Questions, Week 8

Neural Bases of Language

Submitted November 6, 2005

1 Short Answer

(1) What part of the brain is activated when distinguishing if a group of words is a sentence or a word list? Which part of the brain is activated when distinguishing between easy and hard syntax?

(2) Give evidence that syntactic structure building precedes semantic processes as presented in Friederici.

(3) How does the fact that Broca’s area lights up for long distance dependencies (especially those with the arguments in noncanonical order) provide support for the theory that Broca’s area has something to do with working memory?

(4) In Kaan and Swaab’s article “The brain circuitry of syntactic comprehension,” they provide support for the view that Broca’s area is implicated in increasing memory or processing load rather than in reconstructing the canonical word order. What are the three supporting findings? What does it suggest about Broca’s area and syntactic processing?

(5) Discuss the activation in Broca’s Area when processing syntax.

(6) Name two aspects of syntax and give an example sentence for each type.

(7) In the properties of English syntax, what does "in-situ" mean in relation to question words (words with w/h elements)?

(8) What did the Kaan and Swaab review article conclude about the location of syntactic processing in the brain.

(9) Explain why Broca’s area is not a likely locus of syntactic composition.

(10) Why do researchers compare the processing of complex and simple sentences to understand syntactic processing?

(11) What is the main difference between ELAN and MMN?

(12) What is the ELAN and when is it activated?

(13) Briefly explain the 3 phases of Friederici’s neurocognitive model of auditory sentence processing.

(14) Jabberwocky and/or semantic prose are used instead of normal, attested sentences in certain syntactic studies. Briefly explain the apparent advantage of these as opposed to normal sentences and describe the principle difference between Jabberwocky and semantic prose.
(15) Explain the difference between center embedded clauses and right branched sentences?

(16) The temporal characteristics of the neurocognitive model of sentence comprehension is said to consist of three phases. Identify and explain the three phases.

(17) How are questions made in English syntax? What are the exceptions to the rule? Give an example of each.

(18) In functional imaging studies, what is the effect of syntactic processing speed on fast processing subjects versus slow processing subjects? Explain.

(19) What is an explanation for the fact that “The scientist criticized Max’s of proof the theorem.” elicits an ELAN effect but the equally ungrammatical sentence “The mother criticized Mary’s dress, and the father criticized Susan’s of the evening.” does not?

(20) What does comparing simple and complex sentences tell us about syntactic processing?

(21) How could the accuracy/legitimacy of results can be compromised in an fMRI imaging experiment of syntactic processing, given that the procedure itself was free of errors and the subject was standard relative to the other subjects?

(22) There are two models that have been offered to explain the syntactic and semantic processing of sentences. One proposes that syntax is processed separately and prior to semantics. The other proposes that the two act together at each stage of language comprehension. In Angela Friederici’s article entitled "Towards a neural basis of auditory sentence processing," which view does she adopt through PET and fMRI studies of prosodic processes?

(23) According to the article ‘Towards a neural basis of auditory sentence processing,’ sentence comprehension consists of three functionally distinct phases which are:

(24) question: how was speed of processing found to relate to broca’s area activation in the Waters, Caplan, Alpert and Stanczak study shown in class.

2 Multiple Choice

(25) Except for pronouns, case is marked in the English language with what?
   a. silent grammar
   b. suffixes
   c. prefixes
   d. affixes

(26) Which is NOT a phase of sentence comprehension according to Friederici?
   a. A late phase of revision including semantic/syntactic interaction
   b. An early phase involving phonological/morphological/semantic interaction
   c. Thematic assignment based on semantic and morphosyntactic information
   d. Initial parsing phase

(27) Which example is a sentence error due to agreement?
   a. The mice is cat-chasers.
   b. I saw he.
c. These mice are cat-chasers.
d. Is raining.

(28) Which of the following is true about the sentence “The child spilled the juice that stained the rug”?
I. It is a less complex subject-first sentence.
II. It is a complex object-first sentence.
III. One of the words is not in its canonical position.

a. I & II
b. II & III
c. I, II, & III
d. II only
e. I & III

(29) Which of the following statements is NOT true regarding properties of English syntax?
 a. The word order follows: Object-Verb-Subject
 b. All sentences must have a subject.
c. Question words generally move to the front of the sentence.
d. All of the above answers are correct.

(30) Which of the following is NOT a property of English syntax?
 a. All sentences must contain a subject.
b. English syntax dictates a word order of: Subject-Verb-Object.
c. Question words usually move to the front of the sentence.
d. English syntax dictates a word order of: Object-Subject-Verb-Adjective.

(31) Broca’s Area lights up for:
 a. ambiguity
 b. Long distance dependencies
c. For various non-syntactic manipulation such as semantic competition in lexical processing.
d. all of the above.

(32) In the Friederici paper they found that when a word-category violation (shown by ELAN) and a semantic violation (reflected by N400) occurred in one stimuli the result was:
 a. ELAN and N400
 b. N400
c. Neither
d. ELAN

(33) which of the following does broca’s area NOT light up for
 a. ambiguity
 b. long-distance dependecies, esp. in noncanonical word order
c. nonsyntactic manipulations, e.g. semantic competition
According to the study by Osterhout and Mobley, a left anterior negativity response is elicited by:

- Subject-verb agreement violations
- Number and Gender agreements
- A and B
- None of the above

Which part of the brain is NOT activated when processing complex sentences?

- Left posterior superior and middle temporal
- Right posterior superior and middle temporal
- Left inferior frontal
- Right inferior frontal

As discussed in the class on complex versus simple sentences, Broca’s Area is activated for all of the following activities except:

- Long distance dependence
- Various non-syntactic manipulations
- Sentence versus word lists
- Ambiguity

Choose the correct statement about Broca’s Area based on what you know about imaging studies that have looked at complex vs. simple sentences.

- BA is not involved in non-syntactic processes
- BA is activated for tasks that involve semantic competition in lexical processing.
- BA is most likely the locus of composition
- BA is not activated for sentences that exhibit long distance dependencies.

Broca’s area is probably not a locus of composition because:

- It is active during long distance dependencies
- It fails to activate during simple syntactic constructions
- It is activated during syntactically ambiguous sentences
- It is activated during processing of complex sentences

Broca’s area lights up for which conditions?

- Ambiguity
- Long Distance Dependencies
- Nonsyntactic manipulations such as semantic competition in lexical processing

- i
- i & ii
- i & ii & iii
- i & ii
(40) When considering functional imaging studies, for which of the following is Broca’s area LEAST likely to light up:
   a. ambiguity
   b. long distance dependencies
   c. easy syntax
   d. none of the above.

(41) Where does the brain show an activation pattern to the condition in the complex versus simple sentences?
   a. In the Broca’s and Wernicke’s area with a much smaller activation in the homologous right hemisphere for those two areas.
   b. Bilaterally in the temporal lobe.
   c. Bilaterally in the Wenicke’s area and in its homologous right hemisphere.
   d. Bilaterally in the Broca’s area and in its homologous right hemisphere.

(42) Which of the following clauses are in order of increasing syntactic effort?
   a. active conjoined; subject relative; object relative
   b. subject relative; object relative; active conjoined
   c. object relative; active conjoined; subject relative
   d. active conjoined; object relative; subject relative

(43) Which of these the most plausible reason to think that Broca’s Area is not the place where basic syntactic processing and composition occurs in the brain?
   a. The effects of Broca’s aphasia.
   b. BA does not light up for easy syntax.
   c. The difficulty of controlling semantic processing while manipulating syntactic stimuli in functional imaging studies.
   d. The idea that some linguists have that syntax does not exist separately from semantics.

(44) Broca’s area does light up for.
   a. Ambiguity
   b. Long-distance dependencies
   c. For various nonsyntactic manipulations
   d. All of the above

(45) Which of the following is not true of syntax in the brain:
   a. More involved [complex] syntactic structures create greater processing demands
   b. It is difficult to localize because the areas in question appear to be multi-functional
   c. It is difficult to localize because of imaging resolution
   d. Syntax-related activation is exclusive to the left hemisphere

(46) Where in the brain are the following sentences most likely processed?
   I. The boy gave me a book from the shelf.
   II. Put the box on the table by the window in the kitchen
a. I- Broca’s area. II- Anterior temporal areas.
b. Both are processed in the anterior temporal areas
c. I- Anterior temporal areas. II- Broca’s area.
d. Both are processed in Broca’s area.

(47) Syntactic effort should increase when performing the following sentence constructions in which order?
   a. Active Conjoined…Object Relative…Subject Relative
   b. Object Relative…Subject Relative…Active Conjoined
   c. Active Conjoined…Subject Relative…Object Relative
   d. Subject Relative…Object Relative…Active Conjoined

(48) Broca’s area has been found to be activated by:
   a. ambiguity
   b. subject/object relative manipulation
   c. long distance dependencies
   d. all of the above

3 Open-ended Research Question

(49) In languages where the cases are marked (for example Latin marks its cases with endings), would speakers have earlier or later case identification? Would they use the endings in categorizing words into nouns, verbs, etc. resulting in an earlier case identificiation, or would they use the case in the lexical naming of a word, resulting in a later case identification? Bonus: Find speakers of languages such as this, and use an fMRI to find out when the posterior region of the MTG is activated, and whether it is earlier, later, or the same.

(50) According to the Just et al study entitled “Brain Activation Modulated by Sentence Comprehension,” brain activation increases with the complexity of a sentence (from Active, to Subject-relative clauses to Object-relative clauses). However the difference in the example provided was that of “The reporter attacked the senator and admitted the error” (Active) to “The reporter that attacked the senator admitted the error” (Subject-relative) to “the reporter that the senator attacked admitted the error” (Object relative). Could the difference in activation between the Subject- and Object-relative clauses be explained by the switching of the semantic roles of the two nouns (i.e. reporter as agent of both attacking and admitting changing to agent of admitting but rather recipient of attacking), rather than the complexity of the sentence? Could this also be modeled on the “auditory rehearsal” principle that, for instance, there may be an instance of priming for words in specific thematic or semantic roles?
   Setup: control for priming via varying words in the specific semantic roles in some conditions, and keep the nouns in those roles constant in others. Tabulate differences between the two, and see if there is a true difference between subject- and object-relatives.

(51) What would the difference be between the brain areas activated for questions such as “Who did you see?” and “You did what?” and “Who did what to who?”
Bonus: My hypothesis would be that Broca’s area might only light up for the last question? Previous studies have shown that Broca’s aphasics can understand questions like “Who did the girl chase?” and “Which boy chased the girl?” However, when the object is displaced they have trouble interpreting sentences. It would be interesting to see if Broca’s aphasics could answer “Who did what to who?”, since the sentence is in the typical subject-verb-object form. This would tell us something about what Broca’s area is used for (working memory, etc...) I would use fMRI to test normal subjects processing each of the first three questions (visually and auditorially) and monitor which areas were activated. This would also tell us about the significance of modality in Broca’s area or other areas of the brain.

(52) Since no brain areas have been shown to be uniquely involved in syntax, could brain imaging of various syntactic language tasks show the interaction of different brain areas needed for syntax? Are there unique combinations within the brain network that are used for various aspects of syntax processing?

(53) How does the ’mirror system’ that is involved with Broca’s Area, influence the results of a subject who is imitating someone saying/articulating a syntactical structure?

(54) If by testing the properties of syntax we are able to show which brain regions are active in syntax formation, can we attempt to localize ungrammaticality by the same process? BONUS: This question would essentially reverse the question posed by many syntax studies and collect data on which areas of the brain are stimulated during periods of being presented with ungrammatical (non-syntactical sentences). In this fMRI study words would be presented visually to subjects who would be asked to read the sentences and determine whether or not they are syntactical. Fifty percent of the trials would conducted with syntactical sentences and the remaining fifty percent would be conducted with sentences of incorrect syntax. The a-syntactical trials would be composed as such: a third of the sentences with subjects missing, a third of the sentence with the wrong word order and a third of the sentences with incorrect agreement or case. The data, once collected would be compared to the trials in which the sentences had correct syntax and the trials in which the syntax was wrong. In the wrong syntax category only the areas that “lit up” for all the trials would be considered areas associated with ungrammaticality.

(55) According to the Functional Imaging Studies, Broca’s Area does not light up for easy syntax, and instead responds to ambiguity, long distance dependencies, and for various nonsyntactic manipulations, such as semantic competition in lexical processing. Since dyslexics have a problem with the language system at the phonological module level, and are likely to interpret easy syntax as hard, does Broca’s Area continuously light up in these individuals? Or it there another module that deals with the complexity of normal sentence structures in dyslexic persons?

(56) At the end of the Kaan and Swaab article it was proposed that syntactic processes may be a result of the interaction of the various areas that were implicated in the article. Perhaps using TMS a study can be done to impair certain structures to observe whether their disruption causes certain functions to be impaired. So if the interaction of structures A, B, C, and D are thought to bring about a certain aspect of syntax, if we disrupt A can B, C, and D still function and can they still bring about the process. Perhaps through using TMS we can more effectively show which structures are responsible for a particular process because it
isn’t enough to say that a structure is responsible for a process just because it lights up. It may also clear up which structures are interacting to bring about certain processes.

(57) How is broca’s area activated in case marked languages? In these languages it is very hard to generate an ambiguity in syntactic structure, since it is obvious what part of speech each word is (e.g.‘s include Russian and Latin.) But of course it’s silly to think that broca’s area serves different functions in different languages. Thus, the question becomes how to activate broca’s area in those languages. Essentially, this study would entail comparing activation when the forms of a word coincided, e.g. if the accusative feminine plural were the same as the dative masculine singular, and words from these categories were substituted, what sort of effect would this have on Broca’s area, if any.

(58) Current research on the role of Broca’s area in syntactic comprehension appears to suggest that it is not necessarily a locus of comprehension, though it appears to be involved in the comprehension of syntactically complex sentences, such as those with long distance dependencies. Would these dependencies evoke similar processing effects in languages that make heavy use of case markings, such as Hungarian or Russian?

(59) When in the auditory processing of language does prosodic processing influence syntactic processing?

(60) In class we discussed how different studies showed different results for the activation of Broca’s Area. Since these studies were conducted in different languages (German, Dutch), could Broca’s Area serve slightly different functions due to the differences in these languages. Perhaps Broca’s area is not built for a set purpose and instead takes on a needed function depending on the set up of a particular language.

(61) The question of modularity becomes quite controversial when related to syntax. While neuroimaging studies suggest that there isn’t one brain region related to syntax, event related studies can identify certain syntactic processes as occurring at distinguishable instances. This evidence suggests that the interaction of various brain regions are responsible for certain processes that attribute to syntax. But is syntax an element itself, housed in the brain or is it merely the result of a combination of language processes. Are the event related effects that we attribute to semantics specific to language, or is there a processing system that recognizes through experience that there are specific patterns found within English (i.e. noun, adj., nounÈetc). Say you were to train a person with shapes, in which certain shapes always followed other shapes, and some never followed others. If you were then to upset this pattern, would you illicit a ELAN response?

(62) We have discussed that function words and morphemes are often omitted by Broca’s aphasics, and that grammaticality is assessed on the basis of these. How does Broca’s area respond to sentences with vs. without their functional elements?

REASONING/BONUS: The fMRI/PET studies reviewed in the Kaan and Swaab article use different methods in an effort to first isolate syntactic processing, and second to identify which neuro-anatomical structures if any would be explicitly activated by this processing. If we assume that functional elements convey the syntax of the sentence, and the content elements the semantics, then it follows that a sound syntactic isolation could be made by subtracting the activation produced by a sentence without function words from the activation produced by the same sentence with function words. In this way we can
more accurately exclude semantic processing as these should cancel out (as opposed to Jaberwocky/syntactic prose where semantic processing may be taking place that we do not expect). A functional study conducted this way would not only add to the body of work on neural basis of syntax in general, but might also shed some light on what is failing in Broca’s aphasias.

(63) Broca’s area seems to be involved in complex sentence comprehension and also seems to be modality independent. But it doesn’t show increased activity when only presented with a simple or easy syntax sentence. But people with broca’s aphasia still seem to have trouble with ‘easy syntax’. Lesion data would imply that the area is necessary for syntax but the fMRI data is in contradiction with that. The question to be studied would be to compare peoples performance with induced BA and control in comprehension of easy syntax. If they can perform well then the fMRI data is to be trusted if not then some fault in imaging is to blame.

(64) How does syntactic comprehension compare when considering auditory sentence processing and sentence processing using sign language? Are different areas of the brain activated? If so, what does this tell us the neural basis of sentence processing?

(65) How is the working memory (a non-linguistic activity) related to the syntax processes? Where can exactly be located?

(66) How can we better separate the individual differences of the subparts of Broca’s area, (ie-frontal operculum, pars opercularis...) when testing for syntactic processing?

(67) If Broca’s Area does indeed have a role in selecting between semantic alternatives in language, does it also play a role in distinguishing meaning from non-linguistic stimuli?

(68) How does syntactic processing differ for complex vs. simple sentences in languages other than English?

(69) How can non-linguistic sequence processing data provide evidence for the function of Broca’s area in language processing? What activation effects on Broca’s area would result from playing a musical sequence and then displacing an element of the sequence, or doing the same with images? Various manipulations of musical prosody could be informative, but specifically the displacement of one note in a sequence would hint at Broca’s area being a component of the working memory. Bonus: Play a recorded musical sequence (acoustically simple) a few times to establish it, then play the sequence with a displaced element. Gather high temporal resolution imaging data. There are so many possible experiments here, such as showing still images of a well-understood sequential act, and then showing that sequence with a displaced element (akin to syntactic violation studies).

(70) It has been found that easy syntactic processing activates anterior temporal areas, while more ambiguous constructions activate Broca’s area. There are a number of different transformations that can occur to bring a sentence from deep structure to surface structure. Some transformations do not alter the sentence structure much from the deep structure, while other transformations create much more complex sentences that vary greatly from the their original structure. Which areas of the brain are activated during these transformations? Does it vary according to how simple/non-ambiguous the final sentence is or does it
vary according to the degree of change the sentence underwent during the transformation from deep to surface structure?

(71) If what was proposed in class is true and if ‘hard’ syntax is in Broca’s area and ‘easy’ syntax is in the anterior temporal areas then if there was a lesion in the anterial temporal area would a person have no trouble with harder sentences with ambiguity and struggle on sentences with easier construction?

Can a focal injection of sodium amytal shed light on broca’s area by selectively disrupting it? What sort of effects would fast vs. slow processors display (as in the experiments shown in class). What about electrical disruption, what sort of effect would that cause on fast vs slow processors– essentially to combine the experiments done by boatman with the fast/slow processor experiments shown in class. (I know this might be hard given the small population of people that undergo boatmans sort of experiment, that’s why I suggest the sodium amytal