11D Word Meaning

1. Introduction
   1. Types of memory
      1. Episodic memory – memory for events and episodes
      2. Semantic memory – general fact based knowledge, *encyclopedia*
      3. Lexicon – our mental dictionary
      4. Although there is a clear distinction between the two, they overlap a lot and may involve the same memory processes
   2. Categorization and meaning
      1. Category – group or organization of related things
      2. Concept – a member of a category (i.e. the thing)
      3. All words have an underlying concept, but not all concepts have words (i.e. we do not have a special word for brown dogs)
      4. Category formation – based on two things
         1. Based on the way we perceive the world (based on related features)
         2. Cognitive economy – memory is organized to be efficient, avoiding lots of duplication (but not be so vague that it’s not useful)
      5. How are categories related?
         1. Levels of categorization
            1. Superordinate – more abstract (animal, mammal)
            2. Basic level names – dog
            3. Subordinate – specific category member (collie, beagle)
   3. Association?
      1. Association arise from words regularly occurring together
      2. Semantics shared contexts and higher level relations (features)
2. Classic approaches to semantics
   1. Definitions
      1. Denotation – its core essential meaning
      2. Connation – all secondary meanings, emotional or evaluative associations
      3. Dog is a four legged creature barks, etc.
      4. Dog might also mean that someone is a bad person
   2. Theories
      1. Referential theory – words mean what they refer to; problem is for abstract words how do you point to justice?, doesn’t explain different senses of words
      2. Intension – abstract specification that determines how a concept is related in meaning to other words
      3. Extension – what the word stands for in the world
      4. Model theoretic semantics – (truth theoretic semantics ) – logical models of complex meaning, originally designed for logical/computing languages
3. Semantic Networks
   1. Semantic network – concepts are linked because of their frequency (association) but also the links between concepts have meaning.
   2. Collins and Quillian semantic network model
      1. Model Specs
         1. Originally developed as a way to help translate between languages
         2. Natural kind terms – a category of naturally occurring things (animals, trees)
         3. Page 326 model
         4. Model is sort of built around a hierarchical network idea (sort of biology kpcofgs)
         5. Connections between nodes have different link types – ISA example
         6. Attributes are stored at the lowest level so that all the things under it have those features (have wings stored at birds and not animals)
      2. Sentence verification task
         1. Participants are given fact sentences and asked to verify if they are true or false – measured their reaction time to each sentence.
            1. A robin is a bird, animal, fish…
            2. A robin has a red breast, wings, lungs…
         2. Shows you the hierarchical structure of the network. Things are responded to fastest at the same node level and correspondingly slower at each node level away you have to travel (so lungs is really slow).
      3. Problems
         1. Not all abstract information can be represented this way
         2. Conjoint frequency – how frequently two words co-occur together…robin and bird occur together a lot, while bird and animal don’t. – this model does not separate out semantic distance with conjoint frequency
         3. Memory structure does not always reflect logical category structure.
            1. A cow is an animal is faster than a cow is a mammal.
         4. Relatedness effect – don’t reject all untrue statements equally slowly.
            1. A pine is a church is slower than a pine is a flower. (have to separate out flower and tree)
         5. Prototypicality effect – we are faster for items that are more typical of a category
            1. A robin is a bird is faster than a penguin is a bird (the model predicts that we should do these at the same rate)
         6. We are faster to categorize items that match more features … especially features that are not true of all category members (birds fly…although this is not true for all category members).
      4. Revisions to model (Collins and loftus spreading activation)
         1. Spreading activation model – structure become more complex, links between notes varied in strength (page 328)
         2. Structure is not hierarchical
         3. Connectionist model – things are linked together and priming is based on spreading activation to other concepts.
4. Semantic Features (decompositional theories)
   1. Semantic features – smaller units of meaning (markers, attributes)
      1. Tend to be called decomposition theories because they break words down into smaller parts or features
      2. These models work very well in simple domains (i.e. think about a survey form were you describe yourself – gender, age, race)
      3. Semantic primitives – represent the meanings of words as combinations of as few features as possible
      4. Schank (big AI guy) has argued that all sentences can be broken down into the relationship between semantic primitives in a sentence.
   2. Katz and Fodor
      1. Meanings of sentences could be figured out by combining the meaning of each individual word in the sentence.
         1. Especially in ambiguous sentences.
      2. Steps to understanding
         1. First, *semantic decomposition* or the breakdown of each individual word into their semantic features.
         2. Second, combination of features across words based on *selection restraints.*
            1. For example if you use the verb “kick” you expect to kick something, so a ball. You would discard the activation for the “party” version of ball.
   3. Feature list theory – sentence verification – feature comparison
      1. Feature list theory argues that our semantic knowledge is based around a list of features that make up that concept.
         1. Defining features – essential to the meaning of words
         2. Characteristic features – usually true of category members, but not always (penguins can’t fly but are birds).
      2. Sentence verification task
         1. Feature comparison theory – sentence verification requires you to compare meanings
         2. First overall feature similarity is computed (both defining and characteristic)
            1. If there is a lot of overlap, we say it is true
            2. Very low levels we say false
            3. Middle levels we use step two
         3. Second stage we consider only defining features
      3. Problems
         1. What exactly are the defining characteristics? People do not always agree (think about what games are)
      4. Probabilistic feature model – extension of the feature comparison model
         1. Core description – essential defining features of the concept (gets at relationship between concepts)
         2. Identification procedures – parts of the meaning were you are indentifying instances of a concept
         3. Features are weighted by saliency and probability of being true for that category
         4. This model solves the problem of fuzzy categories (allows them to vary by individual and importance of that trait), talks about thresholds instead of comparing all features
   4. Evaluation of the decompositional theories
      1. It’s almost impossible to create experiments that distinguish between the prediction of these models and network models.
      2. They seem plausible and by reducing information to small pieces of information they met the economical requirement
      3. Some categories do not have defining features that will work for every category member.
         1. It’s very hard to put together a plausible category list consistently actually (describe your work and show an example word)
      4. Inter-correlated features – the relationship between features is not captured (if you build a nest, you usually lay eggs)
      5. These theories are tied to the sentence verification task – that’s a problem because you don’t want your whole theory to be based on one task
         1. Also if you ask the same question in a different order you get different results (procedural invariance)
            1. Is a robin a bird?
            2. Is a bird a robin?
         2. People use specific strategies to complete a sentence verification task, instead of actually computing all the features (thinking of a counter example).
         3. Feature comparison theory expects category membership to be a little black and white, but it’s not (is a tomato a fruit or vegetable?)
   5. Is semantic decomposition automatic/we have to do it?
      1. Two questions: do we represent in features? Do we use those features in comparison?
      2. Do we activate the features of a word automatically if we see it?
         1. Hard to test experimentally
         2. Pure definitional negatives – words have negative features (not married) and negatives in sentences make you slower. If you combine those two, you should be really slow.
            1. The bachelor married Sara (one negative)
            2. The bachelor did not marry Sara (two negatives)
            3. But you see no difference between the two sentences, so they concluded we do not activate features automatically.
         3. Lexical causatives – verbs that bring about or cause new states of affairs.
            1. For example, “kill” means to cause to die
            2. So picture on 334 – you should get processing between the two but you don’t.
         4. Do you buy all this?
            1. Feature complexity or rich semantic meanings actually appear to help you process
5. Family resemblance and classification
   1. Prototype theories
      1. Prototype – an abstraction that is the best example of a category
         1. These are said to be ideal
         2. May be a combination of different examples
      2. You decide that something is in the category by comparing to the prototype
      3. Schema – a means for organizing knowledge; prototypes are said to be special schemas
         1. In these schemas, the most common features are filled in (typicality effect)
      4. Prototype theory is better than feature theory
         1. Sentence verification is faster for prototypical members
         2. We remember the prototype instead of the specific instance
      5. Not necessarily separate from feature theory – prototype theory holds that features are the fillers in schemas
      6. Basic Levels
         1. Basic levels – default level of categorization at which we think (helps us economize and gives us maximum information)
            1. Definition – the level of representation in a hierarchy that is the default level
         2. These levels are the most salient (show pictures and ask people to name things)
         3. Can easily list the attributes at a basic level
         4. Sentence verification is faster
         5. Children learn these first and use them the most
      7. Problems with model
         1. Not everything seems to have a prototype – what is the prototype for truth?
         2. Balan – women fire and dangerous things category in Dyirbal – doesn’t seem obvious how that prototype would work
         3. Similarity tasks are circular: items are in the same category because they are similar; they are similar because they are in the same category
   2. Instance theories
      1. Exemplar theory – we compare information to a specific stored example
      2. Basically these theories are the same, but the comparison process is different
         1. Specific instances conceptually do seem like a better idea, and research supports them slightly over prototype theory
      3. Instantiation principle – category includes detailed information about the range of instances
         1. Not quite so economic
         2. But you would pull up instances until you could decide if the new thing should be in that category
   3. Theory theories
      1. Definition – people represent categories as miniature theories that describe facts about those categories and how they relate
      2. Mini theories are a set of beliefs about category instances and how they belong to the category
      3. Sort of like a dictionary
      4. Based on research on how children form categories
6. (Skipped combining concepts and figurative language, category specific disorders)
7. Brains – neuropsychology of semantics
   1. Structure of semantic memory – evidence from dementia
      1. Dementia – general label for decay of cognitive functioning
      2. Alzheimer’s disease – subtype of dementia
      3. Semantic dementia – loss of semantic information is greater than other cognitive functions
         1. Impaired word naming, loss of word meaning, syntax intact
      4. Brains
         1. AD – tends to affect the medial temporal lobes first (page 351), the hippocampus
         2. Semantic dementia – starts in the left anterior temporal region, much less early damage to the hippocampus
   2. Semantic memory disturbances in dementia
      1. Impaired at a category fluency task (list as many as you can of a category)
      2. Trouble listing category attributes
      3. Trouble differentiating from same category members
      4. Trouble judging semantic coherence (the door is asleep)
   3. Difficulties with picture naming
      1. Have trouble naming category members – tend to call them something close
      2. May be a slight visual problem – they are better at tasks with highly salient visual information
      3. Phonological problem – trouble naming low frequency items, phonological priming helps
      4. Connectionist modeling (page 353) shows that all these problems can be modeled by eliminating semantic nodes – so it’s probably damage to the semantic system only that causes the visual and phonological problems
8. Connectionist approaches to semantics
   1. Semantic microfeatures – just like every other model we’ve considered, concepts are not a single unit in the model, but activation of several units across the network
      1. Microfeature – single active unit at a low level of processing
         1. May correspond to a single feature (linguistic correspondence) or something more abstract
         2. They are the connection between perception and language
         3. This encoding is likely why you see visual errors in dementia, the microfeatures are partially perceptual
      2. Similar to attractor networks we’ve talked about before – patterns of activation for word meanings that overlap
   2. Semantic microfeature loss hypothesis
      1. Damage to a subset of microfeatures will give you problems with attractors
      2. Since these microfeatures are not encoded as specific features, you will get different results depending on task and question.
   3. Latent Semantic Analysis
      1. LSA – a means of acquiring knowledge from the co-occurrence of information
      2. We probably learn features (or microfeatures) by statistical probability – connectionist models pick up on the probability of a feature leading to a concept quite well
      3. LSA is a procedure that measures similarity based on the context the words occur in
         1. So how exactly do they grade those GRE writing sections?
      4. Over 300 features were necessary to represent the relationship between 4.6 million words of text from an encyclopedia
      5. Says we learn vocabulary by induction based on the context of its use
      6. One problem is that the focus of words in their context does not allow you to figure novel solutions (newspaper to protect you from the rain)
   4. Grounding – connecting language to the world
      1. How do we map meaning and language to the real world considering that’s what it’s used for…?
      2. Grounding is how symbols are connected to perceptual representations
      3. Basically these connectionists models argue that semantic memory is mediator between different perceptual systems (visual – round; verbal – names, functions)