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Abstract

The fields of semantics and pragmatics are devoted to the study of conventionalized and context- or use-dependent aspects of natural language meaning, respectively. The complexity of human language as a semiotic system has led to considerable debate about how the semantics/pragmatics distinction should be drawn, if at all. This debate largely reflects contrasting views of meaning as a property of linguistic expressions versus something that speakers do. The fact that both views of meaning are essential to a complete understanding of language has led to a variety of efforts over the last 40 years to develop better integrated and more comprehensive theories of language use and interpretation. The most important advances have included the adaptation of propositional analyses of declarative sentences to interrogative, imperative and exclamative forms; the emergence of dynamic, game theoretic, and multi-dimensional theories of meaning; and the development of various techniques for incorporating context-dependent aspects of content into representations of context-invariant content with the goal of handling phenomena such as vagueness resolution, metaphor, and metonymy.

The fields of semantics and pragmatics are devoted to the study of the semiotics of language. The fact that two separate disciplines have developed for this purpose reflects the complexity of human language as a semiotic system, as well as the debate as to how it should be analyzed. This complexity is of at least four types. First, we use language not only to represent information (or thought) to ourselves and convey it to others, but also to act on and interact with others in ways that do not directly have to do with the transmission of information, such as greetings, exclamations or orders[1,2]. Second, language is simultaneously highly systematic and flexible. On the one hand, interlocutors are under strong pressure to be consistent in their use of language to transmit messages; otherwise, communication would be more difficult and less reliable than it is. On the other, they continually innovate in using existing linguistic forms to convey new, and sometimes even radically different, messages via metaphor[3], irony[4], and other devices[5]. Third, even if we assume a certain stability in the relation between linguistic form and what is communicated, the immediate context of use is

almost always crucial for determining exactly what a speaker conveys on any given occasion[6,7] – the interpretation of pronouns such as *that* is a paradigmatic example. Finally, some linguistic forms, such as the so-called *it*-cleft construction in English (e.g. *It was his sister who called*), are conventionalized specifically to help interlocutors manage discourse; their semiotic value is, in a sense, meta-communicational[8]. This value must be learned in order for an individual to be competent in the language in question, but it does not contribute to what is normally understood as the information transmitted by an utterance.

All of these sorts of complexity reflect in one way or another a division of labor between convention and context. On the one hand, part of what we mean seems to be associated with words and phrases independently of who is speaking and the context of use, and has a certain stability over time; this part is often connected specifically to the notion of proposition, information, or thought. On the other, part of what we mean depends crucially on context, whether broadly construed as shared knowledge among interlocutors or narrowly construed as a specific conversational record. Among other things, context helps interlocutors determine to what extent information is being transmitted at all and whether language is being used in a conventional way. Very roughly, the former is the domain of *semantics*, and the latter, the domain of *pragmatics*. However, the complexity of what and how we mean has led to different specific understandings of the semantics/pragmatics distinction, associated with different empirical and theoretical concerns. This article presents an overview of the different ways the line between semantics and pragmatics has been drawn; the relative strengths and weaknesses of language-centered versus speaker-centered understandings of meaning; and the main developments that have permitted better integrated and more comprehensive theories of language use and interpretation.

Ways of understanding the semantics/pragmatics distinction

Denotation versus use

Scholars attribute to Charles Morris the first formal definition of the semantics/pragmatics distinction[9]. Morris defined semantics as the study of "the relations of signs to the objects to which the signs are applicable" and pragmatics as the study of "the relations of signs to interpreters" (Reference 9, p.6). These definitions formed part of a very general theory of semiotics that acknowledged a distinction between the concern for "the necessity of the relation of signs to objects which they denote and whose properties they truly state" – the domain of semantics – and for "language as a type of communicative activity, social in origin and nature, by which members of a social group are able to meet more satisfactorily their individual and common needs" – the domain of pragmatics (ibid., p. 10). This very broad understanding of the distinction, and in particular, the characterization of the domain of pragmatics, is particularly associated with disciplines such as rhetoric[10], critical discourse analysis[11], communication studies, and intercultural pragmatics[12], and more generally with scholars primarily concerned with language use as opposed to structure, such as Speech Act Theorists[1,13].

What is said versus what is implicated

However, within the community of scholars concerned specifically with "the relation of signs to objects which they denote and whose properties they truly state" a somewhat narrower distinction is typically referred to with the terms "semantics" and "pragmatics". The crucial fact is that, even if we limit ourselves to cases in which language is being used to transmit information, we find that the same, fully disambiguated expression can be used to convey very different messages or, to use the terminology of H. Paul Grice, *conversational implicatures*[14]. Consider the brief dialogs in (1) and (2), for example:

(1) a. What time will you be finished studying?
b. I will be finished studying by 5pm.

(2) a. When can I borrow your Biology book?
b. I will be finished studying by 5pm.

Assuming that the speaker and the day and time of speech are the same in the two cases, the replies in (b) contain exactly the same content. Nonetheless, the utterances contrast sharply in what they convey. (1b) simply informs the hearer of the time at which the speaker will finish studying; in contrast, (2b) strongly suggests that the hearer may borrow the book after 5pm. The domain of semantics, on this view, is restricted to the analysis of content, or *what is said* in Grice's terminology, while the analysis of the message conveyed, or *what is implicated*, belongs to pragmatics (along with the analysis of all other aspects of language use).

Context-invariant versus context-dependent content

Narrowing our focus still further, we come to a third way of defining the boundary between semantics and pragmatics. Even if we abstract away from the existence of implicature, examples of the context dependence of meaning are rampant in natural language. A typical example appears in (3): the precise shade and distribution of the color red that must be manifest in each case for the sentence to be true are different.

(3) a. The dress was red.
b. The child's nose was red.

The analysis of these sorts of examples has generated considerable debate, particularly within the field of philosophy of language. Some philosophers, such as Charles Travis[15], have argued that these examples show that no consistent semantic representation in the form of truth conditions can be meaningfully assigned to sentences – such a view can be considered radically *contextualist*. On the other extreme, some philosophers have argued that such sentences can in fact be associated with context-independent propositions, but that these are minimal in content[16]: for example, the sentences in (3) express propositions attributing redness to the corresponding objects without specifying exactly what shade or distribution of color are involved. On at least some versions of this view, the specification of the latter is the result of similar processes to those involved in the calculation of implicature. An intermediate approach provides the adjective with a representation that contains one or more context-dependent parameters that must be assigned values before the sentence can be associated with a proposition. It is only once this proposition is determined that inferential processes such as implicature calculation can take place[17,18]. On such a view, the semantic content of a word like *red* and, by extension, a sentence containing it, is just that part of it that is not

context dependent, while the processes by which values are assigned to context-dependent parameters are considered pragmatic. This last view entails that the proposition expressed by the assertion of a sentence – that is, what is said in the Gricean sense – will depend not only on its semantic content but also on pragmatic factors that are distinct from those involved in the calculation of implicature. In other words, semantics is the domain of the context-independent component of content, while pragmatics is the domain of the context-dependent component of content. The semantic content of an assertively used declarative sentence in this sense may therefore in some cases be not a complete proposition but rather an incomplete one; in more precise terms, it can be understood as a function from contexts to propositions.

Truth-conditional versus non-truth conditional content

Finally, especially in some sectors of linguistics, semantics has been associated with the study of those aspects of conventionalized content that establish the conditions under which a sentence is true, while pragmatics (sometimes referred to as *formal pragmatics*[19]) includes the study of those conventionalized aspects of meaning that do not contribute to truth-conditional content, including notably the conditions under which the use of a sentence is felicitous in discourse. The following examples illustrate the two kinds of content.

(4) a. My family went to Menorca for the holidays.
b. For the holidays, my family went to Menorca.
c. It was my family who went to Menorca for the holidays.

Assuming the values of all the referential expressions are held constant across (4a-c), each of these sentences expresses the same basic proposition and will be true or false in the same circumstances. However, they are not fully interchangeable in discourse. For example, (4a) and (4b) could serve as relatively natural answers the question *Where did your family go for the holidays?*, while (4c) is much less felicitous in such a context, and more natural when the question at hand concerns who went to Menorca. This last way of drawing the distinction between semantics and pragmatics is sharply different from the previous two mentioned above insofar as it is grounded in a specifically linguistic, rather than extralinguistic, notion of context, and because it includes within the purview of pragmatics aspects of interpretation that are conventionalized in specific constructions and thus vary from language to language[20].

Given this variation in the definitions of the semantics and pragmatics, any claims concerning the distinction between the two must be interpreted carefully. For example, the fact that information structure is conventionalized, and thus must be learned by speakers, has been offered as grounds by some scholars for not distinguishing semantics and pragmatics[21]. However, it is clearly possible to agree that the task of accounting for information structure is not significantly different from that of accounting for word meaning, without agreeing (for example) to the abandonment of a semantics/pragmatics distinction based on a differentiation between what is said and what is implicated. The rest of this article will abstract away from such terminological issues to the extent possible, and will largely avoid the details of specific debates over the analysis of specific phenomena (for which the reader is referred to the works in the references and "Further reading"). Rather, the focus will be on the considerations that motivate a relative emphasis on convention versus context in the analysis of meaning, and the most important theoretical developments that have permitted bringing the two together in a nonetheless articulated fashion.

Language- versus speaker-centered perspectives on meaning

Perhaps the most fundamental factor influencing the choice of approach to linguistic communication is whether meaning is viewed as something that expressions have versus something that speakers do with language. These views are not incompatible; each is useful for explaining complementary aspects of language.

The idea that linguistic expressions have conventionalized content, whether characterized in terms of some sort of mental representation[22,23,24], or in terms of correspondence to something in the world[25], is essential for explaining that successful communication is possible at all: without it, it would be difficult to understand how hearers respond as predictably as they do to the same sorts of communicative acts. A notion of conventionalized linguistic meaning is also useful for explaining the fact that speakers clearly have intuitions about acceptable and unacceptable uses of language[26]; these intuitions arguably reflect knowledge of the relevant conventions. In addition, there is little question that there are important regularities in the morphosyntax of language that allow words and phrases to be reused and combined to express new thoughts. In order for this to be possible, the interpretations of complex expressions must reflect to at least some degree the interpretations of their component parts, i.e. meaning must be somehow compositional, even if there continues to be debate as to just how compositional language is[27]. It is difficult to see how this property of language could be accounted for without associating expressions with a minimal degree of conventionalized content. It is therefore useful to maintain the assumption that such content exists, even if it ultimately only manifests itself as (or alternatively, reduces to) an abstraction across regularities in many acts of meaning by many members of a speech community. Indeed, the fact that many speech communities have developed dictionaries and grammars strongly indicates that this sort of abstraction is useful.

At the same time, conceiving of meaning as something expressions have, rather than something that speakers do, does not shed much light on the fact that speakers use language in highly creative ways, assigning new interpretations to existing expressions. Looking at meaning outside of the context of use also removes the focus of attention from the many sociological phenomena in which language plays a role, such as the expression of power relations, or the creation of group identities[28]. Finally, there are expressions in language for which it is difficult or impossible to provide a conventionalized content that does not directly reflect what the speaker is actually doing at the moment of utterance, such as the greeting *Hello*; and unless we take into account the variety of acts that speakers perform while speaking – such as promising, ordering, or inaugurating – it will be impossible to explain why some utterances, such as (5a), can be followed by a reply such as (5c), while others, such as (5b), cannot[1,13,29].

(5) a. I promised I would pay you back.
b. I promise I will pay you back.
c. That's true.

The recognition that both ways of conceiving of meaning have a role to play has led to two major innovations in linguistic analysis during the last 40 years. One is the introduction of dynamic and multi-dimensional models of meaning that allow for the treatment of conventionalized conditions on

use in discourse alongside that of propositional content. The other is the development of techniques for integrating context-dependent and context-invariant aspects of meaning. Let us consider these in turn.

Developments towards integrated models of semantics and pragmatics

From static, propositional models to dynamic and multi-dimensional models of meaning

One major line of research in linguistics and the philosophy of language throughout the last century has focused on capturing the relation between language and states of affairs in the world.[25] Methodologically, this work has proceeded by translating natural language into a logic for which precise model-theoretic interpretations can be provided[30] or for which proof theories can be defined[31], by providing model theoretic interpretations directly[32], or by associating language with truth conditions of the sort proposed by Alfred Tarski[33,34]. This work naturally focused at the beginning on declarative sentences and the propositions they express. Although this approach initially had little to say about non-declarative sentences or the differences between different linguistic forms that express the same proposition (as in (4) above), it was gradually extended to take this latter sort of data into account.

Beyond declaratives

One early, significant advance involved the treatment of interrogative sentences. Consider the interrogative form in (6), for example:

(6) What did Andrea read?

This form is typically used to ask a question; it is clearly related to the sentence *Andrea read something* and could be answered by sentences such as *Andrea read the newspaper* or *Andrea read the novel* (or both, if Andrea read both). These observations and the fact that questions are not typically used to make assertions have led to proposals on which the semantic value of an interrogative sentence is something "bigger" or "smaller" than a proposition: the set of all the propositions that could potentially answer the question[35], the set of just those propositions that answer the question truthfully[36], the property of being something that Andrea read[37]. A more complex analysis that combine aspects of both the "set of propositions" and property accounts has also been proposed[38].

Integrated semantic and pragmatic treatments of exclamative forms have also appeared in recent years. The fact that one major subclass of these (both in English and a number of other languages) has a syntax quite similar to that of questions has led to some analyses based on the semantics of the latter[39,40].

(7) What a cute baby you have!

Other exclamative forms show significant similarities to constructions that express degree, particularly comparative and equative constructions, leading to analyses that emphasize their similarity to the latter constructions[41,42]. Compare, for example, the exclamative and comparative constructions in Catalan, illustrated in (8a) and (8b), respectively:

(8) a. Quin nen més alt! (Catalan)
which boy more tall
'What a tall boy!'

b. El nen és més alt.
the boy is more tall
'The boy is taller.'

Whether the exclamative form is assimilated to a question or a degree construction, the basic semantics is complemented with specific assumptions about the discourse conditions under which the forms can be used and what the speaker is doing when he or she makes an exclamation. For example, both (8a) and (8b) have been argued to encode information about the degree to which the boy in question is tall; the difference is that in the exclamative, this information is linguistically marked to be a fact that is not subject to discussion, rather than an assertion put forward by the speaker to be accepted or rejected by others, and what is informatively conveyed is the speaker's attitude (typically, surprise) towards that degree. The difference between factual and asserted information status can be represented using one of the dynamic or multi-dimensional models described in the following subsection. By maintaining a division of labor between form (and corresponding content) and use, it is possible to capture the structural and semantic similarities between exclamative forms, on the one hand, and questions and degree constructions, on the other, while providing an account of the differences in their discourse functions.

Finally, imperative forms such as those in (9a) have also been treated using techniques that build on those originally developed for the analysis of declarative sentences. One important line of work on imperatives[43,44] has adapted semantic analyses of modal sentences such as (9b), based on intuitive similarities between the two.

(9) a. Please be on time!
b. You should be on time.

However, Paul Portner[45,46] has pointed out that simply assimilating the analysis of imperatives to that of modals fail to explain some aspects of their structure, and is insufficient for capturing their use. Imperatives in English are distinguished from all other main clause types, including modal sentences, insofar as the verb lacks tense and the subject is usually not overtly expressed (though it is typically understood to be the addressee). Portner takes these characteristics to indicate that imperatives correspond not to (full) propositions but rather to properties, which is how subjectless and tenseless verb phrases are typically modelled in formal approaches to linguistic meaning. In an effort to explain why precisely such a form should be used to fulfill a directive function, he proposes that the use of an imperative imposes an obligation on the individual to whom it is directed, and which is explicitly represented on a "to do" list that forms part of the model. Thus, the utterance of (9) will add to the addressee's "to do" list the property of being on time.

All of these examples illustrate the importance of distinguishing specific *forms* (and their concomitant conventionalized contents) from *acts* of questioning, exclaiming or ordering. First, if we fail to make this distinction, it will be difficult to develop an account of why the canonical forms for e.g. exclaiming or ordering look the way they do, and why they might resemble forms with other canonical uses. Second, distinguishing form and speech act is essential for explaining the differences

between different forms that are used for similar conversational goals. For example, returning to questions, though all of the forms in (10) can be used to solicit the same information, the contexts in which they can be used felicitously are slightly different (see Reference 47 for discussion).

(10) a. Would you like to go to the movies?
b. You'd like to go to the movies?
c. Wouldn't you like to go to the movies?

An adequate theory of questions must therefore differentiate these forms; it must also say something about the coherence of the question-answer relation. One way this has been done has been to embed a semantics for questions within a more general, dynamic theory of discourse and dialog in which the choice of form used to ask a question can be modeled to reflect the speaker's assumptions about the information states of the different conversation participants, and in which the choice of form can also constrain subsequent dialog moves[48,49,50]. We turn to dynamic models of meaning immediately below.

Finally, distinguishing a conventional interpretation for the different interrogative, exclamative, and imperative forms from their uses in different sorts of speech acts is also crucial for explaining when and why these forms can be used in other ways. In an appropriate context, for instance, a negative interrogative such as (10c) can be interpreted as a proposal on the part of the speaker, whereas the rising declarative in (10b) cannot easily be used in this way. This contrast is unsurprising given the conventionalized conditions on the discourses to which the different forms can be added. Precisely the need to capture such conditions was one of the motivating factors in the development of dynamic models of interpretation.

Dynamic models of meaning

The essential insight driving dynamic models, which emerged in papers by Robert Stalnaker[51] and Lauri Karttunen[52] during the 1970s, is that sentences have as their interpretations not static propositions, but rather their potential to update the contexts to which they are added. In theories such as Discourse Representation Theory (DRT)[53] or File Change Semantics[54] this insight is formalized in the analysis of sentences as functions from contexts to contexts. Part of the result of adding a sentence to a context will be constant across all contexts; however, crucially, other parts (such as exactly who or what a pronoun can refer to) will be different, and most interestingly, there are sentences that may be added to some contexts but not to others. That is, some sentences denote partial, rather than total, functions from contexts to contexts, where a context can be defined as the knowledge and specific conversational background shared by a set of interlocutors.

This dynamic turn has vastly increased the range of natural language phenomena that can be modeled formally, including presupposition[55,56], restrictions on discourse anaphora[57,58] and on the use of non-canonical morphology, syntax or intonation to reflect different sorts of information packaging[59], and speech acts[60,61], in addition to providing a framework for the analysis of the non-declarative expressions described in the previous subsection. To take a very simple example, consider the following:

(11) a. A man laughed.
b. The man laughed.

There are very few, if any, constraints on the contexts to which (11a) can be added; in contrast, (11b) can only be added to contexts in which the man referred to by the definite noun phrase is familiar and accessible to the conversation participants. If we assume (perhaps simplifying slightly) that there are no constraints on the use of (11a), it can be modeled as a *total* function from contexts to contexts that will include the information that there is a man not previously acknowledged in the discourse who laughed. In contrast, (11b) will denote a *partial* function from contexts in which there is a man to contexts that will include the information that that man laughed. When there is no salient man in the context, no updated output context will be defined. This is a formal way of capturing the intuition that the use of (11b) presupposes that there is a salient man in the context; when there is no such man, the presupposition fails. Note that the propositional content of sentences on this view can be retrieved by comparing the input and output contexts when that output is defined.

Alongside dynamic models of sentence interpretation, dynamic models have been developed to characterize discourse structure, including coherence, salience, and rhetorical relations, such as Centering Theory[62] and Rhetorical Structure Theory[63]. Segmented DRT[64] is an example of how sentence and discourse dynamics can be fruitfully combined in a single framework. These models have emerged largely within the field of computational linguistics, with the goal of facilitating natural language processing applications that are able to track reference to a given individual in discourse or automatically summarize texts, for example.

Yet another way in which dynamicity has been introduced into the analysis of language use and interpretation is via game-like models of conversational interaction, whose origins can be found in Ludwig Wittgenstein's later work[65], but whose precise characterization in contemporary linguistics is more directly inspired in the work of David Lewis[66,67] and in Game Theory more generally[68]. These models characterize a variety of semantic and pragmatic phenomena in terms of optimal dialog moves for speakers and hearers given their goals, communicative resources, and the cognitive load involved in both producing and comprehending utterances; they include both explicitly game-theoretic models[69] and so-called Optimality Theoretic models[70]. As with dynamic theories of discourse structure, many of these models of conversation have been integrated with dynamic theories of sentence interpretation.

Multi-dimensional models of meaning

A related development that has led to more complete theories of meaning is the introduction of additional dimensions to the representation of conventionalized content that capture aspects of meaning that are not directly truth conditional. The earliest of these was Mats Rooth's proposal to provide sentences with a so-called focus semantic value alongside their ordinary semantic value[71]. Consider (12), for example, where the uppercase letters indicate focus stress on the verb:

(12) Andrew READ the book.

On Rooth's theory, (12) denotes a proposition (which will be true if Andrew read the book in question), and its focus semantic value is the set of propositions that consists of the denotation of the sentence plus alternatives to that denotation. These alternatives correspond to propositions in which the intonationally marked expression is substituted by another expression of the same type. For instance, the focus semantic value of (12) could be as in (13):

(13) {Andrew read the book, Andrew wrote the book, Andrew bought the book, Andrew looked over the book, Andrew restored the book, Andrew destroyed the book}

The introduction of this set of alternatives as the focus semantic value facilitates the analysis of focalizing expressions such as focus intonation or words such as *only* or *even* in English), as well as a theory of question-answer coherence. For example, one can propose that in order for a question-answer pair to be coherent, the set of propositions that the question denotes has to match the set of propositions that make up the focus semantic value of the answer. The technique of introducing an alternative semantic value has been extended from focus to sentence topics[72,70], and has been argued to have other uses[74]; such values have been very usefully exploited in conjunction with the sorts of dynamic models described in the previous section.

A rather different kind of multi-dimensional meaning representation has been proposed to account for differences in the status of the information a sentence can be used to convey. Consider the appositive relative clause *who is from California* in the following example:

(14) The cyclist, who is from California, won the Tour three times.

Christopher Potts[75] has argued that the appositive contributes to what is asserted when (14) is uttered, but that its content is not *at issue*. Specifically, the hearer typically cannot deny that (14) is true solely on the grounds that the cyclist is not from California, as should be possible if the appositive forms part of what is at issue, and yet Potts provides evidence that the content of the appositive does not behave like presupposed material, either. Borrowing terminology from Grice[14], Potts refers to the contribution of appositives (and certain other sorts of other expressions such as epithets like *damned* in *the damned dog*) as *conventional implicatures*. To account for their contribution, he proposes a multi-dimensional representation on which expressions project at-issue content and conventionally implicated content in parallel. Though the question of how best to analyze appositives and epithets remains controversial, the technique of providing parallel representations for different components of conventionalized content has drawn fresh attention to a variety of recalcitrant linguistic phenomena.

Techniques for integrating context-dependent aspects of lexical and phrasal content

The second major family of developments within semantic and pragmatic theory over the last several decades consists in various strategies for integrating conventional and context dependent aspects of content. These strategies have been applied to a wide range of data, from the interpretation of pronouns to vagueness resolution to metaphor and metonymy.

Parameters of evaluation

The first, and earliest of these strategies was developed to handle the interpretation of pronouns. It is obvious that a sentence such as (15), taken outside of context, cannot be judged true or false until an interpretation is assigned to the pronouns *I* and *it*.

(15) I heard it.

However, the interpretation of the pronouns depends on context in distinct ways and thus must be modeled differently. First, *it* (and most other pronouns) can be assigned the same interpretation independently of the person who utters it, while *I* (and other so-called *indexical* pronouns such as *you* and *we*) cannot: If (15) is first uttered by Ann and then by Bob, *I* will refer to Ann when she utters it and to Bob when he utters it; however, nothing will prevent *it* from referring to the same thing. Second, *it* can be *bound*, i.e. its interpretation can depend on the interpretation of another expression in the same sentence, while that of *I*, as a rule, cannot: In (16a), each group is naturally understood as making an inquiry about itself, whereas in (16b) the inquiries are all about the same individual, namely the speaker of the sentence.

(16) a. Each group asked which task it was responsible for.
b. Each student asked which task I was responsible for.

These sorts of contrasts led to the proposal that sentences are associated with a set of parameters of evaluation that include, as distinct from each other, an assignment of interpretations to ordinary pronouns and assignments of values to indexical expressions[30,76]. Once all of these parameters have supplied values to the different context-dependent expressions, the sentence will correspond to a proposition.

The analysis of bound pronouns has been extended to other cases of context dependence, such as the interpretation of tense[77], the domain restriction on quantifiers[78], and the comparison class with respect to which gradable expressions are interpreted[79]. The argument for treating these on analogy to pronouns generally involves showing that the expression in question can be dependent on some other expression, as was the case for *it* in (16a). Consider the case of the comparison class in the following sentence, for example:

(17) Everyone in my family is tall.

A very natural way to interpret this sentence is that for every member *x* in the speaker's family, *x* is tall with respect to the comparison class *c* for *x*; some parameter of evaluation will have to supply the value for *c*.

On David Kaplan's classic analysis[76], the conventionalized part of the interpretation of indexical expressions is called their *character*, understood as a function from contexts to contents; for example, the character of *I* will be a function whose input is a context and whose output is the speaker in that context. As happened with the analysis of bound pronouns, the notion of character has been extended beyond the domain of indexical pronouns, in this case to deal with underspecification in lexical semantics more generally. The different interpretations of adjectives, illustrated in (3) above and more extensively in (18), offer just one example[80,18].

(18) a. a red dress
b. a red grapefruit
c. a red pen
d. a red traffic light

On these analyses, part of the content of the adjectives must be supplied by a contextual parameter; for example, context determines that in order for a traffic light to count as red, a particular one of its bulbs must be illuminated, whereas in the case of the red pen, it is the color of the ink that is

relevant. Nonetheless, there remains a context-invariant component to the content, such as the fact that color is always a gradable property when it strictly refers to the hue of an object, as in (18a) (e.g. the dress can be *very* red), whereas it is not necessarily gradable when the color is crucially correlated with some other property of the object in question, as in (18d) (e.g. it makes no sense to talk about a very red traffic light if the color is indicating the illumination of a particular bulb)[81]. This context-invariant component can be considered the character of the color term[80].

Coercion

An apparently different sort of context dependence involves cases in which a word or phrase appears in a context where, given naïve assumptions about its usual interpretation, it should not be appropriate. Metaphoric and metonymic uses of language, illustrated in (19) and (20), respectively, are representative. Here, "metonymy" is used somewhat loosely to include so-called deferred ostension, as in (20a)[82], as well as any other case where a property is ascribed to an entity in virtue of holding of another entity or event related to that object, as in (20b), where what is really quick is some event involving the beer in question, such as drinking:

(19) I'm a zombie.

(20) a. I'm parked out back.
b. a quick beer

The examples raise the question of how we arrive at coherent interpretations for expressions that should be anomalous. One line of thought suggests that they are first interpreted literally and then, in the face of apparent anomaly and the presumption that the speaker is being cooperative, are provided with a meaningful interpretation via inference; however, such examples are so pervasive in language as to suggest that a metaphorical or metonymic interpretation is provided directly in at least some cases, and this conclusion is supported by experimental data (see Reference 83 for discussion, examples, and additional references). The interest thus arises in representing this interpretation directly.

The main formal mechanism that has been used to account for mismatches in predication is *coercion*. Coercion simply amounts to reinterpretation of an expression so as to eliminate any conflicts in interpretation due to mismatches in the conditions imposed by a predicate and the nature of its argument. In order for a theory of coercion to have any predictive power, constraints must be imposed on when and how it can apply.

Perhaps the most complete and sophisticated theory of coercion to handle mismatches in predication has been developed by Nicholas Asher[7]. Simplifying considerably, Asher assumes that the words in a given language are classified into a hierarchy of types that essentially correspond to an ontology that is specific to that language. When words are combined, the content associated with their type is mapped into a standard predicate logic representation that composes complex contents. Building in part on ideas developed by James Pustejovsky[84] and others, Asher proposes a set of operations that can coerce a word from one type to another. For example, one such operation might take the type of an artefact and yield the type of the possessor of that artefact; such an operation plays a role in the analysis of (20a). Asher's theory also allows for types to be modified under certain discourse conditions.

Asher's system of types does not correspond to world knowledge, but in certain respects it approximates it. However, the relation between the information encoded in the type hierarchy and world knowledge, and the exact way in which discourse can effect coercion, are not made fully explicit. The final theoretical innovation to be discussed in this overview, namely the development of distributional semantic models, at least partially addresses these gaps.

Distributional models

Distributional semantic models (see References 85 and 86 for recent overviews) build on the hypothesis that the semantics of an expression can be represented as or extrapolated from information about the distribution of that expression in a sufficiently large corpus of written or spoken text. Though different distributional models vary at the level of detail, as a rule they represent a word as a vector or matrix that encodes the (absolute or weighted) frequency with which that word co-occurs with other words in a given context. For example, the semantic representation of the word *book* could be a vector that includes the number of times (and possibly in what syntactic relation, within a reasonable window) *book* occurs with all other words of English, or some reasonably large subset of them. From this representation we might go so far as to hypothesize that this vector also models the concept we might have of books, insofar as we might expect *book* to appear very frequently with words such as *read*, *write*, *pages*, *author*, etc., and very rarely with e.g. *fur*, *bark*, *tail*, or *leash*. In contrast, the latter words should appear with high frequencies in the vector for the words *dog* and *puppy*. Distributional models thus build on the notion that our idea of a word's meaning is in large part (if not entirely) the product of our linguistic experience.

Distributional models are naturally suited to handling word sense disambiguation[87] and offer the promise of being fruitfully extended to account for metaphor[88]. However, they also have at least three important limitations. First, it is not obvious that meaningful distributional representations can be given for function words such as determiners or conjunctions, which are highly unselective in the words that they combine with. Second, it is still far from clear how to compose the representations for individual words into accurate representations for phrases or sentences. Finally, it is not yet clear how discourse dynamics can be captured in distributional models. For this reason, though some researchers are attempting to develop algorithms for composing distributional representations[89,90], others are connecting distributional representations for words to logical representations for phrases and sentences[91,92]. Either way, these models promise to increase the empirical coverage of computationally tractable semantic theories and bring together insights from cognitively- and functionally-oriented linguistics, on the one hand, and formally-oriented linguistics, on the other.

Conclusion

Despite the increasing trend towards the integration of conventionalized and context-dependent aspects of the semiotics of natural language, a number of heated debates remain open. Some of these concern foundational questions such whether it makes sense at all to distinguish conventional and context-dependent aspects of meaning, or specifically linguistic content vs. world knowledge; whether metaphorical sentences are interpreted directly or only via an inference procedure

posterior to the computing of a literal interpretation; how broad the phenomenon of implicature is and what sorts of facts the notion of implicature should have to explain[93]; whether, in some cases, the truth of an assertion should be relativized to individuals, as opposed to being absolute[94]; or whether dynamic theories of sentence content are preferable to static theories[95]. Others involve the analyses of specific linguistic phenomena, including many of those used to illustrate various points in this overview. In this respect, one of the most promising recent trends in semantic and pragmatic research is the increasing effort to provide answers to these questions through a wide variety of experimental data, including judgment tasks, eye tracking, electrophysiological studies, and brain imaging[96,97], even if, at least for the immediate future, the sort of evidence these studies bring to bear remains rather indirect. Meanwhile, an increasingly sophisticated set of analytical tools is making it possible to develop more precise theories with better predictive power.

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Further Reading/Resources

Association for Computational Linguistics Special Interest Group on Computational Semantics. http://www.sigsem.org/wiki/Main_Page.

Association for Computational Linguistics Special Interest Group on Discourse and Dialog. http://www.sigdial.org/.

Association for Computational Linguistics Special Interest Group on the Lexicon. http://www.siglex.org/.

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