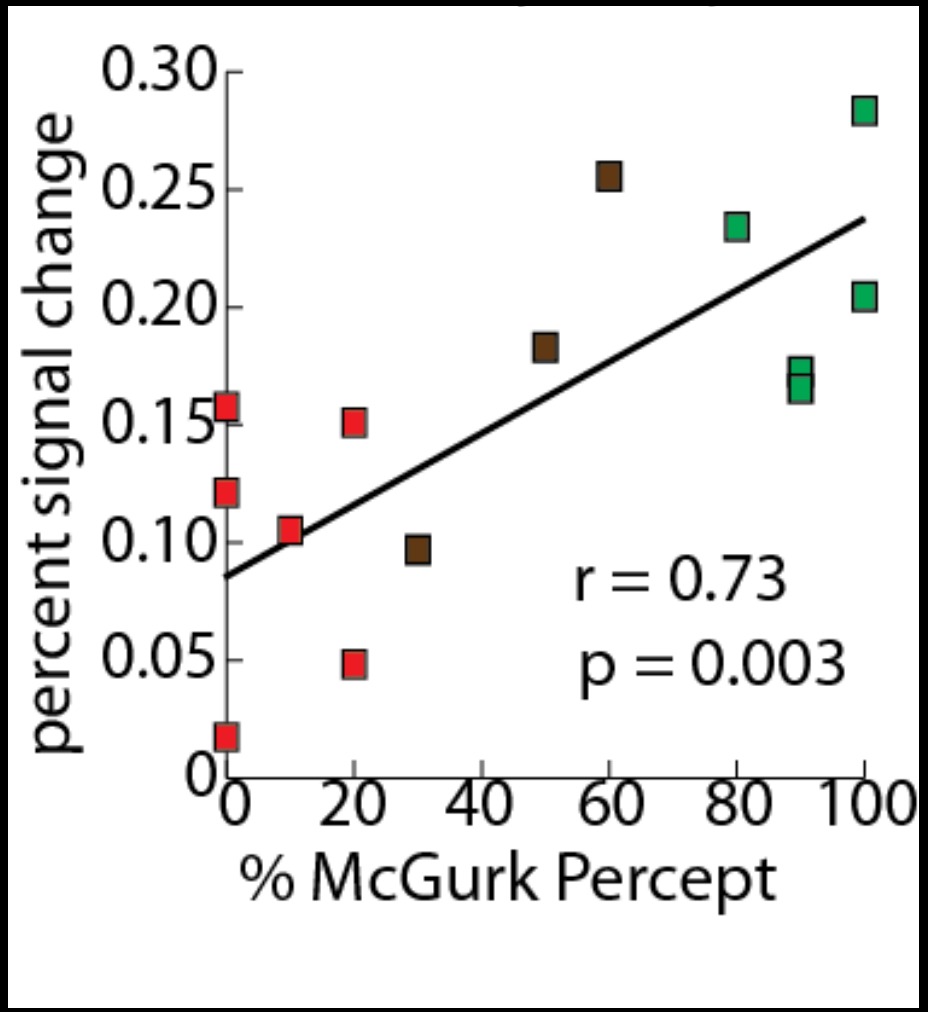


Measure fMRI Response to Incongruent Speech





Correlation with perception



Correlation with perception