Logic and Lexicon

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1. Introduction

The truth-conditional approach to semantics is based on the assumption that conveying information about the world is a central part of what language is about, and therefore the judgments of human subjects as to whether sentences are true or false of a given situation are a fundamental source of empirical data about the meaning of natural language sentences. This approach has proved remarkably successful: speakers' intuitions about the truth conditions of sentences have given us the closest approximation(s) to a mathematical theory of sentence meaning we have at the moment. Yet many find the assumption on which truth-conditional semantics rests controversial. Perhaps the most serious among the reasons for skepticism is that humans find it difficult, if not impossible, to assess the truth or falsity of statements as simple as *Kim is tall* or *Robin is blond*. *Vague* statements such as these are well within the scope of semantics, even when intended narrowly; thus if humans cannot assign them a clear truth value even when all contextual factors have been resolved, then perhaps truth conditions are not a solid enough foundation for semantics, after all.

Manfred Pinkal's *Logic and Lexicon*, a revised translation of his *Logik und Lexikon* (Pinkal 1985), is the most comprehensive argument to date in favor of the position that the meaning of vague statements can in fact be expressed in truth-conditional terms. Pinkal also provides in his book a theory of *ambiguity*, a property of natural language utterances that is the source of endless trouble for computational linguists. Ambiguity—syntactic ambiguity and lexical ambiguity in particular—is a central concern both in computational linguistics and in psycholinguistics, but hasn't been a central area of research in linguistics, and in particular not in formal semantics. However, the interest in theories of semantic-ambiguity processing has been raised in recent years by the development of theories of semantic interpretation based on *underspecification* (Alshawi and Crouch 1992; Reyle 1993; Poesio 1995; van Deemter and Peters 1995) as well as by work on the lexicon (Copestake and Briscoe 1995 and Saint-Dizier and Viegas 1995 for example). Pinkal's proposals concerning ambiguity will be of great interest to those working in these areas.

2. The content of the book

Logic and Lexicon consists of three parts. The first part does not require much prior technical knowledge, and is recommended to those readers who have no formal propensities or only want to learn about Pinkal's main ideas. The range of phenomena to be discussed in the book is outlined in chapter 1. A gentle introduction to logical semantics (chapter 2) is followed in chapter 3 by a presentation of the idea of *precisification*, which is central to Pinkal's approach to vagueness and ambiguity. Next comes an informal, but very thorough, discussion of his theory of ambiguity, vagueness, and related topics such as polysemy and homonymy in chapter 4. In these chapters Pinkal puts forward the second main idea of the book, namely, that ambiguity and vagueness, though distinct phenomena, are both aspects of a more general phenomenon that he calls *indefiniteness*, and have a common model-theoretic foundation in the notion of precisification.

The second and third parts of the book are more technical. The second part consists of two chapters. In chapter 5, Pinkal discusses various ways of formalizing the notion of indefiniteness, including well-known proposals based on various forms of three-valued logics and on fuzzy logics, and he argues for an approach based on the *supervaluation* technique developed by van Fraassen (see, for example, van Fraassen 1969). In chapter 6, Pinkal's Precisification Logic is presented in detail; in particular, the two operators *in all respects* and *in some respects* are defined. These operators are used to formalize the theory of indefiniteness presented in chapter 4.

In the third part of the book, Pinkal reconsiders his treatment of vagueness in the light of problems raised by measure statements such as *John is 1.80 meters tall* and especially by the so-called *sorites paradox*, or the paradox of the heap. The result is a reformulation of the notion of precisification in terms of context-change.

The book is essentially free of typographical errors, except for a number of incorrect references to page numbers: the reference to page 129 on page 139 should really be a reference to page 127, the reference to page 128 on page 157 should really be a reference to page 123, and so forth.

3. Main ideas

Logic and Lexicon is a long and dense book; only the main points can be summarized here. Pinkal's main idea is that indefiniteness—of which both ambiguity and vagueness are special cases—occurs because natural language statements are rarely completely precise. Pinkal's example is the assertion *The Santa Maria was a fast ship*. Is this statement true or false? It depends: if we are comparing the Santa Maria to modern ships, then the statement is probably false. If instead we are comparing it with the ships of its time, then perhaps the statement is true, although again it depends on what we mean by *fast*. According to Pinkal, the existence of such alternative "ways of making the sentence precise" is what makes it indefinite; and he argues that both the ambiguity of a noun like *bank* and the vagueness of an adjective like *fast* reflect the existence of alternative precisifications. What distinguishes ambiguity from vagueness is, according to Pinkal, whether the *precisification spectrum*—the range of available precisifications of an expression—is discrete or continuous: in the first case, we have ambiguity, in the second, vagueness. Pinkal intentionally leaves open the possibility of borderline cases, which cannot be properly classified as either ambiguous or vague.

Having motivated the precisification approach to indefiniteness in chapters 3 and 4 on intuitive grounds, Pinkal's next step is to present in the next two chapters an argument for the approach on logical grounds. Building on work by Fine (1975) and

Kamp (1975, 1981a), Pinkal demonstrates how the notion of precisification can be implemented by revising the supervaluation technique,[1] and how this formulation leads to a logic—Precisification Logic—that not only allows him to formalize the distinctions introduced in Chapter 4, but is "conservative," by which he means that all the classical tautologies and entailment relations are retained. On the contrary, formalizations of indefiniteness that rely on the introduction of a third value either result in the loss of tautologies that one would want to preserve, or achieve conservativity at the expense of very unintuitive definitions of the truth conditions of the basic connectives. Perhaps the most surprising among Pinkal's claims is that natural language is not *truth-functional*, by which he means that the value assigned to an expression does not depend only on the values assigned to its subexpressions. Pinkal contrasts statements such as *John is either tall or not tall*, which intuitively seem to be true even if the statement *John is tall* is indefinite, with statements such as *John is tall or blond*, to which we want to accord the status of "indefinite" when both disjuncts are. One of the most convincing arguments in favor of Pinkal's Precisification Logic is that it is in accord with our intuitions on these cases, unlike most logics based on three (or more) truth values.

In the last two chapters of the book, the question of vagueness is taken up again, in the light of problems raised by measure statements and by the sorites paradox. Pinkal concludes that a more radical approach than Precisification Logic is called for, and develops a new formalization of precisification in which an increase in precision corresponds to a *context change* in the sense of Kamp (1981b).

4. General comments

Why should a computational linguist read this book? One reason is that it is a very accessible introduction to the literature on vagueness, and an accessible compendium of many useful techniques in formal semantics. Computational linguists who believe that truth conditions have to do with the meaning of natural language expressions—and this reviewer agrees with Pinkal that at the moment there is no other way of expressing mathematical generalizations about meaning—should, in addition, find the question of how logic relates to the "natural world" extremely important. As for computational linguists who dismiss logic on the grounds that it depends on implausible assumptions, they may discover in Pinkal's book that such assumptions can be relaxed in various ways.

The most convincing part of Pinkal's theory is his account of vagueness. The supervaluation-based approach, as revised in the last chapters, is extremely attractive because it is a way to "tame" vagueness that does not require us to abandon the basic laws of logic entirely, and can be built into essentially any semantic theory. The tools introduced in Precisification Logic to characterize precise expressions and relative expressions provide a way of specifying properties of lexical items not usually captured by existing lexica.

I found the arguments supporting the connection between ambiguity and vagueness less convincing. I have no problems with Pinkal's claim that both ambiguity and vagueness have to do with precisification in a loose sense (rather than with, say, the number of possible readings that an expression may have). However, it's by no means clear that the same sort of precisification is involved in both cases. My intuitions about the distinction between ambiguity and vagueness could be rephrased

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1 A supervaluation is a partial function that assigns a value to a logical expression α on the basis of the values assigned to α by a set of classical interpretations. If all of these interpretations agree on a value for α, the supervaluation also assigns to α that value; otherwise, the function is not defined.

using Pinkal's terminology as follows: Vagueness has to do with the relation between language and the world; hence, the sense of precisification that we want to use for this form of indefiniteness is "precisification with respect to the world," and Pinkal's treatment neatly captures this notion. The sense of precisification that seems to matter for ambiguity, instead, appears to be meta-theoretic: what gets precisified is not the content of what the speaker said, but what the hearer thinks the speaker said. This form of precisification seems to involve an augmentation of the context in the sense of "what the speaker intended." *Prima facie*, these intuitions would be captured most accurately by a theory in which different forms of precisification are handled in different ways. Pinkal does not provide a convincing argument to the contrary; his claim that vagueness and ambiguity are but extremes of a continuum relies almost entirely on his observation that ambiguity and vagueness cannot be distinguished by simply saying that ambiguous statements have a finite number of readings, whereas vague statements have an infinite number of them—which is probably correct, but from which his conclusion doesn't follow. There are similar problems with some of the other proposals that Pinkal introduces in chapter 4, such as his characterization of the distinction between polysemy and homonymy. His suggestion doesn't reflect the traditional descriptive characterization as formulated by, say, Lyons (1977), and Pinkal's argument in favor of his alternative view is not entirely convincing.

A computational linguist hoping to find in *Logic and Lexicon* new ideas about disambiguation will be disappointed. Although the *disambiguation imperative* provides an intriguing characterization of the semantics of a class of ambiguous expressions in terms of their disambiguation properties, and although the notion of *context update* plays an important role in the last chapter, the question of which forms of reasoning underlie disambiguation, and whether the logic Pinkal proposes is appropriate for this task, is never raised.

This said, this book fills such a gap in the literature, and Pinkal's discussion is so thorough, that anybody who is interested in either ambiguity or vagueness is likely to benefit from it.

References

Alshawi, Hiyan and Crouch, Richard. (1992). "Monotonic Semantic Interpretation." *Proceedings, 30th Annual Meeting of the Association for Computational Linguistics*, Newark, DE, 32–39.

Copestake, Ann and Briscoe, Ted. (1995). Semi-productive Polysemy and Sense Extension. *Journal of Semantics*, 12(1): 15–68.

Fine, Kit. (1975). "Vagueness, truth, and logic." *Synthese*, 30: 265–300.

Kamp, Hans. (1975). "Two Theories About Adjectives." In *Formal Semantics of Natural Language*, edited by Edward Keenan. Cambridge University Press, 123–155.

Kamp, Hans. (1981a). The Paradox of the Heap. In *Aspects of Philosophical Logic*, edited by U. Mönnich. Reidel, 225–277.

Kamp, Hans. (1981b). A Theory of Truth and Semantic Representation. In *Formal Methods in the Study of Language*, edited by J. Groenendijk, T. Janssen, and M. Stokhof. Mathematical Centre, Amsterdam.

Lyons, John. (1977). *Semantics*. Cambridge University Press.

Pinkal, Manfred. (1985). *Logik und Lexikon: Die Semantik des Unbestimmten*. Berlin: Walter de Gruyter.

Poesio, Massimo. (1995). Semantic Ambiguity and Perceived Ambiguity. In van Deemter and Peters (1995).

Reyle, Uwe. (1993). "Dealing with Ambiguities by Underspecification: Construction, Representation and Deduction." *Journal of Semantics*, 10: 123–179.

Saint-Dizier, Patrick and Viegas, Evelyn. (1995). *Computational Lexical Semantics*. Cambridge University Press.

van Deemter, K. and Peters, Stanley, editor. (1995). *Semantic Ambiguity and Underspecification*. Stanford, CA: Center for the Study of Language and Information.

van Fraassen, Bas. (1969). "Presupposition, Supervaluations, and Free Logic." In *The Logical Way of Doing Things*, edited by Karel Lambert. Yale University Press, 67–91.

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