Questions, Week 3

Neural Bases of Language

Submitted September 25, 2005

1 Short Answer

(1) What is one similarity and two differences between auditory agnosia and pure word deafness? Begin by naming the major deficits of both.

(2) There is a bilaterality of speech processing in the brain but the left and right hempishperes have different temporal integration windows. Explain the differences:

(3) How does the McGurk Effect combine visual and auditory stimuli?

(4) Explain support for the special "speech mode" of processing hypothesis in regards to sine-wave speech.

(5) Describe the McGurk Effect?

(6) Although language is generally thought to be a left hemisphere processes, speech has proven to be bilateral. What is each hemisphere responsible for and what is their corresponding temporal integration windows?

(7) What is the difference between the M100 and MMN?

(8) Name two ways we can test for contrastiveness between phonemes and allophones of a language, explain and give an example of each method.

(9) As explained in the reading, what is one reason why problems with auditory processing are less common that visual processing problems and therefore more difficult to study?

(10) What is the M100, and what is its relevance in speech processing?

(11) What is categorical speech perception? What is Voice-Onset-Time? Why is it harder for listeners to discriminate between speech sounds with 0ms and 20ms voice onset times than it is between 20ms and 40ms VOT

(12) What is the difference between phonetic and phonological representations? Phonological representations are not language specific while phonetic representations are. Phonological representations are also symbolic in nature while phonetic are not.

(13) Explain why there is a lack of research in auditory processing (as compared to that in visual processing) of speech.

(14) In the article "Disorders of Auditory Processing: Evidence for Modularity in Audition," Polster and Rose note three (3) possible reasons why models of auditory processing have been slower to emerge that models of visual processing. Discuss two (2) of these reasons.

(15) Why is it that the investigations in the field on auditory processing are limited?

(16) What is the difference between the gradient nature of phonetic categories, and phonological categories?

(17) Briefly explain sine-wave speech, and whether it argues for or against a special "speech mode" of processing.

(18) What is laterality as pertaining to auditory stimuli?

(19) Explain the McGurk effect and what it means to speech processing.

(20) Research has been trying to analyze whether pure word deafness is caused by a general low level auditory processing impairment or a specific impairment in lingustic processing. Recently, it has been suggested that it may be attributable to both. Describe the main contrast between type 1 and type 2 pure word deafness.

(21) Unlike the visual system, the auditory system transmits information about sound to all parts of both hemispheres. How does this effect the studying of auditory processing?

(22) List 2 reasons why there has been limited research of auditory processing systems.

(23) Why is it more difficult to conduct lesion studies on the auditory system than on the visual system?

2 Multiple Choice

(24) There are four separate experiments being conducted simultaneously on sine-wave speech detection by four doctors at NYU. The doctors each prime their subjects with a statement about what they will hear (regardless of the statements truth) after which they will play them all the same sine-wave speech clip. Doctor A tells his subjects they are about to hear sounds. Doctor B tells his subjects they will hear noise. Doctor C tells her subjects they will hear speech. Doctor D tells her subjects they will hear "something," but does not tell them what. According to the sine-wave speech theory which doctor's experiment would be conducted in accordance with the principles of the theory?

a. Doctor A
b. Doctor B
c. Doctor C
d. Doctor D

(25) Which of the following statements describes the auditory processing deisorder that involves the inability to recognise auditorily presented sound (e.g. crying)independent of any deficit in processing spoken language?

a. Amusia
b. Phonagnosia
c. Auditory Agnosia
d. Cortical Deafness

(26) Why do subjects with Cortical Deafness have trouble hearing all types of auditory sounds as opposed to subjects with Phonagnosia, who have difficulty recognising familiar voices?

a. The type of damage the subjects have is bilateral
b. The type of damage is in the right temporal areas
c. The type of damage is in the auditory association cortex
d. The type of damage is due to a sub-cortical lesion in the left hemisphere

(27) Changes in auditory perception due to incongruent articulatory gestures is know as:
a. The McGurk Effect
b. Visual-Auditory Influx
c. The Pylkkänen Effect
d. Articulatory gesture influence
e. The McDonald's Effect

(28) Which of the following would most likely be the strongest primer to the word.
a. born-boring
b. arson-son
c. stated-start
d. Spoken-Speak

(29) The impairment in the ability to recognize familiar voices while speech comprehension and ability to identify non-verbal sounds are still intact is a description of:
a. pure word deafness
b. phonagnosia
c. auditory agnosia
d. cortical deafness

(30) In the McGurk Effect if the subject is presented with an auditory stimulus of "BA" but sees a visual stimulus of "GA" at the same time, he should perceive:
a. An auditory percept of "BA" because the auditory stimulus is always stronger.
b. A auditory percept of "GA"
c. a combined percept of "BA" and "GA" resulting in lets say "DA"
d. A mixture of the "BA" and "GA" percepts one after the other.

(31) Aunt Sally was recently involved in a terrible car accident. She suffered brain damage as a result of the accident and can no longer recognize the voices of her family or famous television personalities. However, Aunt Sally can tell one unfamiliar voice from another as well as speak normally. Which auditory processing disorder does she have?
a. Phonagnosia
b. Pure Word Deafness
c. Auditory Agnosia
d. Cortical Deafness

(32) Which of the following auditory disorders was not discussed in the reading?
a. Pure Word Deafness
b. Auditory Agnosia
c. Phonagnosia

d. Phoneme Agnosia

(33) Why is the VOT longer for a syllable starting with [t] rather than a syllable starting with [d] if they are both alveolar stops?

a. There is no difference in the VOT for [t]- and [d]-onset syllables.
b. Because [t] takes longer to say than [d].
c. Because [t] is an unvoiced consonant and [d] is voiced.
d. Because of the McGurk Effect.

(34) Which of the following disorders of auditory processing is not matched with its definition?

a. Amusia - impairment in discriminating familiar voices
b. Phonagnosia - Impairment in tasks involving musical pattern recognition
c. Pure Word Deafness- inability to understand spoken words, other linguistic skills intact
d. Both A and B
e. Both B and C

(35) Which of the following is NOT an auditory processing disorder?

a. Phonagnosia
b. Cortical Deafness
c. Mutism
d. Auditory Agnosia

(36) What is the significance of the McGurk effect?

a. It is an example of the phonetic restoration effect.
b. It shows how the phonemes of one's first language affect the perception of consonant sounds.
c. Due to studying the McGurk effect, researchers were able to localize where speech information is processed in the brain.
d. It demonstrates the integration of visual and auditory speech information.

(37) A patient that shows an impaired ability to recognize familiar voices is suffering from:

a. cortical deafness
b. auditory agnosia
c. pure word deafness
d. phonagnosia

(38) At how many milliseconds does the voice onset time (VOT) for English, change in the categorical perception from the phonemes /d/ to /t/?

a. 0ms-20ms
b. 20ms -40ms
c. 40ms-60ms
d. 60ms-80ms

(39) Phonetic impairments tend to be more restricted inĚ

a. amnesia patients

b. aphasics
c. hearing impaired patients
d. dyslexic patients

(40) Which of the following is NOT true of the McGurk Effect:
a. it is very robust
b. it has only been shown in the speech domain
c. it shows that incongurent articulatory gestures can change the auditory precept of an otherwise clear signal
d. it has various interpretations

(41) The M100 is
a. always elicited in any task involving sound processing
b. Only elicited for sounds pertaining to speech
c. Only elicited for sounds not pertaining to speech
d. Only elicited by sign language speakers

(42) Phonagnosia includes all of the following characteristics except:
a. inability to recognize auditory presented sounds
b. inability to recognize familiar voices
c. intact speech comprehension
d. all of the above are characteristics

(43) Prosopagnosia is to refer to an impairment in the ability to recognize familiar faces just as phonagnosia is to refer to an ability to recognize familiar voices. This analogy most closely suggests which of the following:
a. language processing is often not closely aligned with studies of aphasia
b. research has so far, most heavily relied on visual experiments such as discrimination tasks
c. performance on testing these disorders would probably reveal that lesions in the brain are dependent on one another
d. voices may be processed by an independent system analogous to the independent system that has been impicated in face processing

(44) A patient exhibits the following: intact hearing, speech production and reading ability, inability to understand spoken words, and a disconnection of Wernicke's area from auditory input due to bilateral damage to his auditory cortex. It is determined that he suffers from a disorder of auditory processing. The disorder is most likely:
a. Cortical deafness
b. Auditory Agnosia
c. Pure word deafness
d. Phonagnosia

(45) Which impairment(s) of the auditory system may be argument for the modularity of speech perception.

a. pure word deafness
b. auditory agnosia
c. amusia
d. pure word deafness and auditory agnosia

(46) An allophonic change differs from a phonemic change in so far as:
a. it cannot engender a semantic change
b. it can engender a semantic change
c. it does not affect the acoustic representation
d. it does affect the acoustic representation

3 Open-ended Research Question

(47) Will falsely priming a subject to believe they will hear speech in a sine-wave recognition task result in an attempt on the part of the subject to create a coherent speech pattern out of the auditory stimulus despite the true lack of its presence?
This question tests the inverse of the sine-wave theory, which says that persons can deduce language when they are made aware that it is language, however this research question would try to determine whether or not people create words from the non structured random sounds they hear in an attempt to create meaning.
Bonus: This experiment/task on "word generation" could be performed rather simply by priming the subjects that they will be hearing "sine-wave" versions of words. They will be asked to write the phrases they heard only if they believe themselves to be 50

(48) Is there brain activity that is specifically sensitive to the properties of speech (as opposed to those of other sounds)?

(49) Although Autism does not cause substantial auditory problems, would it make tasks of differentiating between phonological groups more laborious?
One way to study this is to compare the Mismatch Negativity responses of both Autistic and non Autistic children.

(50) Do ambiodexterous people have the same bilaterality of speech processing? To test this, one might hook an ambiodexterous subject to an MEG and study the temporal integration windows of the two hemispheres. By altering the acoustic changes and intonation changes, one could influcence fast phenomena and slow aspects of speech as a variable. Then, monitoring the MEG data and comparing it to non-ambiodexterous people would suffice.

(51) To further test whether people take in each letter when they read or generalize, is there some inherent structure that would allow you to scramble the rest of the word but have it still be read normally. For instance is the first letter as important as the second letter being in the right position? Or the last?

(52) Considering that LH and RH deal with separate kinds of speech perception would it be possible for a person to understand speech when one hemisphere is chemically ’put to sleep’? For example would it be possible for a person to comprehend speech if their LH,

the hemisphere that works with prosody etc were not functioning or when only that side was functioning?

(53) What is the "VOT" between cultures in concerning common phonetic sounds? (For instance do Americans have a quicker VOT in the same English phonetic sounds that are in Latin American sounds, such as the phoneme 'r', in spanish we roll the R's. And if so, Is this due to the fact that we are more primed to hear certain phonemes than other cultures?)

(54) Is there a way to explain phonagnosia and visual agnosia in terms of memory damage instead of damage to the respective phonological and visual processing regions of the brain? Investigation would require access to a specific part of the population - those with these specified disorders.

(55) Can the people who suffer from word comprehension disorders described in the reading learn and communicate with sign-language?
With a disorder such as pure word deafness, this should be possible because the people seem to be able to comprehend it is simply the process of hearing words that causes them problems. I would assume that since this seems to be the only difficulty, the comprehension would be possible through signing. I would wonder if all the disorders would be fixable this way? For example, if someone was having difficulty matching words to their meanings or visual pictures and therefor had trouble communicating, could it simply be the sound and not the actual brain process?

(56) Can people who have acquired fluency in one or more languages other than their native tongue ever match the degree of accuracy in cross-categorical discrimination that they have in their native language with the phonological categories in their acquired languages? Another question might be if there is a difference in cross-categorical discrimination accuracy/time for people who are bilingual (ie. who acquired two languages at the same time as a child). The larger inquiry for this is if one language, even for bilingual people, is slightly dominant.
(In a broader sense, I'm also interested in whether a different area is involved in processing and producing acquired languages, and if so, do all the languages that an individual acquires share this special area? We haven't talked about foreign language acquisition and the brain, so I don't know if people have already determined this.)

(57) In many languages, tone is an integral part of language comprehension. These include the Tibetan languages, the many dialects of Chinese, and many of the African languages of the Niger-Congo region. Since Amusia, a subvariety of auditory agnosia, an impairment to musical pattern recognition, essentially renders a person "tone-deaf", how would selective transcranial magnetic stimulation to the brain-regions generally associated with amusia affect native speakers of tonal languages in their ability to comprehend speech in said native language?

(58) Can a person with phonagnosia identify their own voice, and if so, under what circumstances?
I hypothesize that if the person could recognize their own voice played back on a recording it would be soley because they remembering saying that utterance and not because the recognized the actual voice. To test this, I would record the person saying something and test that against others saying the same thing. Another trial would be to break up the voiced

segment to produce a new sentence that had not actually been uttered. A third test would be to test how context plays a role in deciphering a familiar voice. Using recordings like Martin Luther King's "I have a dream" speech would test the significance of context.

(59) Are music sounds processed in a specialized location or in the same area of the brain as speech sounds?
Use musical notes to represent a select number of words in varying syntactic categories (in order to be able to create complete sentences). Teach patients suffering from pure word deafness how to represent words using notes to find out whether or not they are able to translate internal mental representations of language into musical sounds.

(60) Models of auditory processing have been difficult to formulate. In light of this, there have been a number of comparisons to visual processing, which has been easier to measure and form models of. Could further investigation of hemisphere-specific damage shed more light into how auditory processing occurs? By utilizing MEG, fMRI, or PET technology, could specific aspects of auditory processing be identified?

(61) To what extent the native language of the subject in an experiment of sine-wave perception speech in English would affect his/her understanding of the sine-wave speech?
The studies to answer the question would be to have subjects with different native language take part in the experiment.

(62) Can people who know more than one language have trouble with creating phonetic categories in their native language if they spend a long enough time speaking another language, or is will that ability always be there?

(63) Is there a MMN when reading various phonemes along a continuum? MMN has been shown with phonological categories in the auditory domain, but is there a correlatory mismatch in the visual domain, maybe in the human visual cortex? This could be tested by having subjects that are fluent in a language with a 3-way (or more) distinction on a phoneme (eg, those that have separate /t/,/d/, and /D/,) presented those stimuli on a screen, rather than hearing them monaurally as in the Phillips/Pellathy article. Alternately, there could be a coupling of visual and aural stimuli, e.g. showing /ta/ while playing it aurally to the subjects, and then applying the subtraction method to subtract the results that are due just to aural stimulation. (e.g. the current data)

(64) Do Bill Clinton / grandmother cells (these being neurons that selectively respond only to very specific stimuli, such as the sound of Bill Clinton's voice) exist in the auditory domain, much in the same manner as they do with the visual domain?

(65) I wonder if the McGurk effect been attempted on those who have pure word deafness. Would receiving blatant or perhaps exaggerated articulatory gestures help them in comprehending the auditory signal? If the McGurk effect is experienced by these patients perhaps they are not suffering from pure word deafness but more of a disorder similar to Wernike's aphasia. If they did not experience this effect and perceived purely on the basis of the visual effect than there would be a true impairment in solely their auditory ability to perceive language. This may help clarify the question of just how important audio-visual integration is to speech perception and perhaps shed light on ways to help patients with pure word deafness.

(66) If you were in an emergency and needed help, which would be more advantageous a mute person or a deaf person?

(67) What effect does extensive bilateral damage to the auditory cortex have on deaf people where speech is not the preferred modality for language? Does it impair language comprehension in any significant or selective way?

(68) Is the condition of "word deafness" due to a deficit in lower level processing, such as an inability to process phonemes?

One could test if the ability to process phonemes of a person with word deafness is different than that of a person with normal auditory and language processing skills. For example, would an individual with this impairment show the same pattern as normal individuals in categorization of native vs. foreign phonemes. Or would they be unable to distinguish between phonemes of even their own language, suggesting an impairment in phonemic perception altogether.

(69) Would left handed individuals born with right side hearing deficits (non-cortical) be more likely to lateralize language to the right hemisphere?

In order to explore this question, one would need to recruit patients who are left handed, and have had right ear deafness since birth. It would be important that this deafness was not caused by any cortical or subcortical abnormalities, as this would introduce a confound to the study. At this point, one could easily do this study by performing a wada test on each subject, although this is rather invasive and would be difficult to pass through the IRB. Alternatively, having checked that the visual systems are normal in all subjects, one could conduct an fMRI study in which subjects are presented with pictures and asked to name the objects presented in them. A subtraction could be done using a fixation cross as a baseline condition. FMRI has been shown to correlate with the wada test at a rate of 91% (see Woermann et al., Neurology 2003;61:699-701) so it is a good alternative. This would lend some insight into whether lateralization is dependent on environmental factors as well as genetic ones.