Chapter 7
Concepts, Language, Meanings, and Definitions

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Chapter Outline

7.1 Chapter Overview

In looking at some of the sources of vagueness and ambiguity these lectures and chapter should give students some insight into how one's thoughts get meaning. This part of the lecture turns specifically to the psychological notion of concepts. The lecture proceeds as follows: (1) This lecture outlines psychologists' and philosophers' understanding of the nature of concepts as well as the functions of concepts in human thought. Specifically, the lecture discusses several important functions of concepts. It also notes some of the ways in which concepts can fail to fulfill these functions. (2) The lecture presents two general approaches to understanding concepts in both psychology and philosophy; the classical approach and the similarity/probability approach. Specifically, the chapter outlines the strengths and weaknesses of the classical approach. It then goes on to characterize how the difficulties for the classical approach lead researchers to formulate the similarity/probability approach. To give students a more concrete understanding of the similarity/probability approach the lecture discusses one concrete theory—the prototype theory of concepts--as an example of the similarity/probability approach. (3) Historically psychologists reject the classical approach in favor of prototype theory in the 1970s and early 1980s. The motivation for rejecting the classical approach to understanding concepts illustrates one important difference between definitions and concepts—a phenomena called typicality. While prototype theory has difficulties and limitations as a general theory of concepts—it does provide a clear a comprehensible illustration of how similarity/probability theories work. It likewise helps to illustrate typicality. Psychology currently does not offer as definitive theory of concepts. However, some of the features of concepts that motivate the abandonment of the classical theory in favor of something like prototype theory prove important for understanding the differences between concepts and definitions. (4) At this point, the lecture and chapter transition from concepts and conceptual structure to communication. Just as concepts act to record only a small set of information from specific cases—a net loss of information—communication faces a similar net loss of information. (5) The lecture and chapter then consider definitions as human artifacts that function to eliminate vagueness and ambiguity in human thought, communication, and argumentation. (6) The lecture and chapter then outline several types of definition with more specific goals. (7) The chapter concludes by summarizing some of the more important differences and similarities between definitions and concepts.

7.2 Concepts as the Primary Psychological Units of Content

In addressing content issues in inferences and argumentation one needs to consider the relationship between one's psychological processes and states and one's linguistic tools for communication and argumentation. Psychologists and cognitive scientists still have a great deal of work to do in understanding, for example, the exact nature of concepts, their development, and their use in communication, inference, and memory. This chapter and lectures focus upon relatively uncontroversial features of content in inference, decision-making, and memory as well as communication and argumentation. Specifically, the chapter and lectures focus upon the ways in which concepts come to bear meanings and the errors that can arise in thought, communication and argument that can result from the manner in which concepts and words get their significance.

The discussion of concepts as the psychological bearers of content in this chapter and lectures serves three purposes. First, this chapter and lecture argues that vagueness and ambiguity prove inherent and ineliminable features of conceptual and linguistic content. Mental states and linguistic entities exhibit vagueness to the extent that one can question the applicability and/or precision of those entities in thought, argument, or communication. For example, ordinary concepts and terms exhibit vagueness when there are borderline cases where people might disagree as to whether or not the concept or term accurately describes the case or whether the concept or term applies. Our concept of fruit exhibits vagueness insofar as people may disagree as to whether or not, for instance, a squash counts as a fruit. In contrast, ambiguity in a mental state or linguistic entity results from the possibility of multiple distinct contents. For example, many terms in the English language have ambiguities. The word "bank" can refer to a financial institution; it can refer to a sharp turn; it can refer to the side of a river. All of these meanings are legitimate within our language.

Nevertheless, when someone uses the word “bank” the possibility of other interpretations can undermine successful communication or argumentation.

The discussion of concepts as the psychological bearers of content also serves to underline inherent and inescapable nature of vagueness and ambiguity in thinking and in linguistic behaviors such as argumentation and communication. Indeed, as we shall see, vagueness and ambiguity enter into cognition and communication at every level. Therefore, students need to cultivate an awareness of the potential for ambiguity and vagueness in their inferences, decisions, arguments, communication, and memories. Students likewise need to recognize that vagueness and ambiguity are inherent in cognition and when necessary and/or possible adopt the conventional techniques for limiting or eliminating vagueness and ambiguity.

Lastly, the discussion of concepts as the psychological bearers of content presents the conventional technique for limiting or eliminating vagueness and ambiguity in communication and conceptualization--definitions. Thus, the chapter and lectures introduce the notion of a definition, discussing the structure and uses of definitions as well as contrasting the strengths and weaknesses of definitions with the strengths and weaknesses of content-bearing mental states and linguistic entities.

7.2.a The Role of Concepts in Cognition

Cognitive psychologists and philosophers assume concepts are the basic constituents of thought and belief. In other words, concepts play a major functional role in the operation of any intelligent system. Most fundamentally, concepts facilitate categorization. One can think of categorization in two ways. First, concepts allow one to treat various objects, properties, events, or relations as instances of the same type of thing. That is, concepts group objects, properties, events, or relations together into a class on the basis of shared features thereby allowing a person to think about an item in a manner that abstracts from many of the particularities of that specific item. So, the first important role of concepts in cognition is to categorize the world—to take the variable and complex world of experience and bundle it into more manageable, useful, and re-identifiable components. By facilitating categorization concepts allow one to sort objects, properties, events, and relations into classes on the basis of shared features. The concept of a bottle groups together all sorts of objects having all sorts of differences and some important similarities (See the animation on the left for an illustration). Namely, bottles serve a purpose of providing a portable container with which one usually carries liquids. By facilitating categorization—the collection of a group of individual objects, properties, events, or relations within a single class--concepts perform a number of additional central functions. Second, in addition to categorization concepts allow one create and organize a record one’s past experiences for future use. Thus, concepts allow us to create a knowledge base from our past experiences and, importantly, concepts provide an organizational structure for that knowledge base. Every time you recognize an object as a bottle you access a set of basic information about bottles gleaned from your past experiences with bottles.

Animated movie illustrating the wide diversity of objects, materials, colors, and shapes that fall under the concept of a bottle. Click to play.

7.2.b Features of Concepts

In order to better understand the role that concepts play in cognition, let’s turn our attention to three significant features of concepts. These features do not exhaust the features and functions psychologist and other cognitive scientist associate with concepts in cognition. However, these three features form the basis for the importance of concepts in making cognition possible at all. As we shall see, concepts enable many of the central functions of cognition

in that they provide a mechanism by which the brain attempts to balance the need for information in cognition with the real limitations of memory, time, and processing capacity.

7.2.b.1 Feature 1: Concepts Promote Cognitive Economy

Concepts promote cognitive economy. Recall that the inferences chapter and lectures emphasize the real limitations on the amount of information and the complexity of information humans can process. Concepts facilitate cognition by allowing one to think of an object, property, event, or relationship in terms of general classes. In other words, concepts allow one to think about an individual object, property, event, or relation in a manner that abstracts away from much of the details of that specific individual object. Concepts, therefore, act to decrease the amount of information regarding that individual one must process when one perceives, learns, remembers, communicates, decides, or reasons. For example, if I tell you I own a dog you gain a significant amount of information. You know that I own a four-legged domesticated canine most likely descended from wolves or foxes and commonly owned as pets. You can quickly infer that it barks, eats, breathes, etc.. However, there is a great deal of information that you still do not possess. You do not know the sex, size, weight, age, color, breed, disposition, etc. of this particular dog. Indeed, were I to start to provide you with all the particularities regarding my dog, you might well start looking for a graceful way to exit the conversation.

A little information about my pet might prove useful, but the length of its nails, the age it was neutered, if it has tartar build up on its teeth, etc. … these facts likely serve no useful purpose for you. What holds true about information regarding my dog also holds true for information regarding one's experiences of dogs in general. **When one interacts with the world, one ideally wants to do so in a manner that utilizes a relatively small, highly relevant set of information.** For instance, suppose that whenever you are driving and see a stop sign, you immediately start recalling:

(a) all of the times you have seen stop signs
(b) other things you have seen that were red
(c) the other colors stops signs can have
(d) the definition of an octagon
(e) the other shapes used around the world for a stop sign
(f) the different words in different languages for stop, etc..

You would not live long if your conscious resources were overwhelmed with massive amounts of stop sign related data every time you encountered a stop sign. Instead, you are much better served by quick access to the most salient fact about stop signs when driving—you need to stop.

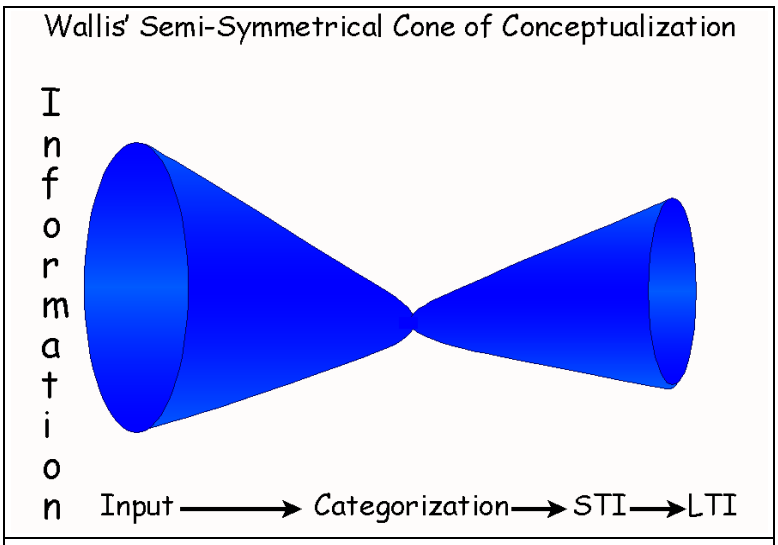


Diagram depicting the process of categorization. In the diagram a large and complex input is made manageable through categorization. Once categorized one can access important information about the object, property, event, or relation—first through short-term memory, then through long term memory.

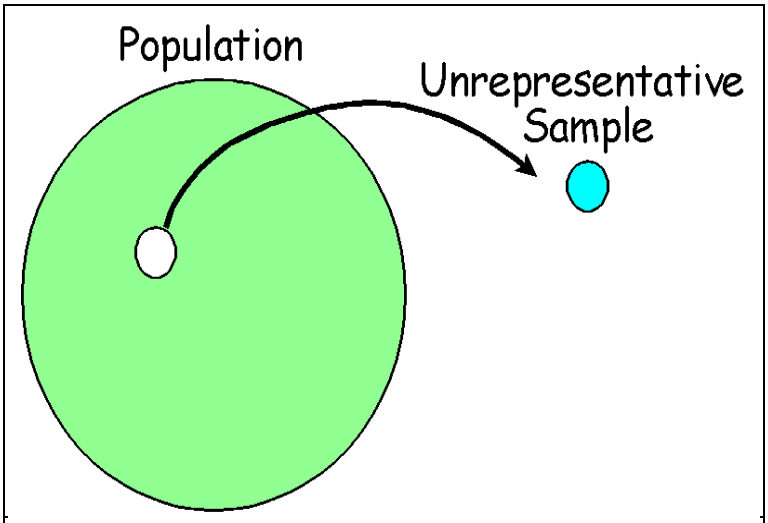
So, one important function of concepts and categorization lies in the management of information so as to facilitate a balance between the amount and complexity of information and the limitations of both conscious and unconscious resources. In the best case scenario, the use of concepts facilitates quick categorization allowing one to perceive, learn, remember, communicate, decide, or reason efficiently by drawing upon a manageable amount of highly relevant information. As a result, **promoting cognitive economy emerges as the information management equivalent of tractability in inference and decision-making.** Tractable inference and decision-making strategies balance the need to complete the inference or make the decision within the timeframe where the result can matter while

utilizing only the available cognitive resources. Cognitive economy balances the benefits of information against the cost of recalling and processing that information by organizing your knowledge around manageable units of information that prioritize thereby prioritizing information based upon its usefulness in past experience.

To illustrate cognitive economy I use semi-symmetrical cone of conceptualization diagram (above). As you drive down the street approaching that stop sign an incredible torrent of raw information surges through your senses into your brain. This blooming buzzing confusion of raw sensory data has no inherent and definitive interpretation. Do you see a sign, a stop sign, a patch of red, an octagon, a piece of metal…all of categories apply and each might prove a useful in the right circumstance. **The world exhibits an inherent ambiguity many categorizations potentially apply to every object one encounters. To manage this ambiguity your brain focuses upon a few salient objects and properties and categorizes your perceptions in the manner that (ideally) best matches the context and your information needs. By introducing categorizations your brain dramatically reduces both the ambiguity in your sensory information and the amount of information that you have to process.** You see a stop sign. You have passed through the categorization bottleneck in the diagram. Your brain then uses that category to access a manageable amount of highly relevant information about stop signs based on your past experiences—you now have access to the information that you need to stop at the intersection. If you have more time, you can use that stop sign category to access more information from your long-term memory. For instance, you might search your memories because you wonder if this stop sign has been here for a long time or has just been installed. If the first categorization does not suit your information needs, you can search related categories or you can re-categorize.

7.2.b.1.a Feature 1: Failures of Cognitive Economy

Sadly, one's use of concepts does not always exemplify this best case scenario. People don't notice the right objects or don't make the right categorizations and blow through intersections causing collisions all the time. Ideally, concepts provide one with a general classification of objects, properties, events, or relations together with ready access to a manageable amount of highly relevant information for interacting with objects of that type. In allowing one to think about objects using a manageable and relevant set of information, concepts allow one to more optimally exploit one's limited conscious working memory so as to think more effectively. In similar fashion, concepts and categorization work to provide the content and context information driving System 1 inference strategies. Of course, concepts do not always provide one with just the right amount and kind of information one needs to make inferences, decisions, etc.. The discussion of the representativeness heuristic in the inferences lecture provides an excellent example of how concepts can sometimes fail to facilitate effective reasoning.



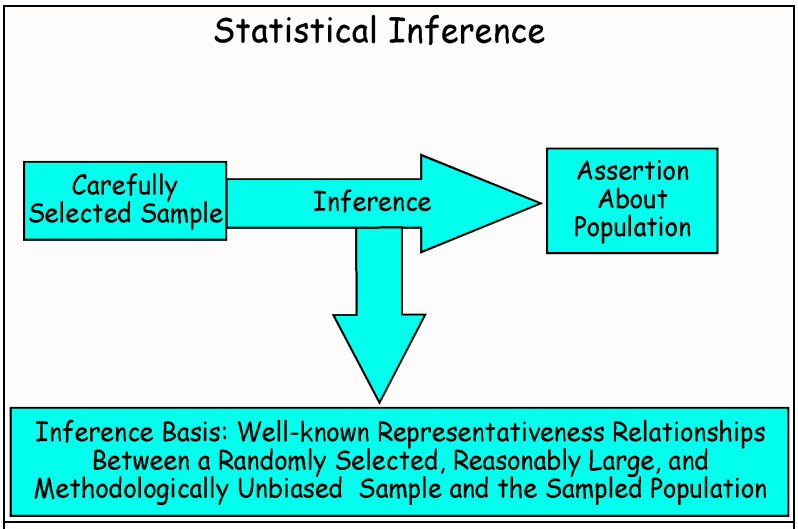
Video depicting the relationship between (1) a sample and a population, (2) a representative sample and a population, and (3) an unrepresentative sample and a population. Click diagram to play.

Recall, the inferences lecture introduces the representativeness heuristic as a general heuristic reasoning strategy. Thus, like all System 1 inference strategies, the representativeness heuristic operates automatically with little conscious awareness, oversight, or insight. Specifically, the representativeness heuristic acts to estimate the probability of an object, property, event, or relation based upon how typical the object, property, event, or relation appears given one's concepts and schemas—those executive summaries of one's experiences. That is, the representativeness heuristic guides one's real world likelihood judgments for an object, property, event, or relation based upon the extent to which that object, property, event, or relation typifies the

essential or salient (prominent) features of one's own models and concepts.

As a result, Amos Tversky[1] and Daniel Kahneman[2] tell readers that "*representativeness* is an assessment of the degree of correspondence between a sample and a population, an instance and a category, an act and an actor or, more generally, between and outcome and a model."[3] (p. 22) In other words, the representativeness relation holds between a population and some bit of knowledge had by the reasoner—a sample of the population. As the inference lecture notes, the representativeness relationship between the real world population and a sample—a small subset of instances taken from the population--provides the key to understanding many ampliative inferences like statistical inferences. Statistical inferences move from partial information about objects, properties, events, or relations in some population—a sample--to information making claims about those objects, properties, events, or relations in the entire population—a generalized conclusion. Thus, the sample, the partial information, serves as the data or evidence taken from the population, and the ampliative inference extrapolates from that sample to make explicit claims about the entire population. For example, representativeness provides the basis for statistical inference in that statistical inference uses the incidence of objects, properties, events, or relations within a sample (subset of the population) to infer the incidence of those objects, properties, events, or relations within a population.

Statistical inference proves reliable because it operates by collecting and analyzing samples in accordance with a set of methods and rules developed since the 17th century—possibly as far back as the 9th century. These rules and methods act so that the dimensions and degrees of representativeness between the sample and the population remain relatively constant. That is, the sample consistently corresponds to the population with regard to some target object, property, event, or relation. In short, the value in the sample provides an excellent basis for estimating the value in the population.

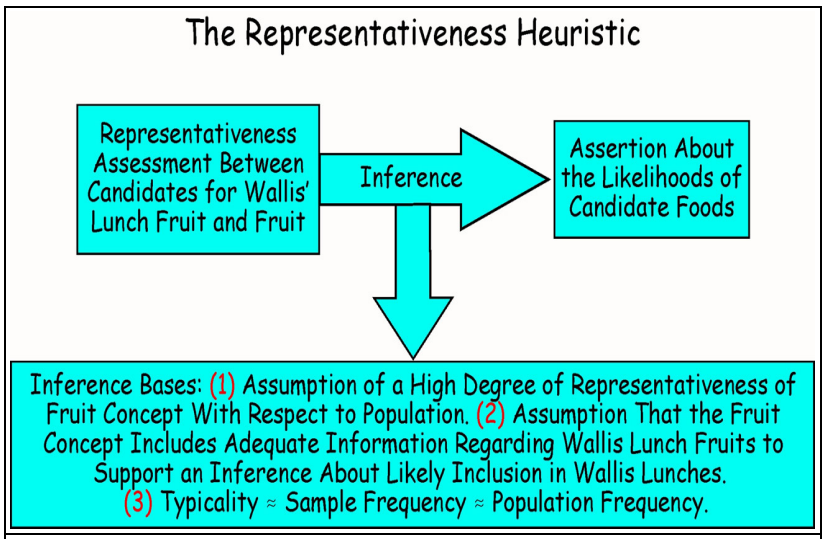


Video depicting statistical inference and its underlying assumptions. The inference takes information about the sample and infers a similar range of values in the population based upon well-known representativeness relationships between randomly selected samples of certain sizes and the population. Click on diagram to play.

The representativeness heuristic, in contrast, uses one's own concepts and schemas as samples of the population. The representativeness heuristic directs one's real world likelihood inferences about an object, property, event, or relation using a slightly different implicit assumption: The representativeness heuristic assumes that real world likelihood corresponds to how typical the object, property, event, or relation seems in one's own experiences. Specifically, the representativeness heuristic estimates real-world probability based upon the object's, property's, event's, or relation's typicality given one's concepts and schemas—the executive summaries of one's experiences. Thus, the representativeness heuristic infers the likelihood of an object, property, event, or relation in the real world by judging the extent to which the object typifies the essential or salient features of one's own models and concepts.

In other words, the representativeness heuristic embodies a contextualized inference strategy in that (1) the content and context (e.x. the presentation of the problem) partially determine the concepts one takes as samples, and (2) the samples one employs—one's own concepts and schemas—can prove idiosyncratic. For instance, suppose that I ask you to estimate the respective probabilities that my pet is a dog, cat, parrot, or walking stick (insect). You will likely base your estimates of the probabilities of each kind of pet based upon typicality, .i.e., how typical each kind of creature--dog, cat, parrot, or walking stick —is of a pet given your pet concept. On other words, you evaluate each candidate's probability by determining how typical each kind of creature is given your concept of a pet. Since people tend to find

dogs very typical examples of pets given their concept of a pet, you will likely rate a dog as most the most probable. Since walking sticks do no not have high typicality ratings, you will likely rate walking sticks as the least probable creature I own as a pet.



Schematic drawing depicting the representativeness heuristic inference and its underlying assumptions. The inference determines a value for the probability of a property, object, event, or relation in the sample—in this case a concept or schema representation—it infers a similar range of values in the population. The bases (underlying implicit assumptions) behind the representativeness heuristic are: (1) The assumption that the concept or schema is representative of the population. (2) The assumption that the concept or schema representativeness with respect to the populations includes target parameter (object, property, event, or relation). That is, that the value for the target parameter as given by the concept or schema is representative of the value for the target parameter in the population. Click on diagram to display animated version.

So, the representativeness heuristic, as an instance of inductive inference, relies upon the truth of its presuppositions in order to extend one's knowledge beyond one's experiences. As a result, the representativeness heuristic generates good probability estimates for objects, properties, events, or relations in the real world whenever those presuppositions apply. Conversely, the representativeness heuristic systematically generates poor estimates whenever its presuppositions fail to apply. Specifically, when one deals with a relatively small, stable, and homogenous population one's experiences, as well as the concepts and schemas one forms on the basis of those experiences, are much more likely to provide a representative sample, and to generate good estimates. When one deals with larger, dynamic, and heterogeneous populations one's experiences, as well as the concepts and schemas one forms on the basis of those experiences, likely provide one with a much less representative sample--generating bad estimates. For instance, recall that people expect the outcomes of chance events to look random. When asked to rate the relative likelihood of the following two sequences of rolls of a fair die, people tend to rate the later sequence as far less likely: 1,3,5,2 or 3,3,3,3. Yet probability theory dictates that the two sequences prove equiprobable (1/1296). Similarly, when asked to rate the relative likelihood of dying in a terrorist attack compared to the likelihood of dying from accidental suffocation, people tend to rate terrorism more likely. However, according to the U.S. State Department 56 U.S. citizens died world-wide from terrorism in 2005,[4] while on average about 6,000 U.S. citizens—roughly 100 times as many--die of accidental suffocation each year.[5]

7.2.b.2 Feature 2: Concepts Facilitate the Encoding, Organization, and Retrieval of Knowledge

So, concepts, like words or phrases, allow one to think of the world in more general terms thereby focusing one's mind on a smaller, more manageable, and highly relevant set of information. This balancing act between too much and/or too complex information and too little or irrelevant information does not always optimize cognition--but it proves necessary to effective cognition all the same. Concepts also provide the basic elements with which one encodes, organizes, and retrieves one's knowledge about the world. For instance, suppose I ask you to tell me what you know about Hydronium Hydroxide or HH. You might tell me that you do not know anything. Suppose that I then tell you that:

> Hydronium Hydroxide, or simply Hydric acid, is colorless, odorless, tasteless. It kills uncounted thousands of people every year. Most of these deaths are caused by accidental inhalation of HH, inadvertent respiratory saturation do not exhaust but the dangers of Hydronium Hydroxide. Its basis is the highly reactive hydroxyl radical, an agent shown to mutate DNA, denature proteins, disrupt cell membranes, and chemically alter critical neurotransmitters. A number of caustic, explosive and poisonous compounds such as Sulfuric Acid, Nitroglycerine and Ethyl Alcohol contain the atomic components of HH. Hydric acid is the major component of acid rain. Prolonged exposure to its solid form causes severe tissue damage. Scientists have found HH in excised tumors of terminal cancer patients. Symptoms of HH ingestion can include excessive sweating and urination, and possibly a bloated feeling, nausea, vomiting and body electrolyte imbalance. You might have read about the dangers of Hydronium Hydroxide on the internet.[6]

Hydronium Hydroxide sounds like dangerous stuff. On the other hand, suppose that I ask you to tell me about H_2O, you would likely have little difficulty recalling that water is H_2O and thereby potentially gain access to all your knowledge regarding that substance. You might realize, or search web and discover, that Hydronium Hydroxide is simply an unusual name for H_2O, that is, water.[7] Of course, once you experience this hoax, usually attributed to an April Fool's Day edition of a local Michigan paper, you will likely remember this name and the association between it, H_2O and water—at least for a while. The hoax continues to live on the internet today. Indeed, a joke site, DHMO.org, held first position in search returns as late as 2020. Both Wikipedia and Snopes have pages debunking the prank.[8, 9]

7.2.b.2.a Feature 2: Failures in the Encoding, Organizing, and Retrieving Knowledge

You might also recognize Hydronium Hydroxide as a case of referential opacity—i.e., as a case where the intensional meaning one associates with various words or phrases does not accurately mirror the extensional meaning of those words or phrases. That is, the words or phrases do not determinately fix the real world reference of those words or phrases. Indeed, cases of referential opacity pose problems in thought and communication precisely because they do not facilitate access to relevant information and connection between ideas. Students have no trouble accessing information about H_2O when some asks, "Tell me what you know about water." Since, one's concepts serve as the means by which one "gets ahold of the world" and through which one encodes, and organizes one's knowledge of the world, one's ability to properly categorize one's experience affects one's ability to access relevant knowledge and make appropriate inferences.

Like terms in our language, concepts have an intensional meaning and an extensional meaning. They get these meanings because, like terms, concepts are really just bits of the world that we use to refer to other bits of the world. In the case of concepts, one can identify two sorts of intensional meaning; the information guiding categorization (i.e., when one conceptualizes an object, property, event, or relation) and the larger body of information encoded, organized, and retrieved through one's concepts. Likewise, concepts, like terms, have an extensional meaning consisting of the objects, properties, events, or relations one—rightly or wrongly—subsumes under the category. The chapter returns to the topic of intensional and extensional meaning in discussing sources of ambiguity in thought and language.

Whenever one miscategorizes an object, property, event, or relation one potentially falls victim to a failure in the encoding, organizing, and retrieving of knowledge. One likewise falls victim to such errors whenever one fails to recognize co-referential concepts or terms (like water and Dihydrogenated Monoxide), whenever one experiences a tip-of the tongue failure to categorize an object, etc..

7.2.b.3 Feature 3: Learning and Induction

Concepts allow one to bring past experience to one's present concerns. The ancient Greek philosopher Heraclitus of Ephesus (535 BCE-475 BCE) writes what people often loosely translate as, "you never step into the same river twice."[10] In this quote Heraclitus expresses a central theme of early Greek philosophy; the world is constantly changing. Indeed, the Greek philosopher Plato (427 BCE - 355 BCE) thought that knowledge comes from identifying and exploiting the constancies in experience amidst the many changes.[11-13] A poignant example of the ability of concepts to knit our experiences together comes some 2000 years later in a passage from Rene Descartes' *Mediations on First Philosophy* [14]

> Take, for example, this piece of wax; it is quite fresh, having been but recently taken from the beehive; it has not yet lost the sweetness of the honey it contained; it still retains somewhat of the odor of the flowers from which it was gathered; its color, figure, size, are apparent (to the sight); it is hard, cold, easily handled; and sounds when struck upon with the finger. In fine, all that contributes to make a body as distinctly known as possible, is found in the one before us. But, while I am speaking, let it be placed near the fire--what remained of the taste exhales, the smell evaporates, the color changes, its figure is destroyed, its size increases, it becomes liquid, it grows hot, it can hardly be handled, and, although struck upon, it emits no sound. Does the same wax still remain after this change? It must be admitted that it does remain; no one doubts it, or judges otherwise. What, then, was it I knew with so much distinctness in the piece of wax? Assuredly, it could be nothing of all that I

> observed by means of the senses, since all the things that fell under taste, smell, sight, touch, and hearing are changed, and yet the same wax remains. (M II, ¶12)

Descartes notes that even though all of the features of the solid wax change as it melts, he can nevertheless recognize the liquid as wax. He rightly notes that nothing inherent in the features of his experience allows him to identify the hot, colorless, odorless, shapeless liquid with the cold, opaque, sweet-smelling, distinctively shaped solid. Instead, Descartes supposes that his judgment, i.e., his ability to categorize instances of wax derived from his concept of wax, allows him to understand the constancy of the wax amidst the changes in its properties. In short, concepts can allow one to interact with the world in a way that allows one to focus upon important similarities between objects, properties, events, and/or relations. Naturally, concepts do not infallibly achieve this goal, but they provide a mechanism through which one can think about the world effectively.

Indeed, the act of conceptualization and categorization is itself and ampliative inference. Whenever one exploits one's conceptual knowledge of a class of things through categorization one makes an inductive inference—one infers that the particular item falls into the class picked out by that concept. Likewise, one can exploit that categorization inference by inferring that the regularities encoded by the concept hold for that particular item (and generally, for all or many instances one will encounter in the future). Thus, when one uses a spoon to eat one's cereal, one supposes that it is the same sort of object one has used in the past, and hence it will serve that function now. When one recognizes the object as a spoon, one supposes that the information that guided one in past categorizations of objects as spoons applies in the current case as well.

7.2.b.3.a Feature 3: Failures of Learning and Induction

Whenever one supposes that certain objects, properties, events, or relations form a class and one starts to employ that distinction to categorize similar instances one begins the processes of concept formation. Sometimes one's concepts work well for categorizing objects, properties, events, or relations. When one's concept allows one to encode, organize, and retrieve information about that class so as to better interact with world concepts do their jobs. However, not all concepts look like good candidates for future categorization. For instance, people once thought that the shape of a person's skull provided a useful way of sorting people in terms of their dispositions towards character and moral traits.

A drawing depicting various areas of the skull thought by phrenologists like Gall to indicate various personality and moral character traits. From: eso-garden.com

A drawing of Franz Joseph Gall (1758-1828) a major figure in phrenology. From: phrenology.com

One infamous advocate of this conceptual scheme is Franz Joseph Gall (1758-1828), a German physician tours Europe for two years beginning in 1805 lecturing on his theory *'Schiidellehre'* or doctrine of the skull.[15] Gall's doctrine proves very influential in 19th century Europe. It likewise has a period of influence in the United States between 1820 and 1850. Gall's theory, and the concepts he uses to formulate it have no basis in neurological or skeletal fact. His inferences and categorizations do not allow Gall to gain insight into people's intellectual, character, and moral traits through the structure of their skulls, though he clearly thinks that they do. Dr. John van Whye notes:[15]

> I could not think that with so many individuals a good memory and protruding eyes only coincidentally coincided. I surmised that there must be a connection between memory and such prominent eyes. By manifold consideration of this I had the idea: if the memory betrays itself through an external trait, should not other mental qualities be externally recognizable? (p. 22)

Gall compares plaster casts of skulls to the surface features of wax molds of brains and he also infers the locations of various traits from the shapes of the skulls of his patients, school children, criminals in prisons, and inmates in insane asylums.[15] (pp.21-22) Many functions of the brain have specific anatomical locations in the brain. For instance, an area

called Broca's area facilitates human language use. Nevertheless, the shape of the skull does not bear any significant relationship to the surface features of the brain.

Whenever one tries consciously or unconsciously to categorize experience using inapt groupings one suffers from a failure in learning and induction. Likewise, whenever one--consciously or unconsciously--associates inaccurate information with a concept one falls victim to a failure in learning and induction.

7.3 Two Theories of Concepts

The previous section discusses some of the central features of concepts and connects those features to cognition and to facilitating cognition. In this section we discuss two important theories regarding the nature of concepts. Psychologists have come to reject the first theory, the classical theory of concepts, due to its inability to explain real-world behavior on tests like categorization, memorization, and inference. The second theory this chapter discusses, prototype theory, illustrates a group of theories often called the similarity/probability theory of concepts. Prototype theory, as well as other related theories, replaces the classical theory as the dominant framework for understanding concepts in psychology because prototype theory shows promise in explaining real-world performance by human beings on various cognitive tests-- particularly on categorization tasks. Prototype theory explains performance on categorization tasks by supposing that concepts have a structure that renders them inherently vague. As a result, our best understanding of the nature of concepts supposes the concepts exhibit vagueness because of their very structure and use.

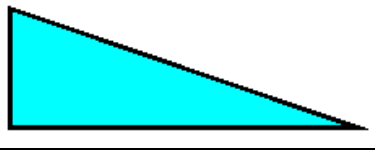
7.3.a The Classical Theory of Concepts

So, concepts provide one with a means of thinking about individual objects, properties, events or relations as instances of some class of things. In other words, concepts facilitate categorization allowing one to treat various objects, properties, events, or relations as instances of a class, the members of which share various features. Early work on concepts focuses primarily upon concepts of concrete objects and how humans categorize such concrete objects. The first theory psychologists explore is a favorite (classic) among philosophers: Concepts give the one a definitional understanding of the conceptualized objects. In short, one can express the meaning of one's concepts by formulating a definition. Indeed, one attractive feature of the classical theory of concepts lies in the potential of the theory to connect concepts with language. On the classical view, one's words and one's concepts both get their meanings through a definitional understanding. Thus, on the classical view of concepts, every word simply corresponds to the concept signified by that word. The classical theory of concepts also has a nice advantage when it comes to conceptual knowledge: concepts that specify individually necessary and jointly sufficient conditions provide one with a formula for picking out all and only objects that fall into the category.

Indeed, the classical view equates possession of a concept with possession of a perfect definition, i.e., one expressing the essential nature of the conceptualized objects. Such definitions provide one with the individually necessary and jointly sufficient conditions for an object to count as an instance of the concept. Individually necessary conditions specify the features that an item must have in order to count as an instance of the concept. Jointly sufficient conditions specify the features that together prove adequate for an item to be an instance of a concept. Thus, another attractive feature of the classical view lies in the nature of the insight into the conceptualized objects that a concept provides under the classical view. Indeed, on the classical view possessing a concept gives one a complete handle on the object.

Concepts that specify individually necessary and jointly sufficient conditions provide one with a formula for picking out all and only objects that fall under the category.[16, 17] Some concepts seem to exhibit the features proposed by the classic view. For example, kin concepts like grandmother and father seem to capture the individually necessary and jointly sufficient conditions of being a grandmother or father. A grandmother is the mother of one of your parents. Likewise, geometrical and mathematical concepts seem to provide one with a means of picking out all and only the instances of that concept. Triangles just are closed three-sided planar figures. All triangles must have the three-sides forming a

closed figure on a plane—the necessary conditions. Likewise, a figure that is closed three-sided planar figure has all the features required to count as an instance of a triangle—the sufficient conditions.



Animation displaying the variety of triangles clearly falling under the definition of a triangle. Click the image to view the animation.

So, the classical view of concepts connects the functions and semantics (meanings) of concepts and words. It seems to reflect the content of at least some kinds of concepts. It also reflects an aspirational ideal for concepts that dates back all the way to the ancient Greek philosopher Plato. Plato supposed knowledge of objects was based upon grasping their essential natures. The classical view of concepts provides those who possess a concept with a deep insight into the instances of that concept. However, the classical theory of concepts has difficulties as well. One difficult arises when one considers how people would rapidly categorize their experiences under the classical view. In his work *The Theaetetus*, Plato (like Descartes) supposes that people categorize sense experiences using their knowledge of the essential natures of those categories. While cases like Descartes' melting wax might lend credence to such a model, it seems unlikely in most cases of perceptual categorization. For instance, people likely do not categorize instances of water using their knowledge of its molecular structure, H_2O. Human simply have no native mechanism for detecting atomic structure. Rather, people recognize water based upon its typical sensory properties—water is the odorless, colorless, and tasteless liquid that quenches thirst. Likewise, the classical view provides a rather rigid mechanism for categorization. One must detect all of the individually necessary properties of a category that together prove sufficient for category membership in order to categorize an object as an instance of the category. Failure to detect even one feature results in a failure to categorize.

7.3.b Problems With The Classical View

Psychological researchers generally cite two problems as conclusive reasons to reject the classical view as a general view of concepts. First, people seem to possess concepts without the ability to specify the necessary and sufficient conditions for membership in the category. To illustrate this difficulty take a moment to define the concept of the concept of life. If someone formulates a definition of life that captures the individually necessary and jointly sufficient conditions for something to be alive, then biologists want to hear from them. The average biology textbook does not define life in terms of individually necessary and jointly sufficient conditions for life. Instead, biology textbooks discuss the characteristic properties that biologists associate with life. Living things, on this account, exhibit many or most of the properties on this fairly standard list: organized structure, metabolism, irritability (sensitivity to features in the environment), reproduction, adaptation, growth, and the ability to maintain homeostasis.[18-20] The average ant cannot reproduce and most bacteria do not exhibit irritability, yet both count as living. Crystals exhibit organized structure and growth but fail to count as living. Other entities, like viruses, have an unclear status under the definition. Viruses adapt, exhibit an organized structure, and reproduce, yet for most of the 20th century biologists classified viruses as non-living.

In sum, people who seem to possess concepts and use those concepts with considerable success often cannot formulate anything like a definition of that concept. The classical view has to explain why people have difficulty offering the sorts of definitions that constitute the meaning of those concepts. A second, even more troubling difficulty for the classical view came into focus in psychological research in the 1970s.[21-23] The classical approach predicts that all instances of a concept are equally members of the concept's class. Hence, one should not find that people rank some individual instances of a concept as more typical instances of that concept than other instances. However, researchers in the 1970s discover that people often find some instances of concepts more typical than others. For instance, Eleanor Rosch's[24] now classic 1975 study demonstrates a clear variation in typicality for a variety of objects falling under various concepts such as furniture, vehicle, and weapon.[21] Rosch's summary ranking (below, left) shows that the 200 college students in her study find chairs to be the most typical piece of furniture and telephones the least typical instance of the concept of furniture. Similarly, automobiles score as the most typical object within the concept of a vehicle amongst

Rosch's subjects, while elevator ranks lowest.[21](p.579)

Type of Fruit	Typicality Rating	Furniture	Vehicle
Apple	6.25	Chair	Car
Peach	5.81	Sofa	Truck
Pear	5.25	Table	Bus
Grape	5.13	Footstool	Motorcycle
Strawberry	5.00	Lamp	Cart
Lemon	4.86	Piano	Wheelchair
Blueberry	4.56	Radio	Tank
Watermelon	4.06	Closet	Raft
Raisin	3.75	Vase	Wheelbarrow
Olive	2.25	Telephone	Elevator
A partial list of typicality ratings for fruits from Malt and Smith [25] (p.261)		Furniture and vehicles in order of relative subject typicality ratings taken from Rosch 1975 (p.579)	

Researchers go on during the 1970s and 1980s to demonstrate that typicality ratings predict performance (usually in terms of reaction time) for a wide variety of categorization, memory, naming, and reasoning tasks.[21-23, 25, 26] The more typical an item is of a category the easier people find the task. Worse still, typicality effects seem to result from the presence or absence of accidental features of the class of items—contradicting the predictions the classical view. These features prove poor candidates for a set of necessary and sufficient conditions for category membership. Fro instance, size influences inclusion in the fruit concept and the typicality ratings of particular fruits. Yet, nothing about being a fruit dictates a necessary size range. Ultimately, Rosch concludes that,[21]

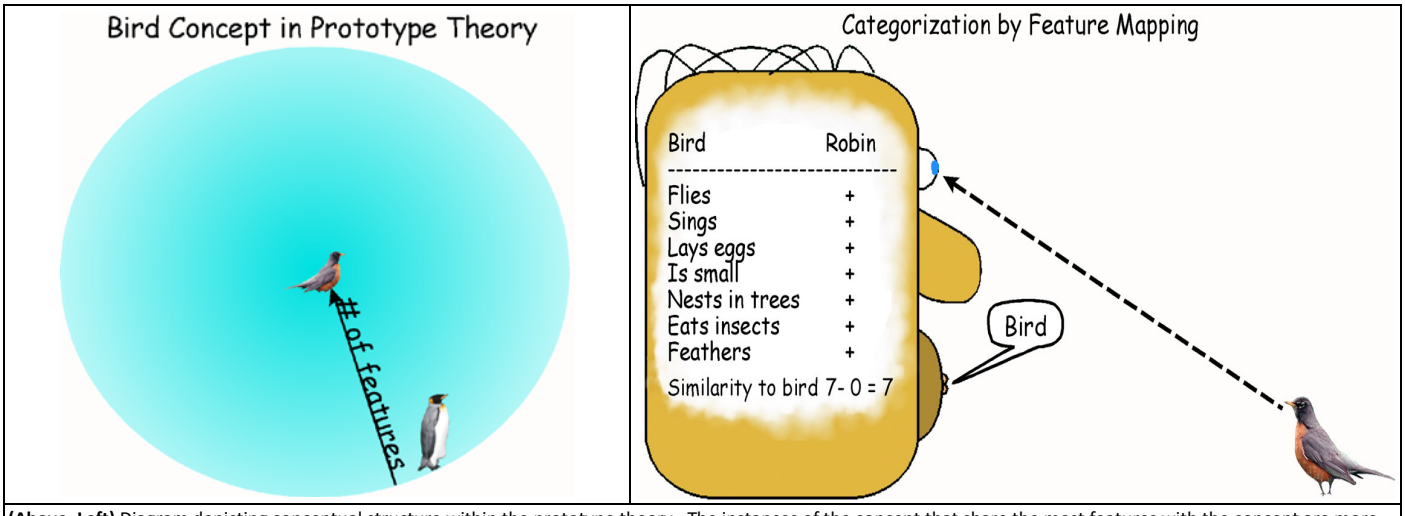
> An account of the meaning of … category names by means of a definitive list of attributes or features necessary and sufficient for category membership requires considerable additional explanation to account for such findings. (p.225)

7.3.c The Prototype Theory of Concepts

To account for typicality ratings psychological researchers like Rosch adopt theories that later researchers refer to as the similarity/probability view. The common idea of similarity/probability theories lies in their hypothesis that people represent concepts, not as definitions, but as lists of features. Rosch describes her own view as[22]

> …the hypothesis that the members of categories which are considered most prototypical are those with most attributes in common with other members of the category and least attributes in common with other categories. (p.573)

Typicality effects arise on the similarity/probability view because in categorization people compare the item to their



(Above, Left) Diagram depicting conceptual structure within the prototype theory. The instances of the concept that share the most features with the concept are more central, while those instances with fewer features are peripheral. Central instances are the most typical, while peripheral instances are significantly less typical. Prototype theories do not contain a clear differentiation between membership and non-membership—meaning that prototype models depict concepts as inherently vague. **(Above, Right)** Animated movie illustrating the general process of categorization proposed by the prototype theory of concepts. The example illustrates the data for robins and penguins listed in the table to the left. Click on picture to view animation.

stored representation of a concept's features, judging conceptual membership on the basis of similarity between the item and the concept measured in terms of these features. When theorists understand concepts as weighted lists of

features, concepts naturally become fuzzy—introducing a certain degree of vagueness in concept application. Categorization based upon similarity between the item and the concept as measured by the number of shared features naturally results in typicality effects. Researchers cash out the idea that concepts consist of lists of features and that categorization consists in judging similarity based upon numbers of shared features in two general ways. This chapter looks at briefly look at one of these two ways—prototype theory.

Though psychology has no definitive theory of the nature of concepts or the process of categorization, prototype theory provides a concrete example of a similarity-based theory of concepts. Prototype theory likewise illustrates the phenomena of typicality and how concepts and concept-driven categorization differ from definitions and definition-driven categorization in the classical view of concepts.

Prototype theory presumes people extract a representation of the central tendency from a collection of objects. That is, the person forms an abstract representation (summary) of the class of objects, properties, events, or relations encompassed by the concept. The abstract representation acts like a list of perceptually salient (easily noticeable) features common to many, but not all, instances of the concept. This summary may also assign a relative weighting (assignment of relative importance) to features. For instance, people generally consider flying to be more central to being a bird than eating insects. Researchers call such representations of a class through a weighted set of typical features prototypes. One classifies an item as an instance of a concept (a prototype) if that item proves sufficiently similar, where similarity consists in the number of features that the concept (the prototype) and the item share. The similarity of items to prototypes (concepts) explains the speed with which one categorizes items and related effects. In other words, the more features an item and a concept share, the quicker the items meets the minimal level of similarity to qualify as an instance of the concept.

Properties	Robin	Penguin
Flies	+	-
Sings	+	-
Lays eggs	+	+
Is small	+	-
Nests in trees	+	-
Eats insects	+	-
Feathers	+	+
Similarity to bird	6-0-0=6	2-5-0=-3

(Above, Left) Some of the features of birds taken from Malt and Smith together with the similarity scores for a robin and a penguin when these birds are matched to this list of features. [25] (p.258) **(Above, Right)** Psychologist Eleanor Rosch whose research helped to bring typicality to the attention of researchers in the 1970s.

By explaining typicality in terms of degree of similarity to a prototypical list of features prototype and related theories introduce an inherent vagueness into concept meaning. Indeed, the applicability of a concept to an object, property, event, or relation becomes a matter of degree within these views. However, it turns out that vagueness is likely a feature and not a bug when it comes to concepts and categorization. As Rosch's experiments demonstrate, even ordinary commonly used concepts admit of a gradation of vagueness. For example, consider the concept of chair and our ability to categorize objects as chairs. One can categorize many objects as chairs instantly and easily. However, as the progression in the video (left) suggests, as we move father away from objects that manifest the typical features and function of chairs people begin to have difficulties and disagreements. Categorization judgments become more labored and less certain.

Video illustrating how even common concepts admit of a vagueness gradient that likely facilitates quick and robust categorization. Click on image to play.

However, while vagueness can introduce difficulties into categorization, thought, and communication, the vagueness inherent in concepts looks more like a feature than a bug on the whole. Classical mechanisms like categorizing based upon individually necessary and jointly sufficient features render categorization brittle and rigid in that the system must identify all of the necessary features in order to categorize an object. Moreover, humans often do not possess sensory mechanisms that exhibit sensitivity to essential properties of categories. Humans, as noted above, cannot sense the molecular structure of substances like water even though the molecular structure H_2O is the defining property of water. Instead, relatively superficial sensory and functional properties most often drive human categorization. These properties exhibit considerable variability across instances of those categories. Humans also categorize from a variety of angles, lighting conditions, and distances. Chairs, for instance, have many material compositions, designs, colors, etc. and we categorize them through rotation, luminance ranges, and distances. Categorization driven by perceived similarity both introduces vagueness to concepts and allows for heightened flexibility in their application across multidimensional variability. Such flexibility undermines precision and introduces risk, but our sense of typicality provides a rough and ready assessment of risk of error inherent in any particular categorization.

Research within cognitive science since Rosch's 1975 has greatly increased our understanding of concepts. The contemporary view has become much more complicated and nuanced. However, no single, definitive theory about the structure of concepts has gained universal acceptance. For instance, prototype theory incorrectly predicts the typicality of combined concepts from typicality of constituents. For example, people judge small spoons as more typical than large spoons and metal spoons as more typical than wooden spoons. This should result in the ordering: Small, metal; small, wooden; large, metal; large, wooden. However, people judge large wooden spoons to be in the second slot.[27] However, the features of human categorization behavior like typicality that drove Rosch's theory remain well-evinced and widely accepted by cognitive scientists.

7.4 Content-Based Non-Logical Errors

Having discussed concepts as the most basic, fundamental bearer of content in cognition, the chapter and lectures now turns toward difficulties in inferences, communication, and arguments arising from the very nature of content. Specifically, this section of the chapter and lectures outlines two content-based, non-logical sources of error in inferences, argumentation, and communication--vagueness and ambiguity. In addition to discussing the difficulties with vagueness and ambiguity generally this section of the chapter and the lectures notes that the very mechanisms whereby human beings assign content to mental states and linguistic entities give rise to vagueness and ambiguity. Thus, the potential for errors resulting from vagueness and/or ambiguity in inferences, argumentation, and communication remains ever present. One can think of the potential for error resulting from vagueness and/or ambiguity as the cost of doing business in information.

7.4.a Vagueness

As noted earlier, vagueness arises with regard to mental states or linguistic entities whenever the user of the consumer of those mental states or linguistic entities cannot easily and definitively determine the applicability of the mental state or linguistic entity to particular cases. For example, the ordinary concept of door exhibits a degree of vagueness in so far as there are objects that do not obviously and definitively fall under the concept for individuals or across individuals. Sliding glass doors count as doors for many people. But others consider sliding glass doors problematic or outside of the concept of doors. Similarly, the hatch of the submarine functions as a door-- yet many people would not describe submarine hatches as doors.

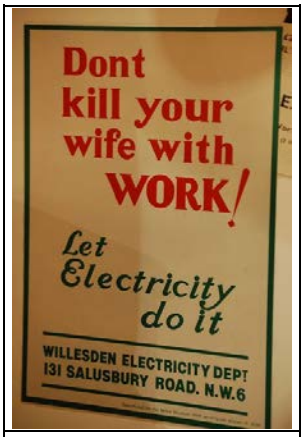
In the discussion of concepts vagueness manifests as typicality--the degree to which individuals will assess a particular case as falling under a particular concept. As noted in the discussion of typicality, people regularly distinguish between better and worse instances of concepts. Olives count as less typical fruits than apples; penguins count as less typical birds than robins; chairs count as more typical furniture then umbrella stands. Typicality, as noted in the discussion of

concepts, predicts human performance on a variety of cognitive tasks. The speed with which, for instance, a person will categorize an object as an instance of a given concept correlates very highly with that object's typicality. Once one sees typicality as a measure of vagueness, such correlations seem obvious; the greater the vagueness, the lack of clarity and precision, exhibited by a concept with respect to an object, the more difficult it becomes to determine whether or not that object falls under that concept. Importantly, since concepts exhibit typicality precisely because of how concepts structure our knowledge of the objects that fall under that concept, one of the morals of the discussion of concepts is that concepts inherently involve vagueness. As one moves outward from the most prototypical instances to cases having successively fewer commonalities concepts become increasingly vague.

Vagueness has benefits, but it also has costs. Unnecessary vagueness can prevent effective communication. Vagueness diminishes one's ability to see connections between ideas in thought and arguments. Vagueness obscures the relationships between ideas and the world making it more difficult to see inaccuracies and to test hypotheses against the world. For example, after a law is passed regulators and courts spend a great deal of time and effort in clarifying the important concepts to facilitate the law's application. Early drunk driving laws in the United States date back to the beginning of the 20th century.[28, 29] These laws often did not precisely specify what constituted intoxication nor did they specify procedures to determine if a person was intoxicated. Until well into the 1950s most locales relied exclusively upon behavioral assessments made by police officers (roadside sobriety tests) or court appointed physicians. Intoxication was not tied to blood alcohol levels until after 1938 when, the American Medical Association and the National Safety Council a blood alcohol limit of 0.15 percent. Implementation of this recommendation was slow due to the paucity of cheap, portable, and reliable blood alcohol testing methods. Though Rolla N. Harper invented a device for measuring blood alcohol levels (BAC) from breath in 1936 that he actually called the "Drunkometer," it was not until 1953 when Robert Borkenstein introduced the refined version now known as the breathalyzer. States began to adopt a BAC level of .10% sometime later and then ultimately in 2013 the National Transportation Safety Board recommended that all 50 states lower the benchmark for determining when a driver is legally drunk from 0.08 blood-alcohol content to 0.05. Laws have also expanded to include other substances like THC and to vehicles including bicycles, scooters, boats, and planes.

7.4.b Ambiguity

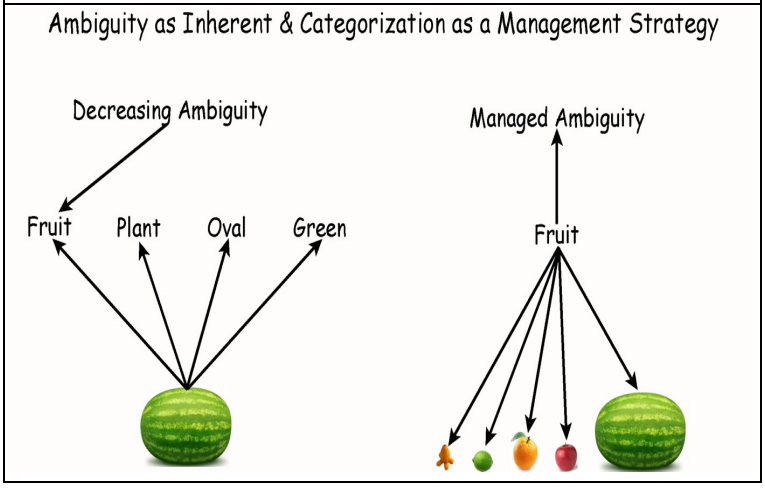
As discussed earlier, mental states and linguistic entities (words, phrases, and sentences) exhibit ambiguity in so far as those mental states or linguistic entities can serve as representations for more than one state of affairs or insofar as more than one mental state or linguistic entity could accurately represent some state of affairs. Thus, a "draw" can refer to a shallow gully, an entertainer who attracts a large audience, a contest that ends in a tie, something chosen at random, a monetary advance, etc.. Ambiguity can lead to errors in inferences, arguments, and communication whenever user or consumer of the mental state or linguistic entity cannot easily or definitively distinguish between the multiple potential contents in the context of the inference, argument, or communication. One can find a nice illustration of ambiguity in the use of pronouns. Pronouns (e.x. he, she, or it) function to refer to previously mentioned individuals or objects in discourse. However, when one mentions more than one individual or object prior to using a pronoun the exact reference of that pronoun becomes ambiguous. Consider the picture on the left as an illustration. The advertisement intends the "it" to refer to work. However, the "it" could also refer to killing—making the ad an ad for how best to kill one's wife. Thus, the ambiguity in the reference of the pronoun in this advertisement undermines its efficacy as a bit of communication. The ambiguity in the ad does not prevent people from understanding its message. However, people must devote additional time and/or cognitive resources disambiguating the message.



Picture of an advertisement for electric service during the 1950s. From: Camilareads.com

The discussion of concepts revealed that widespread typicality in categorization tells us that many concepts have inherent vagueness. This vagueness, as we saw, has both benefits and costs. Vagueness allows a certain flexibility in how we categorize the world. However, vagueness can undermine communication, obscure associations between ideas, render conceptual defects obscure, and hamper efforts to test ideas against the world. Likewise, the task of categorization with limited knowledge proves inherently ambiguous for two reasons. First, the world is inherently ambiguous in that objects are ambiguous with respect to categories. Concepts group objects, properties, events, and relationships together based upon some set of shared features. Every object, property, event, and relation in the world shares many properties with many other objects, properties, events, and relations. Not only do objects almost always share some or other feature with every other object—many of these commonalities prove useful. As a result, for any object there are multiple equally viable concepts that could potentially apply to a given object. Second, our concepts introduce or at least rely upon ambiguity between individual instances of the concept. One can, in fact, think about categorization is as management strategy for ambiguity. Categorization decreases unhelpful ambiguity providing us with access to generalized knowledge for a class of things at the cost of lost specific information (i.e., increased ambiguity). The discussion of concepts notes that concepts promote cognitive economy by gathering together many instances of objects, properties, events, or relations under a single concept. In other words, concepts allow one to think about an individual object, property, event, or relation in a manner that abstracts away from much of the details of that specific object to formulate information that applies generically to instances of the concept. Concepts, therefore, act to decrease the amount of information regarding a specific individual one must process when one perceives, learns, remembers, communicates, decides, or reasons. It does this by selecting one of the many equally applicable categories that potentially apply to the object. The cost of this decreased ambiguity comes from increased ambiguity in the form of information that applies generically and ignores individual details and differences.

(Upper left) A picture of the poisonous fruit, Solanum mammosum, also known as Cow's Udder. (**Upper right)** A picture of the poisonous fruit Solanum dulcamara, also known as bittersweet nightshade. Nightshade berries contain the toxin solanine. From: The Daily Fork (**Below)** Video and diagram depicting the ambiguity inherent in categorization using concepts and terms. It further depicts categorization as an information management strategy outlining the costs and benefits associated with that strategy. Click on image to play video.



Thus, concepts facilitate cognition by allowing one to think of an individual object, property, event, or relationship in terms of general classes. Likewise, concepts provide one access to important and useful information about that kind of object, property, event, or relationship distilled from one's past experiences. When one categorizes an object as a fruit, for instance, one thereby accesses one's cache of information distilled from past experiences about fruits and how best to think about and interact with them. One might, to take an example, infer that the object is edible. However, the benefits to cognition from concepts also come with costs. The very process of conceptualization introduces ambiguity. One categorizes an object, property, event, or relationship under a concept in part to reduce the amount of information one has to process in order to interact with that object. Specifically, that benefit consists in limiting the information to an "executive summary" a set of highly useful information. However, thinking of a specific object as just another member of a concept also means that one's thoughts about that object become ambiguous in that one now contemplates the

object in terms of kind and not in terms of any differences between that object and other instances of that category. For instance, suppose that one categorizes an object as a fruit and then infers that the object is edible. Unfortunately, not all fruits are edible. Some fruits are poisonous. If one identifies the fruits pictured in the top of the table to the left as fruits, infers that they are edible, and eats them one might well die. In other words, by thinking of the object as generic or typical fruit and not as a specific instance or specific variety of fruit, one gains access to useful insights for interacting with fruits generally. However, such insights may not apply to an individual kind or instance within that larger class.

Additional costs arise through the initial categorization itself. Ambiguity arises in the use of concepts in part because any object, property, event, or relationship is an instance of multiple potential concepts. Concepts group objects, properties, events, and relationships together based upon some set of shared features. Not only do objects almost always share some or other feature with every other object—many of these commonalities prove useful. So, one might categorize a watermelon as a fruit, a plant, an oval, a green object, a heavy object, or food. Since one accesses one's stored knowledge about an object through one's concept, the ambiguities in categorization can slow or even prevent access to relevant information. The inability to recognize Hydronium Hydroxide as another name for water discussed above illustrates this potential cost.

The trade-off between loss of individual detail (increasing ambiguity) and gain of generalized knowledge (decreasing ambiguity) that drives categorization makes sense given human inference and decision making needs. Decreasing individual detail helps the brain to manage the huge volume of sensory information and it increases speed. Moreover, such a trade-off tends to work out reasonably well in the long-run since one can often recover individual detail perceptually. Likewise, categorization allows cognizers to access information about objects that goes beyond immediate experience and that often cannot be discovered through careful examination of an individual instance. This benefit comes with its own cost; inapt categorization might prevent access to useful information. However, inapt categorization can be remedied if a reasoner has sufficient time. The reasoner can access related concepts through their interconnected organization in memory. The reasoner can also re-categorize thereby accessing stored knowledge through a different conceptual point of entry.

7.4.c Factual vs Verbal Disagreements

The distinction between factual and verbal disagreements represents a clear way in which vagueness and ambiguity can negatively affect argumentation. Factual disagreements arise over the truth-value of a statement or statements and are most often explicit. For example, people may disagree about the number of people currently residing in the United States. Individuals can most often resolve factual disagreements by determining the truth or falsity of the statement or statements in dispute. The census, for instance, provides an estimate of the population of the United States every ten years. Not every case where people appear to differ about some fact, however, really involves a disagreement about facts. Some of these disagreements may actually turn out to be verbal disagreements. Verbal disagreements arise when the meaning or applicability of a word or phrase differs among individuals. Verbal disputes can arise explicitly, as when you explicitly disagree with someone about the relevant meaning of a term. However, some of the more problematic and vexing verbal disagreements often arise implicitly when individuals do not recognize that their seeming factual disagreement has been complicated by their understanding key terms in different ways. Indeed, one might plausibly claim that a verbal disagreement let to the 1998 impeachment of President Clinton. Recall that the House of Representatives impeached President Clinton on two counts—perjury (lying under oath) and obstruction of justice. In a public statement Bill Clinton said, "I did not have sexual relations with that woman, Miss Lewinsky." He made a similar statement in a deposition. When evidence emerged to the effect that Miss Lewinsky had engaged in what many considered sexual relations with the President, Clinton claimed that he did not understand "sexual relations" to include those specific acts. In effect, Clinton claimed that he had neither lied nor obstructed justice since he had truthfully answered the question as he had understood it.[30-32] It turns out that whether or not President Clinton really

misunderstood the question about his sexual relations, a large volume of research consistently reveals considerable vagueness in people's concept of sexual relations and of sexual fidelity.[33, 34]

7.5 Ambiguity: Multiple Sources of Meaning Inherently Give Rise To Meaning Ambiguity

To this point the chapter and lectures have discussed how the act of categorization using concepts introduces ambiguity to thinking, communicating, and remembering. Moreover, the world itself proves inherently ambiguous in that any object, property, event, or relation can fall under a variety of different concepts. The next few sections discuss other processes and relations through which mental states get significance and meaning. Though each process or relation makes a useful contribution to meaning, these different contributions can sometimes conflict with one another to create errors in reasoning, communication, and decision-making.

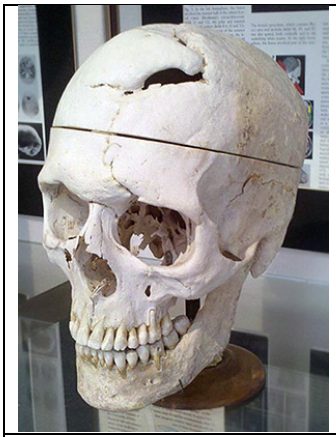
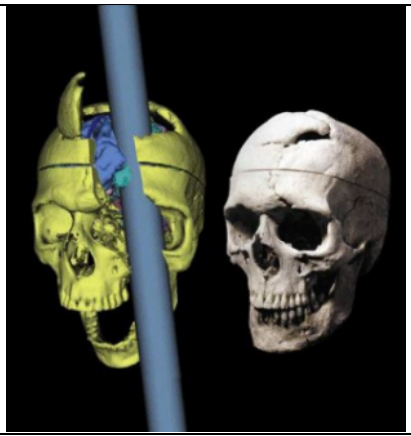
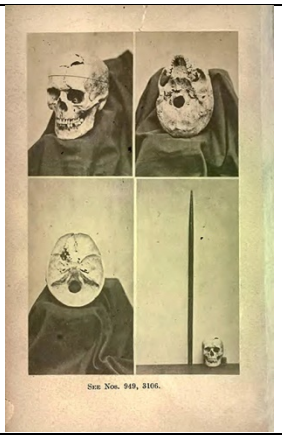
7.5.a Cognitive vs Emotive Meaning

One distinction between types of meaning has given rise to the notions of cognitive and emotive meaning. Cognitive meaning describes the truth-functional notions of meaning. One can think of cognitive meaning as a statement of information stripped of any normative, evaluative, or emotive context. In popular culture characters like Spock and Data personify cognitive meaning. In contrast, emotive meaning refers to the significance one finds in the visceral response one has to a truth expressed in a statement: "How it makes you feel." Thus, emotive meaning captures our understanding of objects, properties, events and relations through the perspective of normative standards, evaluative standards, and emotions. Psychologists often refer to emotive meaning as valance. For psychologists valence describes one's emotional reaction or evaluative perspective on an object, event, property or relation. Positive valance often refers to an object's or event's intrinsic attractiveness. Negative valence or aversiveness often refers to an object's or event's intrinsic unattractiveness.

7.5.a.1 Conflicts Between Cognitive and Emotive Meaning

We can separate these two types of meaning conceptually, and cognitive and emotive meanings do have a semi-dissociable set of circuitry in our brains. Nevertheless, it would be a mistake to suppose that there are varieties of cognition running exclusively upon either cognitive or upon emotive meanings. Mere facts without values, goals, likes, dislikes, etc. leave one without any grounds for making decisions. Conversely, one cannot value, like, dislike or set goals without being able to understand the world in truth-function terms. For instance, how would one know if one's goal has been met unless one can represent the current state of the world?

The case of Phineas Gage[35] illustrates the complex relationship between emotive and cognitive meaning in cognition. In 1848 Phineas Gage works as a construction foreman in Vermont with the Rutland & Burlington the cognitive content. In

			
Phineas Gage's skull on display at Warren Anatomical Museum at Harvard Medical School. From: Slate.com[36]	Photograph of Phineas Gage with the tamping iron. From: Wikipedia	Computer reconstruction of the path of Gage's skull and the path of the iron rod. From: Neurophilosophy	Photos of Gage's skull, the injury and the rod. From Slate.com

such cases, emotional meaning can distort one's perception of a situation in a manner that undermines good reasoning and decision-making. For example, doctors will show different attitudes towards a treatment when described as having a 95% mortality rate as opposed to having a 5% survival rate. In a similar fashion, work by Dr. Paul Rozin consistently demonstrates the effects of disgust upon people's perception and decisions. In one experiment Rozin and colleagues offer some subjects a brownie and others a brownie shaped like dog feces.[37, 38] Rozin notes that merely shaping the brownie like feces dramatically decreases people's likelihood of eating it. People show a similar disinclination to drink a glass of sugar water that they mix themselves when they are first instructed to put a label, "Poison," on that glass. Rozin has likewise noted that a pronounced bias towards negative nouns in 20 languages.[39] Similar phenomena occur in phobias. For instance, people who fear flying exhibit significantly higher levels of anxiety and fear while flying than while engaging in the statistically more dangerous activity of driving to the airport. In a similar vein, Rozin and associates report that moral character—value judgments—have significant impact on first impressions.[40]

Given the above data, it becomes clear that emotional contagion—the inappropriate influence of emotive meaning on cognition exists and leads humans into errors of reasoning and decision-making on a regular basis. However, not all emotive meaning has a negative impact on reasoning and decision-making. As noted above, emotive meaning proves essential to high functioning in social cognition, risk management, decision-making, and planning. Additionally, one should carefully distinguish emotive meaning from cognitive meaning reporting value claims or emotional states. Dr. Wallis might try to get you to value this class or to love it by using emotive meaning, but he might also express facts regarding how you feel about this class!! The former is logically illegitimate, while the latter is logically legitimate.

7.5.b Intensional vs Extensional Meaning

The next pair of processes by which mental states and linguistic terms get their meaning goes under the names intensional meaning and extensional meaning. Critical thinking texts tend to focus on the intensional and extensional meaning of linguistic entities called terms. By a term I mean any word or phrase that can serve as the subject of a sentence. Thus, "the Alps," "the product of five and six," "blue," and "the tallest person in class" all count as terms. In general, any noun or noun phrase functions as a term—this includes proper names, common names, and descriptive phrases. Consider the following two terms, "morning star" and "evening star." I can provide you with the meaning of these terms by defining them as follows: The **morning star** is the last star visible in the morning. The **evening star** is the first star visible at night. The definitions that I have just provided for the terms, "morning star" and "evening star," provide one with the intensional meaning of these terms. The intensional meaning of a term can be thought of as its conventional connotation—the properties that the term connotes. That is, the intensional meaning provides one with a formula for finding or differentiating the morning star from other stars. Thus, one can think of the intensional meaning as a recipe for picking out all and only instances of that kind of term. Likewise, the more properties or features one needs to pick out a kind of object the greater its intension. For instance, the series "fruit, apple, green apple,…" has increasing intension and the series "grey mouse, mouse, mammal, animal,…" has decreasing intension.

Even though the terms "morning star" and "evening star" have different intensional meanings, the have a univocal extensional meaning in that they both pick out Venus. So, the extensional meaning of terms consists of the class of things that that term actually picks out—regardless of the intent of speakers. Thus, the extensional meaning of a word is that to which it actually refers—its denotation. Our concepts exhibit both intensional meaning and extensional meaning just like terms. In the prototype theory, the intensional meaning of a concept consists in the set of features that collectively make-up the prototype by which one categorizes objects. The extensional meaning of a concept consists of all the things that people categorize under some prototype.

7.5.b.1 Conflicts Between Intensional and Extensional Meaning

As the example of the morning star and the evening star illustrate, intensional and extensional meanings can conflict or coincide in a manner that undermines clear reasoning, effective communication, and good decision-making. Historians

believe that Pythagoras[41] was the first human to realize that the morning star and the evening star were the same object. For the Egyptians and Greeks and most all peoples of the ancient world, these two terms had different meanings and hence different extensions. It was a real empirical discovery that they coincide in their extension. Indeed, many objects, properties, events, and relations we now take to be co-extensive had been known under terms having different intensional meanings for most of human history. Consider water: We all know water intensionally as the colorless, odorless, tasteless, substance that quenches thirst. For most of human history people did not know the molecular composition of water and thus they did not know that water and H_2O have significantly overlapping extensional meaning. Most people today incorrectly, believe that water and H_2O have the exact same extensional meanings. However, though most water is, in fact, H_2O, water is also made from several isotopes of hydrogen and oxygen—for instance, dideuteriumoxide, D_2O, also known as heavy water. D_2O can cause death if it reaches 30% of one's body water. Students should not concern themselves about D_2O, however, given that D_2O is virtually non-existent in nature and even HDO only occurs at a rate of about 1 in 3,200 molecules. Oxygen has three isotopes that form water so that when combined with the two stable hydrogen isotopes one finds ten different molecular structures for water: H_2O^{16}, H_2O^{17} or H_2O^{18}, D_2O^{16}, D_2O^{17}, D_2O^{18}, HDO^{16}, HDO^{17}, and HDO^{18}. In addition to unusual isotopes, most water contains all sorts of impurities like dissolved minerals.

Along similar lines, those who make inferences about the gender of George Eliot, author of *The Mill on the Floss*, will likely feel embarrassed when they discover that George Eliot was merely the pen name of Mary Ann Evans. If you passed up the comic book signed by Stanley Martin Lieber at a garage sale, you missed buying a comic signed by Stan Lee. Extensional meaning poses further problems for cognizers. For instance, the terms "round-square," "unicorn," and "largest prime" all have the same extensional meaning because they all have empty extensions. These terms illustrate that even our definitions and descriptive phrases can introduce ambiguities between intensional and extensional meaning. Ambiguity between intensional and extensional meaning often arises in our use of pronouns without clear references. In general, whenever it is unclear whether two terms have the same extensional meaning--the same reference--the terms are said to be referentially opaque. Since humans rely heavily upon intensional meaning (connotation) cases of referential opacity can lead to errors in reasoning, communicating, and decision-making.

7.6 Definitions Are Artifacts

The inferences and arguments lectures suggest that one ought to think of arguments as artifacts. Specifically, arguments are the products of human artifice. Humans create arguments just as they create tables, chairs, cell phones, etc.. Just as when people make tables or any other artifact, people have specific needs and goals in mind when they craft arguments—to create public representations of inferences. This chapter and lectures treat definitions analogously: definitions, like arguments, are artifacts. Definitions function to fix meaning of a word or phrase in the context of some language thereby significantly reducing vagueness and/or ambiguity.

7.6.a The Structure of Definitions

Definitions operate by equating the word or phrase to be defined (the definiendum) with words or phrases (the definiens) that fix the meaning. The definiens allows the definition's consumer to better understand the word or phrase to be defined (the definiendum). To fulfill their function good definitions tend to have two qualities. (1) The definition's consumer already has familiarity with and a clear understanding of the words or phrases in the definiens. (2) The words or phrases in the definiens provide the definition's consumer with and understanding of the word or phrase defined, often by providing a set of characteristics or methods for picking out the referent or extension of the definiendum, i.e., the definiens facilitates categorization.

For instance, if you do not know the meaning of "hendecagon," I might tell you that a hendecagon is a closed eleven-sided planar figure created by joining straight lines. Essentially, a definition provides the definition's consumer with a

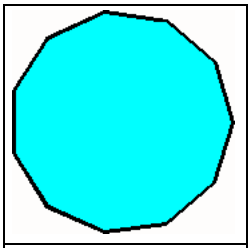


Diagram of a regular hendecagon

recipe for picking out the extension of the word or phrase being defined (definiendum). Most often definitions pick out the extension of the word or phrase to be defined (the definiendum) by equating the definiendum with a definiens that specifies a combination of properties, parts, relations, etc.. Since the goal of a definition is to eliminate vagueness and/or ambiguity--the ideal definition captures all and only the things that comprise the extension of the word or phrase defined. Ambiguity and vagueness disappear in the face of a well-crafted definition since a well-crafted definition acts as an effective decision procedure. Effective decision procedures provide a process or criteria that will always and mechanically determine membership in a class. Thus, an ideal definition will act as an effective decision procedure mechanically dividing all objects, properties, events, and relations into two mutually exclusive and jointly exhaustive classes: (1) Instances of the definiendum or (2) Non-instances of the definiendum. The classes are mutually exclusive since a given object, property, event, or relation can only belong to one class. The classes are jointly exhaustive because every object, property, event, or relation belongs to one of the two classes. How can a definition capture all and only the instances of a word or phrase? The ideal definition gives its consumer the individually necessary and jointly sufficient conditions for an item to count as an instance of the word or phrase defined (the definiendum). All instances of the definiendum possess the necessary conditions specified in the definiens. For example, all triangles have three sides, making three sides necessary for triangularity. Likewise, any object that is an enclosed, three-sided planar figure is a triangle—making those properties jointly sufficient for triangularity.

Not many definitions actually achieve this ideal, since not very many words or phrases have such a precise meaning. Some examples include the following:

Triangle is a closed three-sided planar figure.
Your grandmother is the mother of one of your parents.
A bachelor is an unmarried male.

Of course, as the list of different types of definitions below illustrates, definitions can have more specific goals within the general framework outlined above. For instance, a stipulative definition seeks to present a specific meaning for a term in a specific context and for a specific purpose. A theoretical definition seeks to provide a deeper insight into the nature of the thing defined by offering a definiens informed by a theory regarding the nature of the word or phrase defined (the definiendum).

Definitions, like arguments, are therefore artifacts. Moreover, like arguments, definitions have an analog in one's cognitive processing--a counterpart in human thinking. **Arguments serve as public reconstructions or presentations of one's own or another's inferences. Definitions serve as public reconstructions or presentations of one's own or another's conceptualization of some aspect of the world.** Therefore, just as it proves useful to consider how human inferences work, it helps students to understand a bit about how thoughts get their meanings.

7.6.b Five Common Types of Definitions

Definitions, like arguments, are artifacts with a particular structure created for a particular purpose. The structure of this specific artifact consists in equating a definiendum (word or phrase to be defined) with a definiens (a phrase that fix the meaning). People create definitions for the purpose of fixing meaning—most often to eliminate or decrease vagueness, ambiguity, or both. However, people can have additional goals over and above merely fixing meaning or vagueness and ambiguity reduction. The next few sections discuss five common types of definitions.

7.6.b.1 Lexical Definitions

The type of definition with which students have greatest familiarity is a lexical definition. A lexicon is the vocabulary of a given language, person, or branch of knowledge. Thus, the specialized goal of a lexical definition consists in capturing the common usage or usages of a word or phrase within a given linguistic community. Dictionaries provide one with a

comprehensive collection of lexical definitions for a given language. A good lexical definition has a descriptive component—it describes common usage for a specific community. Additionally, a good lexical definition equates the definiendum with a descriptive phrase that captures common usage simply and effectively using commonly understood words. In other words, good lexical definitions seek to describe common usage of a word or phrase to the widest possible audience in an easily comprehensible manner. People often think of linguistic communities as communities sharing a common language, like English. However, there a numerous, more specialized dictionaries offering more specialized lexical definitions from smaller linguistic communities. Webster's dictionary sometimes bills itself as the dictionary of the American language and not English generally. For instance, the urban dictionary uses crowd-sourcing to create definitions of contemporary slang. The urban dictionary defines "throwing pillows," for instance, as "having a weak punch." Other more specialized dictionaries include the Dictionary of Unusual Words, the Dictionary of Biology, the Science Dictionary, and even Skeleton Key: A Dictionary for Deadheads. Each of these dictionaries seeks to describe the conventional connotation of the specialized lexicon of their specific community.

7.6.b.2 Précising Definitions

Précising definitions seek to define a term or phrase in a more precise manner than common usage. Most often précising definitions seek to eliminate vagueness in the use of a word or term for a specific purpose. For instance, many legal terms go through a series of précising definitions—often as a result of writing regulations or law suits. For instance, when the civil rights act became law in 1964 Title VII prohibited sex discrimination in the workplace. But what constituted sexual discrimination? The use of the term sexual harassment gained an important précising definition of came with the introduction of the term, "sexual harrassment" in 1975 by a group of activists at Cornell University.[42, 43] The first précising definition of sexual discrimination in a legal framework occurred in 1976 and 1977 when courts ruled that quid pro quo (when a person in a position of power demands sexual favors from subordinates) counted as sexual discrimination. In 1986 the United States Supreme Court issued a decision in the case of Meritor Savings Bank vs. Vinson in which they introduced a précising definition sexual discrimination that included the statement that, "that sexual harassment creating a hostile or abusive work environment, even without economic loss for the person being harassed, is in violation of the Title VII of the Civil Rights Act of 1964."[42, 44] A further précising definition comes in the 9th appellate court decision in Ellison v. Brady in 1991. That decision created the criteria of "hostile or abusive work environment" which allowed non-economic injury and established a set of criteria for evaluating hostile or abusive work environments.[45]

7.6.b.3 Theoretical Definitions

Theoretical definitions also seek to define ordinary terms in a more precise fashion. However, theoretic definitions seek to provide the consumer with a deeper understanding of the thing defined by specifying the meaning of the term or phrase using a theoretic framework. For example, "Water is H_2O," defines the substance we know as the colorless, odorless, and tasteless, liquid that quenches thirst using its most common molecular structure. Einstein redefined the nature of energy and manner with his theoretic definition: $e=mc^2$. After Einstein's definition one understands that matter and energy are actually the same thing. Of course, science is not the only source of theoretical definitions. The philosopher Immanuel Kant defines "duty" as the requirement to act or to refrain from acting in some way out of respect (i.e., a recognition of the universal and necessary nature of the action) for the law. In general, theoretical definitions seek to provide a deeper understanding of a term or phrase more than merely to eliminate vagueness or ambiguity.

7.6.b.4 Stipulative Definitions

A stipulative definition seeks to stipulate a specific meaning for a term or phrase in a specific context or for a specific use. One way in which people employ stipulative definitions is when they coin a word or name something new. For instance, one of my old professors coined the phrase, "outchurchlandish," to refer to what he viewed as outlandish

claims about the nature of the mind. In similar fashion, when astronomers recently discovered a planet just 12% larger than Earth and orbiting its star within the range where liquid water can exist, they named it "Kepler-438b." These astronomers stipulatively defined Kepler-438b as the exoplanet (extra-solar planet) orbiting the red dwarf, Kepler-438, in the constellation Lyra roughly 470 light-years from Earth. Often times people use a stipulative definition to introduce their preferred definition of a term in the context of a discussion. Thus, anti-abortionist activists often define human life as beginning at conception.

7.6.b.5 Persuasive Definitions

When someone offers a persuasive definition (also known as an emotive definition) they generally seek to infuse the meaning of a given term with emotive, normative, or evaluative context. As we noted above, emotive meaning can influence our reasoning and decision-making to an inappropriate degree. Thus, people who use persuasive definitions generally seek to bias the consumer for or against the thing defined. The abortion debate provides a classic example of persuasive definitions and their potential for pathological effects on constructive debate. Anti-abortion activists tend to define their movement as pro-life, suggesting that unlike their opponents they assign a positive value to life. Abortion activists tend to define their movement as pro-choice, suggesting that unlike their opponents they assign a positive value to individual choice. Each of these labels traces its origin to the supreme court's 1973 Roe vs Wade[46] decision that made some abortions legal at the federal level. The basis of the decision is an attempt to balance the right to privacy (the right to make decisions about one's own property and body linked to the 14th amendment) and the right to life.[46, 47] The court tried to balance these rights and suggested that the balance tipped from the mother to the fetus during the third trimester. Unlike the court's ruling which recognized both rights and sought balance, these labels represent the assertion of one right and the denial of the other. Thus, these labels tend to dominate discussions about abortion and define each position along a single dimension—each position's dimension being orthogonal to the other position. As a result, one can find very little honest, informed, and multi-dimensional public policy discussion around abortion. There are numerous examples of persuasive definitions in political, religious, and military discussions. One example of such a definition is when a person takes a single person or incident and tries to define an entire group of people using that person or incident. For example, Donald Trump recently said in a speech in June 2015 that undocumented Mexican immigrants are "rapists" and they are "bringing drugs and crime." This statement, together with his later claims that a murder committed by an undocumented immigrant showed, "This senseless and totally preventable act of violence committed by an illegal immigrant is yet another example of why we must secure our border immediately." Portrayed immigrants as ruthless criminals when FBI crime data show an inverse correlation—between 1990 and 2013 unauthorized immigration increased roughly 300% while violent crime decreased roughly 48%.

7.6.c Definitions and Truth

Definitions serve to fix the meanings of terms and phrases and as such they strictly speaking are not true or false. For the most part, definitions function as statements about conventional connotations, or simply conventions about word usage. However, there are certain circumstances where one should construe definitions truth-functionally. In this class, whenever we see a definition in a premise or conclusion of an argument, then we will construe it truth-functionally. Since definitions have an equivalence structure, people often use definitions as premises for arguments. For instance, the following is a simple argument from definition:

> Prime numbers are positive natural numbers that have no divisors other than themselves and 1.
> 3 is a positive natural number.
> 3 is divisible only by 1 and 3.
> Therefore, 3 is a prime number.

The first premise in this argument defines prime numbers and as such we should evaluate this definition as truth-functional in understanding and evaluating this argument.

7.6.d Ostensive Definitions

Recall that we discussed two different ways that words, phrases, concepts, etc. get meanings. Intensional meanings fix meaning by providing a formula for picking out instances of the category. Extensional meanings fix meaning by reference—by the actual denotation or members of the category. It is almost never feasible to display the total extension of a word, phrase, or concept for the purposes of definition. For instance, to define dog extensionally you would have to display every dog that has ever and will ever exist. However, people do use referents to fix meaning when they give ostensive definitions. Consider how you would teach a child the meaning of the term circle. You would not give the child the intensional meaning of circle: a set of points equidistant from a center point on a Euclidean plane. You would show the child circles and say the word. Ostensive definitions fix meaning by indicating the reference through examples. People use ostensive definitions when the term is difficult to define intensionally or when introducing words to novice speakers. Ostensive definitions get their name, in fact, because they are often accompanied by ostension—pointing or showing. Thus, an ostensive definition seeks to convey the meaning of a term using of instances of the term. The goal of an ostensive definition is to help the consumer to abstract a general formula for identifying novel instances of the term based upon features common to the defining instances. For example, when people are learning a language, speakers often give ostensive definitions to clarify what they mean by some word. An ostensive definition only works to the extent that the consumer of that definition can extrapolate an intensional definition of their own in the form of a rule or rules for membership in that class. When you teach a child the word circle you show them many circles—large, small, red, green, etc. until the child comes to identify the word with the shape.

7.7 Differences and Similarities Between Concepts and Definitions

This very superficial discussion of concepts does illustrate some important differences between concepts and definitions. Most obviously, concepts are psychological entities that facilitate dynamic interaction between cognizers and the world. Definitions are static structures used to refine or fix meanings. Most definitions operate with the context of a language to fix meaning by equating the term to be defined with a formula for identifying its instances. Ostensive definitions attempt to use instances of the term to be defined guided by feedback to guide another's efforts to refine or fix meanings.

Definitions function to try to minimize vagueness and ambiguity in argument and discourse. Concepts, in contrast, naturally exhibit a certain degree of vagueness. Indeed, some degree of vagueness seems to facilitate tractability of cognition by allowing for more flexible categorization of novel and atypical instances. Likewise, concepts do not seem to eliminate ambiguity. Rather, concepts seem to facilitate the management of ambiguity for the purposes of cognition. Definitions seek to determine the extension of a word so that any item is either a member of the extension of the word or it is not a member of the extension. Moreover, all members of the extension of a defined term count as equally good or typical instances of the term. Concepts, in contrast, pick out their referents in a manner that allows for differences in typicality. That is, some items seem better instances of a concept than others; chairs seem better examples of furniture than radios. Similarly, membership in the extension of a concept can be unclear for some items.

Students ought to note that this very superficial discussion of concepts also illustrates some important similarities and between concepts and definitions. Both terms and concepts allow one to use one aspect of the world to think about another aspect of the word. "Dog" operates to pick out instances of the class of dogs in the world. Likewise, one's concept of dog operates to pick out instances of the class of dogs in the world. In short, both concepts and terms have extensional meaning. Moreover, both terms and concepts have intensional meaning. A term's intensional meaning consists, in the first case, in the rule or set of features given in a definition for categorizing items in the world either as instances of the term or non-instances. The intensional meaning of a term can also come to be augmented by one's wider body of knowledge regarding that term. A concept's intensional meaning consists, in the first case, in the features

and processes that drive categorization. The intensional meaning of a concept can also come to be augmented by one's wider body of knowledge encoded, organized, and retrieved through that concept.

Finally, neither definitions nor the two theories of concepts discussed in this lecture attempt to capture any aspect of emotive meaning. The discussion of definitions and concepts therefore ignores an important aspect of meaning or significance in human cognition—the emotional, evaluative, and/or normative significance of the item or items. As the lecture on definitions notes, and as the lecture on decisions will further emphasize; emotive meaning provides thinkers with an emotional, evaluative, and/or normative framework that proves important in decision making and social cognition.

7.8 Chapter Summary

7.9 Key Terms

Ambiguity: Mental states and linguistic entities (words, phrases, and sentences) exhibit ambiguity in so far as those mental states or linguistic entities can serve as representations for more than one state of affairs or insofar as more than one mental state or linguistic entity could accurately represent some state of affairs. Thus, a "draw" can refer to a shallow gully, an entertainer who attracts a large audience, a contest that ends in a tie, something chosen at random, a monetary advance, etc.. Ambiguity can lead to errors in inferences, arguments, and communication whenever user or consumer of the mental state or linguistic entity cannot easily or definitively distinguish between the multiple potential contents in the context of the inference, argument, or communication.

Cognitive Economy: Cognitive economy refers to the balancing of too much or irrelevant information against too little information, ideally finding the balance wherein a cognizer has access to a manageable amount of highly relevant information. For instance, concepts provide one with a quick, robust means to classify objects, properties, events, or relations. Thus, concepts allow one to think about an individual object, property, event, or relation in a manner that abstracts away from much of the details of that specific individual. However, concepts also provide quick access to a manageable amount of highly relevant information for interacting with objects of that type. By both abstracting away from the details of individual objects, properties, events, or relations and allowing one to think about objects, properties, events, or relations using a manageable and relevant set of information, concepts allow one to more optimally exploit one's limited conscious working memory so as to think more effectively.

Cognitive Meaning: Cognitive meaning describes truth-functional notions of meaning. One can think of cognitive meaning as a statement of information stripped of any normative, evaluative, or emotive context. In popular culture characters like Spock and Data personify cognitive meaning.

Emotive Meaning: Emotive meaning refers to the significance one finds in the visceral response one has to a truth expressed in a statement: "How it makes you feel." Emotive meaning captures our understanding of objects, properties, events and relations through the perspective of normative standards, evaluative standards, and emotions. Psychologists often refer to emotive meaning as valance. For psychologists valence describes one's emotional reaction or evaluative perspective on an object, event, property or relation. Positive valance often refers to an object's or event's intrinsic attractiveness. Negative valence or aversiveness often refers to an object's or event's intrinsic unattractiveness.

Extensional Meaning: The extensional meaning of terms consists of the class of things that that term actually picks out—regardless of the intent of speakers. Even though the terms "morning star" and "evening star" have different intensional meanings (different definitions), they have a univocal extensional meaning in that they both pick out Venus. Thus, the extensional meaning of a word is that to which it actually refers—its denotation. Our concepts exhibit both intensional meaning and extensional meaning just like terms. In the prototype theory, the intensional meaning of a concept consists in the set of features that collectively make-up the prototype by which one categorizes objects. The

extensional meaning of a concept consists of all the things that people categorize under some prototype.

Factual Disagreements: Factual disagreements arise over the truth-value of a statement or statements and are most often explicit. For example, people may disagree about the number of people currently residing in the United States. Individuals can most often resolve factual disagreements by determining the truth or falsity of the statement or statements in dispute. For example, the census provides an estimate of the population of the United States every ten years. Not every case where people appear to differ about some fact, however, really involves a disagreement about facts. Some of these disagreements may actually turn out to be verbal disagreements.

Intensional Meaning: The intensional meaning of a term can be thought of as its conventional connotation—the properties that the term connotes. That is, the intensional meaning provides one with a formula for finding or differentiating the morning star from other stars. If I provide you with the meaning two these terms by defining them as follows: The **morning star** is the last star visible in the morning. The **evening star** is the first star visible at night. The definitions that I have just provided for the terms, "morning star" and "evening star," provide your with the intensional meaning of these terms. Thus, one can think of the intensional meaning as a recipe for picking out all and only instances of that kind of term. Likewise, the more properties or features one needs to pick out a kind of object the greater its intension. For instance, the series "fruit, apple, green apple,…" has increasing intension and the series "grey mouse, mouse, mammal, animal,…" has decreasing intension.

Referential Opacity: Referential opacity occurs in cases where the intensional meaning one associates with various words or phrases does not accurately or completely mirror the extensional meaning of those words or phrases. That is, the words or phrases do not determinately fix the real world reference of those words or phrases. Indeed, cases of referential opacity pose problems in thought and communication precisely because they do not facilitate access to relevant information and connection between ideas. In the text, the failure to recognize Hydronium Hydroxide as another name for water illustrates both referential opacity and the difficulties it can pose.

Vagueness: Vagueness arises with regard to mental states or linguistic entities whenever the user of the consumer of those mental states or linguistic entities cannot easily and definitively determine the applicability of the mental state or linguistic entity to particular cases. For example, the ordinary concept of door exhibits a degree of vagueness in so far as there are objects that do not obviously and definitively fall under the concept for individuals or across individuals. Sliding glass doors count as doors for many people. But others consider sliding glass doors problematic or outside of the concept of doors. Similarly, the hatch of the submarine functions as a door-- yet many people would not describe submarine hatches as doors.

Verbal Disagreements: Verbal disagreements arise when the meaning or applicability of a word or phrase differs among individuals. Verbal disputes can arise explicitly, as when you explicitly disagree with someone about the relevant meaning of a term. However, some of the more problematic and vexing verbal disagreements often arise implicitly when individuals do not recognize that their seeming factual disagreement has been complicated by their understanding key terms in different ways. Indeed, one might plausibly claim that a verbal disagreement let to the 1998 impeachment of President Clinton.

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