HUL381: Mind, Machines and Language
Minor2, Form: A

Name: _____

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Section 1. Short Answer Questions

1. (10pts) Describe the embodied semantics hypothesis and contrast it with associationist semantics. Your answer should allude to both the theoretical and methodological assumptions of both approaches.

2. (6pts) Describe experimental evidence as to how Jabberwocky speech (real function words+pseudo content words) is processed by the brain.

3. (10pts) Explain the Frequency Ordered Bin Search (FOBS) theory of morphological processing (4pts). Outline the predictions of this theory in terms of processing times for the following classes of words:

   (a) Words with real suffixes (like *speaker*) vs. words with pseudo-su ffixes (like *sister*) (3pts)

   (b) pseudo-words that are made up of a prefix (e.g., *de*) and a real root morpheme (e.g., *juvenate*) vs a comparable pseudo-word that contains a prefix and a non-root (e.g., pertoire). (3pts)

Answer Key for Exam A

Section 1. Short Answer Questions

1. (10pts) Describe the embodied semantics hypothesis and contrast it with associationist semantics. Your answer should allude to both the theoretical and methodological assumptions of both approaches.

   (a) (4pts) Embodied semantics argues that abstract symbols or groups of symbols, like words, carry meaning because those symbols are tied to representations outside of the (traditionally defined) linguistic system. Specifically, words are tied to representations that we build using our perceptual apparatus (our five senses: vision, hearing, touch, taste, and smell). In that way, words do not just activate patterns of abstract symbols, words evoke perceptual experiences with real-world objects. On the contrary associationist semantics doesn't have any means to link meanings outside of nodes in a semantic network.

   (b) (2pts) Some scientists believe that the neural basis for the kinds of mental simulation proposed by the embodied semantics approach involves mirror neurons in addition to motor system. The idea is that the linguisticsemantic system also drives these mirror neurons and uses them to represent the meaning of words that describe objects and actions. On this account, perceiving the word hammer triggers a response in the mirror neuron system that closely resembles the pattern of neural response that happens when we use a hammer ourselves or watch someone else use a hammer

   (c) (4pts) Activation spreading as corroborated by earlier priming and later behavioural studies provide evidence to the associationist semantics position. Quantitative metrics of semantic similarity (HAL and LSA) have also been proposed for the associationist position. In contrast, embodied semantics position relied on introspection and reasoning earlier and transitioned to behavioural

experiments later. Priming and activation have never been key methodological tools used by embodied

2. (6pts) Describe experimental evidence as to how Jabberwocky speech (real function words+pseudo content words) is processed by the brain.

   5pts for the connection between Jabberwocky speech in the context of the larger debate about language cognition.

   (4pts) The systematic finding in the 1950s was that unstructured sets of words were much harder to recall than structured sets i.e. words which were part of sentences. A greater percentage of words was recalled from the structured than from the unstructured sets of words. A straightforward explanation of this effect proposes that syntactic structure is psychologically real. Recalling strings of words is easier if the words are related to each other syntactically. The psychological reality of sentence structure is pervasive and profound, even though syntactic structure itself is abstract and not as consciously available as words are. An alternative hypothesis is that recall is facilitated, not by syntactic structure, but by the semantic relations among words. Can people compute syntactic relations in the absence of meaning?

   When you read or hear Jabberwocky language language consisting of pseudowords placed in grammatical syntactic frames you cannot help but compute the syntactic relations, even though you may have no idea what the words actually mean. You (tacitly) know that toves is the head noun of the subject NP in the first clause, that gyre and gimble are verbs, and that in the wabe is a locative PP indicating where the toves gyred and gimbled. This has been demonstrated by a number of inves- tigations of how people process Jabberwocky language.

   6pts for the description of the experiment below:

   An fMRI study (Friederici, Meyer, and Cramon 2000) attempts to answer the following questions. Are different regions of the brain activated during auditory comprehension of:

   (a) Normal vs. Syntactic/Jabberwocky speech (real function words and pseudo content words)?

   (b) Real content words vs. Pseudo content words

   The first question above is relevant and hence is described. fMRI is a non-invasive technique which measures brain activity by detecting associated changes in blood flow. This is based on the principle that cerebral blood flow and neuronal activation are coupled. The most primary form of fMRI uses the Blood-oxygen-level dependent (BOLD) contrast. They use German stimuli similar to Lewis Carroll's poem Jabberwocky and normal German sentences as the control stimuli. Subjects are made to listen to these sentences.

   Compared to normal speech, there is extra activation in left hemisphere (activation of the deep left frontal operculum) in the case of Jabberwocky speech. Using the fMRI technique, they also show significantly higher neuronal activation in the frontal lobe compared to the temporal lobe in the case of Jabberwocky speech. Thus the final conclusion is that additional computational resources of left inferior frontal cortex are recruited to process Jabberwocky speech.

3. (10pts) Explain the Frequency Ordered Bin Search (FOBS) theory of morphological processing (4pts). Outline the predictions of this theory in terms of processing times for the following classes of words:

   (a) Words with real suffixes (like *speaker*) vs. words with pseudo-su ffixes (like *sister*) (3pts)

   (b) pseudo-words that are made up of a prefix (e.g., *de*) and a real root morpheme (e.g., *juvenate*) vs a comparable pseudo-word that contains a prefix and a non-root (e.g., pertoire). (3pts)

   FOBS: FOBS proposed that word form representations were activated by bottom-up input from the auditory system. According to Taft and Forsters model, lexical access involves people using auditory (or visual) cues to search their long-term memories for a matching stimulus. The FOBS account proposes that morphemes are an important level of representation in lexical access. 2 main properties:

   (a) Frequency ordered searching: This search process is organized so that people do not need to search the entire lexicon every time they need to look up a word. Instead, lexical (word form) representations are organized into bins. The bins are organized according to word frequency. High-frequency words are at the front of the bin and are searched first; lower frequency words are stored toward the back of the bin and are searched later. When you encounter an auditory stimulus, that opens up a bin and you search through the bin looking for an entry that matches the stimulus, starting with the most frequent item in the bin, then the next most frequent, and so on until you have searched the entire bin. The search process ends when you find an item in the bin that matches the stimulus. This kind of search is called self-terminating (the process stops itself when it succeeds), so you dont keep searching the bins for an additional match after you have found one good candidate. One last important characteristic of the model is that words are organized in the bins according to shared roots.

   (b) Affix stripping: According to the FOBS model, the incoming stimulus has to be analyzed according to its root, because the root is what gets the listener access to the correct bin. Whenever a listener encounters a polymorphemic word (dogs, dogpile, dogaphobia), the first thing the listener needs to do is figure out what the root is. Therefore, the first step in lexical access is morphological decompositionthe incoming stimulus needs to be broken down into parts that correspond to individual morphemes before the root can be identified. A word like dogs is analyzed as being made up of the root morpheme dog and the plural inflectional suffix -s.

   Predictions to the 2 situations asked in the question:

   (a) Even though sister is a monomorphemic word, the lexical access process breaks it down into a pseudo- (fake) root, sist, and a pseudo-suffix, -er. After the affix stripping process has had a turn at breaking down sister into a root and a suffix, the lexical access system will try to find a bin that matches the pseudo-root sist. This process will fail, because there is no root morpheme in English that matches the input sist. In that case, the lexical access system will have to re-search the lexicon using the entire word sister. This extra process should take extra time, therefore the affix stripping hypothesis predicts that pseudo-suffixed words (like sister) should take longer to process than words that have a real suffix (like grower).

   (b) People also have more trouble rejecting pseudo-words that are made up of a prefix (e.g., de) and a real root morpheme (e.g., juvenate) than a comparable pseudo-word that contains a prefix and a non-root (e.g., pertoire). This suggests that morphological decomposition successfully accesses a bin in the dejuvenate case, and people are able to rule out dejuvenate as a real word only after the entire bin has been fully searched