languages possess many of the other syntactic orderings that dependent-head languages tend to have (postpositions, main verb–auxiliary verb, possessor-noun (inalienable), and subordinate clause–main clause). All mark person, number, aspect (not tense), mode, and pronominal case in their verb morphologies, and permit noun incorporation. Nominal incorporation is most active in the northern languages: Crow may incorporate entire relative clauses within the verb. Many of the languages have fairly complex phonological inventories, including aspiration, glottalization, and nasalization contrasts for three or four places of articulation among consonants, and length contrasts for five oral and three nasal vowels. Many, if not most, Siouan languages have pitch accent and tend to assign accent to the second mora of words. Phonologists are warned that the practical orthographies, such as those developed by Riggs for Dakota or La Flesche for Omaha, lack detail necessary for phonological analysis.

Future Scholarship

Siouan scholarship is presently flourishing, but much remains to be done. New dictionaries are being or have recently been elaborated for Crow, Hidatsa, Mandan, Dakota, Chiwere, Winnebago, Kansa, Osage, and Quapaw, along with grammars of Crow, Hidatsa, Chiwere, Omaha, Osage, Biloxi, and Ofo. A comparative Siouan dictionary is nearing completion.

See also: Crow; Omaha-Ponca; United States of America: Language Situation.

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Situation Semantics

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Situation theory starts with a fundamental observation: reality consists of situations. A situation is a rich object consisting of individuals enjoying various properties and standing in a variety of relations. It is, in a sense, a 'small' world. We always find ourselves in situations. Right now, you, the reader, are in a reading situation. You are, I hope, satisfied with your being in this situation (notice that this is an attitude you have toward this situation). Some months ago, I, the author of this article, was in a writing situation (distributed over time and place).

Situations describe parts of the real world. Information flow is made possible by a network of abstract links between high-order uniformities, that is situation types. One of the distinguishing characteristics of situation theory *vis-à-vis* the traditional account is that information content is invariably context-dependent (Akman and Surav, 1997).

Situation semantics is applied situation theory. We are engaged in situation semantics if we are using situation-theoretic ideas – mathematical theories of information content – to study meaning in natural language. In fact, the two areas are not clearly separable, as the still-popular acronym STASS (situation theory and situation semantics) neatly shows.

Unlike the older and widely known approaches to natural language meaning (e.g., Montague grammar), there is certain natural feel to situation semantics. This makes it enticing for a newcomer to the realm of semantics. Situation semantics does not impose

human-made assumptions in our conceptual scheme. It may be burdensome for someone to embrace, say, Montagovian intensions, but situations have a certain conceptual clarity and naturalness that make them believable. You may have heard that the classical model theory is a 'model' theory in the sense that it depicts how a logical theory should be like. Likewise, situation semantics is a fine exemplar of what a naturalized theory of semantics should be like.

Classical approaches to semantics underestimate the role played by context; they ignore factors such as intentions and circumstances of the individuals involved in the communicative process. (Or, rather, they place them in the pragmatics basket.) But, linguistic devices such as indexicals, demonstratives, and tenses rely heavily on context for interpretation and are fundamental to the way language carries information. Context-dependence is essential to situation semantics. (The insistence of situation semantics on contextual interpretation makes it compatible with speech act theory and discourse pragmatics.) A sentence can be used over and over again in different situations to say different things (called the efficiency of language). Its interpretation (i.e., the class of situations described by the sentence) is therefore subordinate to the situation in which the sentence is used. This context-providing situation (discourse situation) is the speech situation, including the speaker, the addressee, the time and place of the utterance, and the expression uttered. Because speakers are always in different situations, having different causal connections to the world and different information, the information conveyed by an utterance will be relative to its speaker and hearer (called the perspectival relativity of language).

Context supports not only facts about speakers, addressees, and so on, but also facts about the relations of discourse participants to other contextually relevant situations such as resource situations. Imagine two card games that are going on, one across town from the other. Suppose Alice is playing rummy with Bob and Carol is playing rummy with David. Elwood, watching the former card game, mistakes Alice for Carol, and mutters, *Carol has the ace of clubs*. According to the classical theory, if Carol indeed has the ace of clubs (A♣), his claim would be true since *Carol* and *the ace of clubs* are used to pick, among all the things in the world, the unique objects satisfying the properties of being someone named Carol and being an A♣, respectively. In contrast, situation semantics identifies these objects with respect to some limited situation – the resource situation exploited by Elwood. The claim would then be wrong even if Carol had the A♣ in the other card game.

In traditional semantics, statements that are true in the same models convey the same information. Situation semantics takes the view that logically equivalent sentences need not have the same subject matter because they need not describe situations involving the same objects and properties. The notion of partiality leads to a more fine-grained notion of information content and a stronger notion of logical consequence that does not lose track of the subject matter.

Ambiguity is another aspect of the efficiency of language. Natural language expressions may have more than one meaning. There are factors such as intonation, gesture, the place of an utterance, and so on that may play key roles in the interpretation of an utterance. Instead of downgrading ambiguity as an impurity of natural languages, situation semantics tries to build it into a full-fledged theory of linguistic meaning.

Intelligent agents generally make their way in the world by being able to pick up certain information from a situation, process it, and react accordingly. Being in a situation, such an agent has information about the situations he or she sees, hears about, believes in, and so on. Thus, upon hearing Bob's utterance *a wolf is running toward you*, Alice would have the information that her friend is the speaker and that he is addressing her with *you*. Moreover, by relying on the situation the utterance described, she would know that there is a wolf fast approaching her. She would then form a thought about this – an abstract object having the property of being a running wolf – and, on seeing the wolf around, her thought would start to correspond with facts. Normally, the realization of some type of situation causes an agent to acquire more information about that situation and to act accordingly. Alice would run away, having in her possession the acquired knowledge that wolves are hazardous. She activates this knowledge from the situation she finds herself in via a constraint – the link between wolves and their fame as life-threatening creatures. The role of constraints in information flow is best illustrated with an example. The statement *smoke means fire* expresses the lawlike relation that links situations in which there is smoke to situations in which there is a fire. If s is the type of smoky situations and f is the type of fire situations, then, by being attuned to the constraint $s \Rightarrow f$, an agent can pick up the information that there is a fire in a particular situation by observing that there is smoke.

Meaningful expressions are used to convey information not only about the external world but also about our minds (called the mental significance of language). Returning to an earlier example, consider the sentence *a wolf is running toward you* uttered by

Bob. It can give Alice information about two different situations. The first one is the situation that she is located in. The second one is Bob's mental (belief) situation. If Alice is certain that he is hallucinating, then she learns the second situation, not the first. Situation semantics differs from other approaches in that in attitude reports we do not describe our mind directly (by referring to states of mind, ideas, senses, thoughts, and whatnot) but indirectly (by referring to situations that are external).

According to situation semantics, the meanings of expressions reside in systematic relations between different types of situations. They can be identified with relations on discourse situations d, (speaker) connections c, the utterance situation u itself, and the described situation e. Some public facts about u – such as its speaker and time of utterance – are determined by the discourse situations. The ties of the mental states of the speaker and the hearer with the world constitute c.

A discourse situation d involves the expression uttered, its speaker, the spatiotemporal location of the utterance, and the addressee. Each of these defines a linguistic role (the role of the speaker, the role of the addressee, etc.). The utterance situation u constrains the world in a certain way, depending on how the roles for discourse situations, connections, and described situation are to be filled. For instance, an utterance *I am crying* defines a meaning relation:

$$d,c[[\text{I am crying}]]e$$

Given a discourse situation d, connections c, and a described situation e, this holds just in case there is a location L and a speaker s such that s is speaking at L, and, in e, s is crying at L.

In interpreting the utterance of an expression f in context, there is a flow of information, partly from the linguistic form encoded in f and partly from contextual factors provided by the utterance situation u. These are combined to form a set of constraints on the described situation e. This situation is not uniquely determined; there may be several situations that satisfy the constraints. The meaning of an utterance of f and hence its interpretation are influenced by other factors such as stress, modality, and intonation. However, the situation in which f is uttered and the situation e described by this utterance seem to play the most influential roles.

Guide to Literature

Ground-breaking work on STASS is due to the late Jon Barwise, well-known mathematical logician, and John Perry, prominent philosopher of language and mind. Barwise and Perry were the founders of Stanford University's Center for the Study of Language and Information (CSLI), which became almost synonymous with STASS research. In the beginning, the development of situation theory was hampered by a lack of appropriate tools. Later, the theory assembled its foundations based on innovations coming from set theory (Barwise and Etchemendy, 1987; Aczel, 1988). Barwise and Seligman (1997) further advanced the theory by introducing the concept of an information channel, which preserves information as it is transmitted through a system. Their work is in the spirit of Dretske's (1981) landmark work on information flow.

It is impossible to do justice to the profundity of STASS in a brief summary of this kind. The reader is referred to two seminal books, Barwise and Perry (1983) and Devlin (1991), for a thorough understanding. Although somewhat dated, the former is densely packed with excellent semantic common sense. The latter volume proposes a streamlined vocabulary and pays close attention to the foundations; it is the only modern introduction to STASS. (However, it does not render the Barwise and Perry volume obsolete; each book has its own merits.) Seligman and Moss (1997) is a beneficial survey that is mathematically demanding; it also has an excellent bibliography.

Various versions of situation theory have been applied to a number of linguistic issues (mainly) in English. The ideas emerging from research in situation semantics have also been coalesced with well-developed linguistic theories and have led to rigorous formalisms (Fenstad *et al.*, 1987). On the other hand, situation semantics has been compared to another influential approach to the theory of meaning, discourse representation theory (DRT).

Indexicals, demonstratives, referential uses of definite descriptions, deictic uses of pronouns, tense markers, and names all have technical treatments in situation semantics. Gawron and Peters (1990) focused on the semantics of pronominal anaphora and quantification. They argued that the ambiguities of sentences with pronouns can be resolved with an approach that represents anaphoric relations syntactically. They use a relational framework that considers anaphoric relations as relations between utterances in context. Cooper (1991, 1996) offered painstaking studies of linguistic problems to which situation semantics has been applied with some success. Tin and Akman (1994, 1996) showed how situation theory can be given a computational twist. They implemented a prefatory prototype (named BABY-SIT for obvious reasons) to program some practical problems, including anaphora resolution. Devlin and Rosenberg (1996) explored applications of situation

theory to the study of language use in everyday communication to improve human–computer interaction.

There used to be a specialized series of conferences devoted to recent developments in STASS. The first three volumes of proceedings were published as Cooper *et al.* (1990), Barwise *et al.* (1991), and Aczel *et al.* (1993). Nowadays, it is possible to find situation–theoretic papers dispersed in numerous conferences on logic, language, and information.

Finally, Devlin (2004) provides – despite the specific sounding title – a general appraisal of what STASS is all about; it may be consulted to get a better grasp of the historical developments that shaped STASS. Many of the Barwise papers reviewed by Devlin can be found in Barwise (1989), a fertile collection for technically oriented readers.

See also: Anaphora: Philosophical Aspects; Conditionals; Context and Common Ground; Context, Communicative; Demonstratives; Discourse Representation Theory; Expression Meaning versus Utterance/Speaker Meaning; Formal Semantics; Indexicality: Philosophical Aspects; Logic and Language: Philosophical Aspects; Logical Consequence; Meaning: Overview of Philosophical Theories; Metaphysics, Substitution Salva Veritate and the Slingshot Argument; Montague Semantics; Possible Worlds: Philosophical Theories; Pragmatic Determinants of What Is Said; Pragmatics and Semantics; Propositional Attitudes; Quantifiers: Semantics; Relevance Theory; Representation in Language and Mind; Semantics–Pragmatics Boundary; Sense and Reference: Philosophical Aspects; Speech Acts; Thought and Language: Philosophical Aspects.

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