Understanding the Structure of Sentences 10D

1. Definitions / important stuff
   1. After word processing – what happens next? We have both the meaning information and the syntactic information
   2. Thematic roles – who is doing what to whom – the goal of sentences is to place roles
   3. Verb’s argument structure – the set of possible themes associated with a verb (agent-theme-goal)
   4. Picture 288
   5. Parsing – analyzing the grammatical structure of a sentence to help us to get to assigning those thematic roles
      1. First figure out what each word is (n, v, etc)
      2. Put them into phrases
      3. Must determine the subject of the sentence
      4. Word order in English is especially important
   6. Model types
      1. Autonomous models – initial stages of parsing, syntax can only influence syntactic representation
      2. Interactive models – both syntax and semantics can influence the syntactic processor
      3. One stage models – both syntactic and semantic information are used to construct the model in one go
      4. Two stage models – syntax is processed first, then semantics
2. Dealing with structural ambiguity
   1. Ambiguous sentence examples: police seek orange attackers, enraged cow injures farmer with axe
   2. Lots of people study ambiguity because it’s a strain on the processor, so it helps understand what the processor is doing (like studying brain lesions)
      1. Lots of this research is done with eye tracking because it will show you when people have trouble and they don’t realize it’s a hard sentence to process
   3. Serial autonomous model – creating a parse tree with syntax only and if it doesn’t work, we go back and recreate the parse tree
   4. Parallel autonomous model – creating all syntactic representations possible and choose the one that makes the most sense.
   5. Interactive model – using semantics along with syntax to create the most plausible model
   6. Garden path sentences – sentences that lead you astray in processing so that you have to go back and reprocess (type of sentence where the syntactic structure leads you astray to expect a different conclusion from what which it actually has.
      1. Often due to participles – a type of verbal phrase where the verb is turned into an adjective by adding ed or ing to the verb
      2. The old man the boats, the horse raced past the barn fell
      3. Reduced relative – a relative clause that has been reduced by removing the relative pronoun and “was”
      4. Complementizer – a category of words (that) used to introduce a subordinate clause.
      5. Helpful:
         1. Commas or other punctuation that gives you a clue it’s a clause
         2. Normal speech pauses
      6. Most people consider these reduced clauses implausible and they do not occur very often in speech/writing.
3. Early work on parsing
   1. Chomsky’s generative grammar – understanding sentences involves pulling up their deep structure
      1. Derivational theory of complexity – the more complex the syntax, the more transformations you will need to get to deep structure.
         1. So they should take you longer to process – which can be measured by reaction time.
      2. Autonomy of syntax – syntax and semantic processing are separate things
      3. Transformations
         1. Obligatory – transformations that are required for the sentence to be grammatical. Like verb subject matching.
         2. Optional – Things that are not required – for example, making things passive voice.
      4. Kernel sentences – active, affirmative, declarative forms of English, where obligatory transformations have occurred.
      5. Some research supports the idea that sentences with more transformations (passive, question, negative, etc) take longer to process than no transformations.
   2. Problems with transformational grammar
      1. It shouldn’t be surprising that transformed sentences take longer, since they are more complex and have more words.
      2. Reversible versus irreversible passives
         1. The ghost was chased by the robot / the robot was chased by the ghost.
         2. The flowers were watered by the robot / the robot was watered by the flowers.
         3. People take longer on reversible sentences because you are transforming it – however the irreversible sentences do not show this effect because semantics has deemed it implausible (problem with autonomy of syntax as well).
      3. Chomsky’s answer was that his theory was linguistic competence and not our online processing.
   3. Psycholinguistic work on parsing
      1. Syntax proposes; semantics disposes – we build a parse tree at each clause based on syntax and then go back when the semantics doesn’t make sense.
      2. Size units of parsing
         1. Sentences are major processing unit, after a sentence boundary has occurred we forget the actual words of the previous sentence and remember only the gist of the information.
         2. Clauses are also important – group of related words containing a subject and a verb.
            1. Clause boundary effect – words are best remembered from the clause you are currently processing
            2. Eye fixations are longest at the end of each clause
         3. Click experiments
            1. People were given sentences in one ear and clicks in the other ear. The clicks fell in the middle of a clause. When people reported these clicks, they said they were at the end of the clause.
            2. Furthermore, if you don’t actually give them the clicks (tell them it’s subliminal perception) and ask them when they heard the clicks, they will say it was at the end of the clause.
         4. However, there are many studies that show that people process both syntax and semantics on a word by word basis (the click studies show memory effects basically).
         5. They also show effects of word generation – as we process we generate expectancies of what should come next. If you gave people sentences with a gender marker (he) and then a non-match term (Christina), they show strong brain spikes.
         6. Eye tracking experiments also show an effect of word by word processing – your eyes will move around a visual scene depending on words that were presented.
            1. The woman will spread the butter (look at the bread)
            2. The woman will slide the butter (look at the man in the scene)
      3. Processing strategies based on surface cues
         1. When we hear “the” “a” we know it’s the start of a noun phrase
         2. Canonical sentence strategy - We use SVO – so noun verb noun, so the first noun is the subject, the second is the object.
   4. Two early accounts of parsing
      1. Kimball proposed 7 principles of parsing, where we use surface structure to uncover syntactic structure. All these processes help minimize memory load.
         1. *Parsing is top down* – we start at the beginning of the sentence and look one or two words ahead and predict constituents (minus when you see an “and”).
         2. *Right association* – the new words are attached to the lowest structure build so far (so attached at the end with the last words)
         3. *New nodes* - function words signal a new phrase
         4. *Processing limits* – can only cope with two sentence nodes (so embedded clauses with 3+ nodes are hard to read)
         5. *Closure* – prefer to close a phrase structure as soon as possible
         6. *Fixed structure* – do not want to go back and restructure a clause (which is why garden paths are so slow).
         7. *Processing*  - when you close a phrase it goes from short term memory to semantic processing (which is why we don’t know the words).
      2. Redesigned Kimball to “sausage machine” two stage model of parsing
         1. Preliminary phrase packager – can see about 6 words and cannot add words with longer dependencies (clauses) – uses syntactic heuristics and rules to construct phrases (like minimal attachment – prefer simpler structures)
         2. Sentence structure supervisor – constructs what the PPP gives it, but cannot undo the work from it
         3. Eventually added right attachment to model for when minimal attachment doesn’t work
         4. Became very influential for the most popular model now.
4. Processing structural ambiguity
   1. Garden path – autonomous two stage model
      1. Processor uses syntactic information in the first stage
      2. Ambiguous material – only one interpretation is created
      3. We use only late closure and minimal attachment
         1. Minimal attachment – incoming material is attached making the fewest nodes possible.
         2. Late closure – incoming material should be added to the phrase currently being processed.
      4. Second stage is thematic semantic information, if the model in that stage doesn’t pass this stage, we go back to stage one.
   2. Constraint based models – interactive one-stage model
      1. We use multiple *constraints* from semantics, thematic, discourse, syntax to create the current phrase tree.
   3. Evidence for the garden path (autonomy)
      1. Example sentences with garden path late closure, minimal attachment rules:
         1. Since Jay always jogs a mile and a half this seems a very short distance to him. (late closure)
         2. Since Jay always jogs a mile and a half seems a very short distance to him. (not late closure but we try)
         3. The criminal confessed his sins harmed many people (minimal attachment).
         4. The criminal confessed that his sins harmed many people.
      2. Semantic information doesn’t always help us survive the garden path either.
         1. The defendant examined by the lawyer turned out to be unreliable (the defendant semantically can examine, so we get lead astray to think that this is the verb.)
         2. The evidence examined … same sentence. Here the evidence can’t “examine” so we know it’s got to be a DO or clause, but still causes us problems.
      3. Some evidence that we do not use very much information in the first pass of processing.
         1. The verb visited can get a DO, but the verb sneezed can’t…however we still get garden path-ed because it’s a verb.
      4. Brain information shows that you can damage semantics or syntax separately.
         1. N400 is supposed to be lexical access or semantics for words. You get activation when shown things like: Boris noticed the puncture and got out to change the wheel on the castle.
         2. P600 seems to be syntax related, and you see it after this: Boris persuaded to fly.
         3. You can get them separately or together depending on how you put together a sentence.
            1. The cats won’t bake the food that Mary leaves them (semantic)
            2. The cats won’t eating the food that Mary leaves them (syntactic)
            3. The cats won’t baking the food that Mary leaves them (both).
      5. What is the separation though?
         1. Representational modularity – semantic and syntactic information are represented separately (stored differently in the brain etc.)
         2. Processing modularity – do they work together or separately or is information restricted?
   4. Evidence for interaction (constraint based models)
      1. Semantic bias – when the sentence biases the phrase structure to create non-minimal attachment rules. (taraban picture page 302).
      2. When semantic information is violated we can get led down a garden path:
         1. The granite rocks during the earthquake
         2. The table rocks during the earthquake
      3. People identify the garden path sentences as ungrammatical because of the semantic context
      4. You can disambiguate where a phrase needs to go based on previous text (i.e. eliminate the garden path).
      5. Referential theory - Generally it is thought that we create the phrase structure tree word by word with a strongest one at the best. All others are generated but ruled out (or weaker) by context.
         1. General world knowledge is used later in processing, so it’s probably not a strong interaction between semantics and syntax.
         2. For example, we can use discourse based information to avoid garden paths:
            1. The vampires loaned money at low interest were told to record their expenses.
            2. Only vampires loaned money at low interest were told to record their expenses.
            3. The ONLY helps us avoid the garden path.
      6. Back to the evidence examined…if you have sufficient semantic bias, that effect does goes away.
         1. The fossil examined
         2. The archeologist examined
      7. Verb bias – the frequency of verb interpretation will be an important factor.
         1. Direct object verbs – most frequent continuation is a direct object (gave)
         2. Sentence complement verbs – common continuation is sentence complement (realize)
         3. Direct object verbs give us more problems than sentence complement verbs (especially when the sentence complement verb does not require a “that”).
      8. Just like the dual route model – these models are about competition – when two models are highly likely they compete and we have trouble with the sentence.
         1. Competition integration model – checks the interpretation after each new word.
         2. Digging in – if the ambiguity lies farther away then we have decided on one model and don’t want to give it up (so even harder)
            1. After the Martians invaded the town that the city bordered…was evacuated.
      9. Brains
         1. When sentences are ambiguous, it takes up more brain power to process them.
         2. Broca’s seems to be involved in processing the syntactic representation (it is in the PFC).
         3. Wernicke’s follows close behind with the semantic interpretation.
   5. Does this hold in other languages?
      1. Not so much.
      2. Spanish does not seem to have the late attachment issue – they tend to attach the information to the first noun phrase. (or French or Dutch)
      3. Tuning hypothesis – emphasizes the role of exposure to language
         1. Parsing is biased or based on resolving ambiguities in the way you have before.
         2. Probabilistic model – meaning that we solve things based on their frequency and our use of them.
   6. Other models of parsing (combination of two models)
      1. Unrestricted race models – all forms of information are used to create alternatives to phrase structure (interactive constraint idea)
         1. Whichever interpretation is constructed the fastest “wins” and is adopted.
         2. We are really slow if we figure out later we were wrong and have to reanalyze (two stage model)
   7. Processing syntactic category ambiguity
      1. Lexical category ambiguity – words that can be two different word types (verb or a noun, trains watches)
      2. We process these different phrase structures in parallel, but no one is chosen until further disambiguation.
      3. Semantic bias does seem to be important – how often those words are used as either nouns or verbs
         1. The young bear … the weight of caring for the old …ate Billy.
         2. The first is much harder because we don’t think about bear as a verb very much.
5. Gaps Traces and Unbound Dependencies
   1. Sometimes constituents get deleted or move (bob was selling and tina was buying), people delete the second “was”
      1. Gap – an empty part of the syntactic construction that is associated with a filler.
      2. Fillers – words that fill a gap
      3. Unbounded dependency – when words have a DO but it’s been moved to another part of the sentence
         1. Which sword did Vlad **sharpen** yesterday?
   2. Findings:
      1. More brain activity as we use fillers to go back and trace the original words (more working memory?)
      2. Recent filler strategy – ambiguity in the gap is filled with most recent plausible thing
         1. This is the girl the teacher wanted to talk.
      3. Words become semantically reactivated at the gap point – can prime other words or help memory.
   3. Strategies
      1. Active filler – when we hit a gap, we fill it with the most active item
      2. Recent filler see above
6. Neuroscience of parsing – appears to be in Broca’s and Wernicke’s
   1. Comprehension abilities of agrammatic aphasics
      1. Agrammatism – without grammar, a type of aphasia distinguished by the impairment of syntactic processing caused by damage to Broca’s area (show video)
      2. Mapping hypothesis – agrammatics are able to do low level phrase tree mapping, but unable to do anything with that output.
      3. May be a working memory deficit? The quick fading of working memory leaves them unable to do use the output from processing or come up with words to say (people talk too fast to understand)
      4. Could also be an attentional deficit – hard to tell with the tasks that are used to measure problems with language.