CHAPTER 21

Situated Semantics

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It is perhaps worth while saying that semantics . . . is a sober and modest discipline which has no pretensions of being a universal patent-medicine for all the ills and diseases of mankind, whether imaginary or real. You will not find in semantics any remedy for decayed teeth or illusions of grandeur or class conflicts. Nor is semantics a device for establishing that everyone except the speaker and his friends is speaking nonsense.

– Alfred Tarski (1944)

1. Situations and Context

What is it that we really want to convey when we say "situated semantics"? We begin with a brief digression and then proceed toward the main concern of this chapter, semantics.

Stage works in which the humor derives from the situations the characters are placed in (sitcoms) make one thing clear. Placed in social situations, people construct the meaning of these situations in a subjective way. This affects the way they behave in these situations (e.g., the sort of roles they play and the views they hold).[1] Following Milton Rokeach (1998), we define an attitude as a relatively lasting organization of beliefs around an object or situation preparing a person to respond in some preferential manner. We care about attitudes because we think that we can use them to predict behavior. This requires that social agents maintain considerable uniformity to act in a certain (more or less consistent) way in situations. It was Erving Goffman's (2002) idea to look behind situations to discover the structures that implicitly govern them. These structures he called "frames." Where a situation is given by its contents, a frame is described by its components having a definite arrangement and stable relations (Gonos, 1977, p. 860). Each of the forms of daily activities scrutinized by Goffman has names (e.g., one is at a birthday party or a fund-raiser). On the other hand, situations are describable but nameless (e.g., a shareholders' meeting that ended in a fistfight; Goffman, 2002).

Situated semantics can be regarded as an attempt at placing situational context

(context of situation) at the center of all discussions of meaning. The word *situation* (or more properly, *context of situation*) was used by John Rupert Firth to cover all the relevant circumstances in which a specific act of speech takes place. Also termed *extralinguistic context*, this referred to the entire situation in which an utterance is made (e.g., who is the speaker, who is the addressee, whether the delivery is formal or informal, the aim of utterance, the time of utterance, the location of utterance). In the analysis of a language, Firth (1957) thought, features recurring in individual utterances will be related to types of situation and to specific features in them.[2]

Blackburn (1994) offers a similar definition: "In linguistics, context is the parts of an utterance surrounding a unit and which may affect both its meaning and its grammatical contribution" (p. 80). He then adds that context also refers to "the wider situation, either of the speaker or of the surroundings, that may play a part in determining the significance of a saying." Angeles (1981) regards context as the totality of associations, preconceptions, and so forth that are closely related to a thing and influence one's perspectives, judgments, and knowledge of that thing. Accordingly, if something is seen in context (or put into context), it is considered with all the factors that are related to it rather than just being considered on its own, so that it can be properly understood.[3]

Clark and Carlson (1981) take context as information that is available to a person on a given occasion. Their intrinsic context (sometimes called the "common ground") refers to the totality of knowledge, beliefs, and suppositions that are shared by the speaker and the hearer.[4] Adopting a stance attributable to Leech (1981), we can say that "the specification of context has the effect of narrowing down the communicative possibilities of [a] message as it exists in abstraction from context" (p. 66). Thus, context has a disambiguating function,[5] for a so-called fleshing-out strategy – converting statements into decontextualized (eternal) sentences – cannot always be used. One seldom has full and precise information about the relevant circumstances.

Context has long been a salient issue in social studies of language; namely, how human beings employ language to build the social and cultural organizations that they inhabit. Lyons (1995) finds this inevitable: "In the construction of a satisfactory theory of context, the linguist's account of the interpretation of utterances must of necessity draw upon, and will in turn contribute to, the theories and findings of social sciences in general: notably of psychology, anthropology and sociology" (p. 292). Influenced by Firth, Goodwin and Duranti (1992) judge context as basic in ethnographical studies of language use. They claim that context "stands at the cutting edge of much contemporary research into the relationship between language, culture, and social organization, as well as into the study of how language is structured in the way it is" (p. 32).

2. Enter STASS

Situation theory is a theory of information content that takes context very seriously (Akman & Surav, 1996, 1997). Groundbreaking work on situation theory is due to the late Jon Barwise, noted logician, and John Perry, prominent philosopher of language. Barwise and Perry were the founders of Stanford University's Center for the Study of Language and Information (CSLI), which became almost synonymous with situation-theoretic research.[6]

The theory matured over the years. It was applied to a number of linguistic issues, resulting in what is commonly known as situation semantics. Situation semantics aims to construct a mathematically rigorous theory of meaning and the application of such a theory to natural language.[7] One is engaged in situation semantics if one is 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.

Situation semantics is based on the following general observation: in evaluating a certain statement, one needs not only certain indices like times and worlds (of possible-world semantics). As Recanati (2004) notes:

> *Why not also, for example,* locations*? If I say "It's raining," the location is unarticulated, but it is relevant* qua *feature of the circumstance of evaluation: what I say (or think) is true [if and only if] it's raining* at the contextually provided location. *Why not also consider the* agent *of the speech act (the speaker) or the thought act (the thinker) as (part of) the circumstance of evaluation, to handle cases in which the content to be evaluated is a property of agents which the speaker or thinker self-attributes? Why not extend [this approach] also to ordinary objects? If, talking about my car, the mechanic tells me "The carburetor is in good condition but there is a problem with the front wheels," my car is a crucial feature of the circumstance of evaluation. It is true (or false)* of my car *that the carburetor is in good condition, and so on. The same thing could have been said of another car, but as things turn out it is my car which figures in the [content] of the mechanic's utterance. (p. 122)*

Situation semantics does not impose man-made assumptions on our conceptual scheme.[8] This makes it enticing for a newcomer to the realm of semantics. It is burdensome for someone to embrace, say, Montagovian intensions (Dowty, Wall, & Peters, 1981), but situations have a certain conceptual clarity. Actually, situation semantics is a fine exemplar of what a naturalized theory of semantics should be like.

In the history of natural language semantics, there was a period when it was considered *bon ton* to distinguish meticulously between formal semantics and pragmatics.[9] If you worked on the former, you counted as doing idealized – as opposed to ordinary – language philosophy. Two important desiderata – truth conditions and compositionality – were crucial to the meaning of a declarative sentence. Originating in the work of Donald Davidson, knowledge of meaning of a sentence coincides with knowledge of truth conditions (i.e., what the world is to be like if the sentence is true). (It is noted that actual knowledge of truth conditions is not required.) Compositionality fastidiously maneuvers to determine the meaning of the sentence in terms of the meanings of its constituents (Pietroski, 2003; Pulman, 1997).

The ordinary-language approach, on the other hand, studied the activity of saying things.[10] Thus, one has speech acts to analyze and as one could no more ignore irony, metaphor, implicature, and so on, one has to consider the so-called speaker's meaning. Communication succeeds as soon as the intentions (the m-intentions of Paul Herbert Grice) of the speaker are recognized by the hearer.

Idealized approaches to semantics underestimated the role played by context; they ignored factors such as intentions and circumstances of the individuals involved in the communicative process. (Or rather, they placed them in the pragmatics wastebasket.) But linguistic devices like indexicals, demonstratives, and tenses rely heavily on context for interpretation and are fundamental to the way language carries information. A sentence can be used over and over again in different situations to say different things (the so-called efficiency of language).[11] 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 (the so-called perspectival relativity of language). The insistence of situation semantics on contextual interpretation makes it compatible with speech-act theory and discourse pragmatics.

Situation theory starts with a fundamental observation: reality consists of situations. A situation is a rich object consisting of individuals having various properties and standing in a variety of relations. It is, in a sense, a small world. We always find ourselves in situations. J. J. Gibson (1979) famously argued that perception was regulated by response to properties in the visual world. He thus embraced the position that most thinking depends on suitable responses to environmental demands (Turvey & Carello, 1986). Deep down, the Barwise-Perry stance is also an ecological one.[12]

Although situations are commonsensical entities on the one hand, they can be quite problematical as soon as we start asking probing questions about their fundamental nature. Devlin (1991a, pp. 31–32) exemplifies this by imagining a dialogue between two participants (John and David) about a particular football game they have both seen. John and David can have an extended discussion about this game while maintaining informativeness and avoiding disorientation or puzzlement. How is that possible? Neither John nor David can enumerate every bit of information that this particular game situation supports. Actually, this would make their postgame discussion superfluous and not very enjoyable. Thus, the following query of Devlin (1991a) becomes vital:

> *[I]f you were to interrupt John and David in the middle of their conversation and ask them* what *they were talking about, they would reply "Last night's football game." Are we then to conclude that they were in fact talking about nothing; or that neither was really sure* what *it was they were discussing? (p. 32)*

"Clearly not," Devlin replies, and mentions our inability to reduce situations to an amalgam of more familiar entities. Devlin considers the latter as one good explanation for people's disinclination to regard situations as bona fide objects. Devlin's question is in some sense relatively old. In discussions of vagueness in philosophy, vague objects have received considerable attention (Tye, 1990). Consider a certain mountain. Keefe (2000) notes that

> *any sharp spatio-temporal boundaries drawn around the mountain would be arbitrarily placed, and would not reflect a natural boundary. So it may seem that [the mountain] has fuzzy boundaries, and so, given the common view that a vague object is an object with fuzzy, spatio-temporal boundaries, that it is a vague object. (p. 15)*

It is not hard to generalize the approach briefly outlined above to situations of any kind. Although the description "last night's football game" does succeed in picking out a unique object, it is evident that that object (situation) has blurry spatiotemporal boundaries. Suppose John says, "The game was watched (in the stadium) by an even number of spectators." Because the woolly boundaries of the game situation, this should come out to be neither true nor false (hence indeterminate). Note that, in general, John and David would hardly ever argue about the truth of such statements. They are more likely to talk about matters regarding the Coke bottles thrown at the players or the colorful shirts worn by referees. In both of these cases, there can be little disagreement as to the truth value of the propositions under discussion.

Barwise and Perry were the first to formulate a full-fledged proposal about the use of situations for semantics, but it is worth mentioning that Austin (1979) saw the need for situations in his famous 1950 paper on truth. In this work, Austin makes key observations about statements. He notes that the making of a statement is a historic event: a speaker is uttering certain words (a sentence) to an audience with reference to a historic situation. Usually these words are used to talk about the world ("something other than the words"). This world exhibits similarities and dissimilarities; in an extremely chaotic or perfectly ordered world, there would be little to say. Austin then makes a fundamental distinction (1979, pp. 121–122) between descriptive and demonstrative conventions. The former correlate the words (sentences) with the types of situation, thing, or event

present in the world. The latter correlate the words (statements) with the historical situations and so on present in the world. The truth of a statement then simply reduces to this: the historical state of affairs with which the statement is correlated by the demonstrative conventions is of a type with which the sentence used in making the statement is correlated by the descriptive conventions. As a simple illustration of the idea, take a signpost that reads "Checkpoint ahead." This says that there is checkpoint ahead (descriptive conventions). The word *ahead* probably means something like a couple of hundred yards. The sign makes a true statement if there is indeed a checkpoint ahead (at a reasonable distance). It would be making a false claim if one encounters no such checkpoint.

3. Ontology

Individuals, properties, relations, and spatiotemporal locations are basic constructs of situation theory. Individuals are conceived as invariants; having properties and standing in relations, they tend to persist in time and space.

Infons (Devlin, 1992) are discrete items of information. They are denoted as $\langle R,a_1,\ldots,a_n,p\rangle$, where R is an n-place relation, $a_1,\ldots,a_n$ are objects appropriate for the respective argument places of R, and p is the polarity (0 or 1). If $p = 1$ (respectively, 0) then $a_1,\ldots,a_n$ stand (respectively, do not stand) in relation R.[13] A situation is a structured part of the reality that an agent manages to pick out. Situations are intensional objects. For this reason, abstract situations are proposed to be their counterparts amenable to mathematical manipulation. An abstract situation is defined as a set (Devlin, 1991c). Given a real situation s, the set $\{i|s \models i\}$, where i is an infon, is the corresponding abstract situation. Here, s is said to support an infon i (denoted as $s \models i$ above) just in case i is true of s.

A scheme of individuation – a way of carving the world into uniformities – is an essential aspect of situation theory. The notions of individual, relation, and spatiotemporal location depend on this. In other words, the basic constituents of the theory are determined by the agent's schema of individuation. Formal representation of these uniformities yields types. Situation theory provides a collection of basic types for individuating or discriminating uniformities of the real world: situation, infon, individual, n-place relation, temporal location, spatial location, type, and parameter. (We choose not to count polarities as types.)

Parameters are generalizations over classes of nonparametric objects (e.g., individuals, spatial locations). Parameters can be associated with objects that, if they were to replace the parameters, would yield one of the objects in the class that parametric object abstracts over. Hence, allowing parameters in infons results in parametric infons. For example, $\langle see,\hat{g},Alice,1\rangle$ and $\langle see,\hat{g},\hat{h},1\rangle$ are parametric infons where $\hat{g}$ and $\hat{h}$ stand for individuals. These infons are parametric on the first, and the first and second, argument roles of the relation *see*, respectively. (Their meaning can be rendered as "someone sees Alice" and "someone sees someone," respectively.) Anchoring (binding) parameters of an infon to objects yields parameter-free infons. For example, given $\langle see,\hat{g},Alice,1\rangle$, if $F(\hat{g})$ = Bob, then we obtain the parameter-free infon $\langle see,Bob,Alice,1\rangle$.

Given a situation s, a parameter $\hat{g}$, and a set of infons I (involving $\hat{g}$), one can define $[\hat{g}|s \models I]$ to denote the type of all objects for which the conditions imposed by I hold in s. This process of obtaining a type is type abstraction. Here $\hat{g}$ is the abstraction parameter and s is the grounding situation.

A situation s′ is part of another situation s just in case for all infons i, $s' \models i \rightarrow s \models i$. This relation is antisymmetric, reflexive, and transitive, and consequently provides a partial ordering of situations.

Situations in which a constituent sequence is assigned both polarities are incoherent. For instance, a situation s is incoherent if $\langle has,Alice,A\clubsuit,0\rangle$ and $\langle has,Alice,A\clubsuit,1\rangle$ are both supported by s. Although there cannot be a real situation

s validating this, the constituent sequence <has,Alice,A♣> may be assigned these polarities for spatiotemporally distinct situation types (say, s and s′).

Situation semantics makes simple assumptions about the way natural language works. Primary among them is the assumption that language is used to convey information about the world (the so-called external significance of language). Even when two sentences have the same interpretation (i.e., describe the same situation), they can carry different information.

Suppose Alice was eating ice cream yesterday. She is eating ice cream now. Both of these situations share the same constituent sequence <eat,Alice,ice cream>. These two events, occurring at different times, have the same situation type. Situation types can be more general. For example, a situation type in which someone is eating something at home contains the situation in which Alice is eating ice cream at home. If Alice is not present in the room where this chapter is being written, then "Alice is eating ice cream" is not part of the room situation s and hence gets no truth value in s. Thus, situation theory allows partiality.

To see this more clearly, imagine two games that are going on, one across town from the other. Alice is playing cards with Bob, and Carol is playing cards with David. Elwood, watching the former game, mistakes Alice for Carol, and mutters: "Carol has the ace of clubs." According to the classical theory, if Carol indeed has the ace, 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 the ace of clubs, respectively. In contrast, situation semantics identifies these objects with respect to some limited situation – the resource situation exploited by Elwood. Elwood's claim would then be false even if Carol held the ace in the other game.

Partiality makes it possible to distinguish between logically equivalent statements. For example, the statements "Bob is angry" and "Bob is angry, and Bob is shouting or Bob is not shouting" are logically equivalent in the classical sense. In situation semantics, these two sentences will not have the same interpretation. A situation s describing the circumstance in which Bob is only angry will not contain anything about Bob's shouting (i.e., s will be silent on Bob's shouting). However, another situation s′ obtained as the union of two situations ("Bob is angry and Bob is shouting" plus "Bob is angry and Bob is not shouting") will contain something about Bob's shouting.

To recap, in Tarskian 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, for 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.

4. Constraints

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 would have information about the situations it sees, hears about, believes in, and so on. Thus, on hearing Bob's utterance "A wolf is running toward you," Alice would have the information that her friend is addressing her with *you*. Moreover, by relying on the situation described by the utterance, she would know that there is a wolf fast approaching her. Alice would run away, having in possession the acquired knowledge that wolves are hazardous. She would activate this knowledge from the situation she finds herself in via a constraint – the link between wolves and their reputation as life-threatening creatures.

A network of abstract links between high-order uniformities (i.e., situation types) provides such information flow. The statement "Smoke means fire" expresses the lawlike relation that links situations where there is

smoke to situations where there is a fire. If s is the type of smoky situations and f is the type of fire situations, then having been attuned to the constraint s▶f, an agent can pick up the information that there is a fire in a particular situation by observing that there is smoke.[14] Anchoring plays a major role in the working of constraints. Cognitively, if the preceding constraint holds, then it is a fact that if s is realized (i.e., there is a real situation s_o of type s), then so is f (i.e., there is a real situation f_o of type f). To invoke the constraint, we have to use an anchoring function that binds the location parameters to appropriate objects present in the grounding situation (i.e., we have to first find a place and time at which there is smoke).

It is possible to identify three forms of constraints. Necessary constraints are those by which one can define or name things (e.g., every dog is a mammal). Nomic constraints are patterns that are usually called natural laws (e.g., blocks fall unless they are supported). Conventional constraints are those arising out of the customs that hold within a community (e.g., the first day of the month is payday). These are neither nomic nor necessary (i.e., they can be violated). All types of constraints can be conditional or unconditional. Conditional constraints can be applied to situations that fulfill some condition, and unconditional constraints can be applied to all situations.[15]

5. Meaning

Meaningful expressions are used to convey information not only about the external world but also about our minds (the so-called mental significance of language). Clearly, language could not work if it did not have information significance – if it were not about matters in a public world. 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 belief situation. If Alice is certain that he is hallucinating, then she cares about 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). To appreciate this point, consider the sentence "The wolf is approaching." Understanding what situations this sentence describes is essential to grasping its meaning. One such concrete situation is the one Bob is currently facing. But there are countless other (potential) situations that can be described in the same way. In other words, on hearing this sentence in our mind's eye are evoked all those situations accurately described by it. Now take the sentence "Bob wants a big stick," expressing a certain wish of Bob. It may be possible to understand this by trying to imagine all those private (internal) mental states of Bob correctly described by it. However, it is much more meaningful (less baffling) to resort to public situations for an explanation. Thus, Bob wants to achieve (arrive at) a situation in which he is holding a big stick. This he normally does by looking around to find something like that or by (creatively) crafting one – say, by breaking a tree branch – when he is not able to locate one lying on the forest floor.

In situation semantics, propositions are conceived as situations, and propositional attitudes are characterized as relations to such situations. To believe that a particular wolf is dangerous is then to stand in a relationship to that wolf and the property of being dangerous. Several researchers concur that major difficulties threaten the situation-theoretic rendering of propositional attitudes. Davis (2003, pp. 351–352) cites what he calls Frege's and Russell's problems: "Frege's problem arises from the intensionality of propositional attitude contexts, the fact that substitution of coextensive terms in such contexts does not always produce equivalent statements. Someone can believe that Cary Grant is famous, for example, without believing that Archibald Leach is.[16] Russell's problem arises from the intentionality of propositional attitudes, the fact that

people can think about nonexistent objects and have other propositional attitudes concerning them. Many children believe that Santa Claus brings presents at Christmas, even though Santa Claus does not exist."

Davis notes that common responses to the former problem typically dispose of the view that propositional attitudes are relations between individuals and situations. Rather, such attitudes are assumed to be relations connecting individuals, situations, and modes of presentation (i.e., ways of believing).[17]

In their thorough account of propositional attitude reports, McKay and Nelson (2005) make similar claims:

> *Recall that one of the problems facing naive Russellianism was that*
>
> *Lois believes that Superman is stronger than Clark Kent.*
>
> *threatens to entail*
>
> *Lois believes that Superman is stronger than Superman.*
>
> *which in turn threatens to entail*
>
> *Lois believes that Superman is stronger than himself.*
>
> *Because the situation that Superman is stronger than Clark Kent just is the situation that Superman is stronger than himself, these are the same beliefs. The situation semanticist cannot appeal to the difference between the property of being taller than Superman and the property of being taller than oneself, as the neo-Russellian can, to distinguish the properties. This is because a difference in structure doesn't correspond, for the situation semanticist, to a difference in proposition. But then the situation semanticist, as opposed to the naive Russellian, is committed to the claim that Lois believes that Superman is stronger than himself. But surely that is irrational!*

According to situation semantics, 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 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, and so on. The utterance situation u constrains the world in a certain way, depending on how the roles for discourse situations, connections, and described situations are to be filled. For instance, an utterance of "I am trembling" defines a meaning relation:

$$d, c \parallel \text{I am trembling} \parallel e.$$

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

Besides discourse situations, the interpretation of an utterance depends on the speaker's connections with objects, properties, times and places, and on the speaker's ability to exploit information about one situation to obtain information about another. Therefore, 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. Resource situations are contextually available and provide entities for reference and quantification.

In interpreting the utterance of an expression S in context, there is a flow of information, partly from the linguistic form encoded in S 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 others satisfying the constraints. The meaning of an utterance of S and hence its interpretation are influenced by other factors such as stress, modality, and intonation. However, the situation in which S is uttered and the

situation e described by this utterance seem to play the most influential roles.

In the remainder of this chapter, we give two applications of situation semantics. The first application is situated inference. This application is presented after the following section, which introduces some background material. The second application is literary interpretation.

6. Oracles

Let G be a collection of parametric infons. G provides one with a framework for conversing about some part of the world (or the whole world). By anchoring the parameters in an infon belonging to G, an item of information is obtained.

Given an individual or a situation s, the G-oracle of s, denoted as O(G,s), is the situation comprising that part of the world and the entire body of knowledge that concerns s. This is relative to a set of issues (i.e., it is understood to be meaningful within the framework provided by G). Thus, different sets will enable one to talk – and glean information – about different aspects of the world.[18]

Oracles were invented by Devlin (1991a):

> *Just as various kinds of number (e.g., complex numbers) 'exist' because we postulate their existence (in the mathematical realm), so too with oracles. As with different kinds of number system, oracles are intended to provide a theoretical construct that corresponds to a certain feature in the world being studied. In this case, the 'feature' concerned is the situation comprising precisely those objects and facts of relevance to a given individual or situation. (p. 48)*

If we stick to the classical assumption that among the situations available there is a unique, maximal situation ω – in STASS, ω is commonly known as the world – then the following can be stated. For any G-infon i in which only objects that are the constituents of O(G,s) occur, $O(G,s) \models i$ if and only if $\omega \models i$. One particularly natural way to understand this is as follows. If the only kind of information available to an agent is that supplied by G, then O(G,s) cannot be distinguished from ω.

As an illustration, consider the Jerry Fodor oracle O(G,*Fodor*), for an appropriate G. Stretching back in time to include his granny, and forward in time to include his grandchildren, it will contain Fodor's birthplace, his favorite books (including *The House at Pooh Corner*, of course!), positions he has held, students he has taught, and so on. One key observation has to do with the extent of this oracle. Different people at different times may have access to different information about it. Ernie Lepore must surely know more about it than I do, for I never met Fodor but am familiar, to some degree, with his oeuvre. Fodor himself will know considerably more about it, though a biographer of this philosopher may unearth facts that could be news even to Fodor.

Various observations regarding oracles can be stated (Devlin, 1991b):

- Oracles are situations. This necessitates that an agent would have only partial information about a particular oracle.
- Oracles (ipso facto, situations) make little sense if one tries to specify them in terms of which infons they support. The right way to specify an oracle is in terms of a description that is less primitive.
- In natural language, a single word or phrase can bring into focus an entire oracle situation corresponding to an individual.
- The more information two agents share about an oracle, the more efficient is the communication between them.[19]

7. Situated Inference

As noted in the preceding section, a set of issues is a collection of parametric infons that provide us with an information-theoretic framework for discussing the world or some part of it. By anchoring the parameters in this set, we obtain an item of information. Clearly, using different sets of

issues, we can talk about different aspects of the world. For example, when talking about Bob in the context of a colloquium in Hawaii (PHIL '05), we may include stuff like his being the organizer of the colloquium, things that happened to him around the time of the colloquium, the personal characteristics of Bob that help one recognize him, and so on. However, what happened to Bob when he was five years old is probably not included in the set of issues (unless his colloquium talk is about his experiences in his early youth).

For example, O(G,Bob) contains (this is a very brief list):

$$<\text{organize},\text{Bob},\text{PHIL'05},1>$$
$$<\text{go},\text{Bob},\text{Hawaii},2005,1>$$
$$<\text{male},\text{Bob},1>$$

G is, in some sense, a template of information which determines what portion of O(G,Bob) is to be considered. O(Bob) may contain a large amount of information about the medical state of Bob, but if G does not discuss these issues, O(G,Bob) would not include such information.

Because we need a notion of relevance here, we consider Sperber and Wilson (1986), in which relevance is psychological relevance of a proposition to a context. Their assumption is that people have intuitions of relevance (i.e., they can consistently distinguish relevant from irrelevant information). A proposition is relevant to a context if it interacts in a certain way with the (context's) existing assumptions about the world (i.e., if it has some contextual effects that are accessible). These contextual effects include the following[20]:

1. Contextual implication: a new assumption can be used together with the existing rules to generate new assumptions.
2. Strengthening: a new assumption can strengthen some of the existing assumptions.
3. Contradicting or eliminating: a new assumption may change or eliminate some of the existing assumptions.

Sperber and Wilson talk about degrees of relevance. Clearly, one piece of information may be more relevant to a particular context. Their following definition does the job: "An assumption is relevant in a context to the extent that its contextual effects in this context are large. An assumption is relevant in a context to the extent that the effort required to process it in this context is small" (Sperber & Wilson, 1986, p. 125).[21] To estimate relevance, we can try to measure the relevance of i to G. Here, we use the criterion proposed by Sperber and Wilson; namely, maximum contextual effect and minimum processing effort.[22] We interpret the effects of i on G as contextual effects. An infon is relevant to a context if it has some contextual effects on the context with a small-sized anchoring. It is irrelevant to a context if either it has no contextual effect on the context or otherwise some contextual effects with a large-sized anchoring.

Let us consider a context that contains the regularity "Birds fly." We represent this as

$$b = [\hat{s}|\hat{s} \models <\text{bird},\hat{y},1>]$$
$$f = [\hat{s}|\hat{s} \models <\text{fly},\hat{y},1>]$$
$$b \blacktriangleright f$$

The infon i = <bird,Tweety,1> is relevant to this context, as with the anchoring $F(\hat{y})$ = Tweety we can conclude that Tweety flies. The size of anchoring is 1, and thus the processing effort is minimal.

Consider now the following dialogue between Carol and Bob:

> Carol: Did you see the fight in the baseball game on Foo TV last night?
> Bob: I always watch Foo TV.

Did Bob see the fight? We begin by noting that Carol's utterance carries the following presupposition: A baseball game was shown on Foo TV last night. Additionally, we are aware of the (commonsense) rule: If some event is broadcast on a TV channel and someone watches that channel, then he or she also sees the event. The encoded

versions of the first three items of information are, respectively, <see,Bob,the fight,?>, <watch,Bob,Foo TV,1>, and <show,Foo TV, the baseball game,1>. The constraint suggested by the commonsense rule is b►e, where b = [ŝ|ŝ ⊨<show,ŵ,û,1>&ŝ ⊨ <watch, ŷ,ŵ,1>] and e = [ŝ|ŝ ⊨<see,ŷ,ŵ,1>]; using the anchoring F(ŷ) = Bob, F(ŵ) = Foo TV, and F(û) = the baseball game, we achieve a contextual effect (i.e., the invocation of the constraint) and conclude that Bob saw the fight (i.e., the polarity denoted with ? above is 1). (Clearly, the fight situation is a part of the game situation.) Notice that the size of the anchoring is 3 this time.

8. Interpretation

In his work on literary criticism, Barwise (1989a) suggests a mock equation (a constraint C) to relate the basic constituents of content:

$$C(R,S,c) = P.$$

Here, S is a sentence and c is the situation in which S is used. R is defined as the language conventions holding between an author and a reader (or better yet, his readership). P is the content of S (i.e., the intended meaning). We assume that the communication between an author and a reader is limited only to written text. Thus, it is not feasible to ask the author about his intention for writing S; that will have to be discovered by a reader. For many kinds of written material, P is a single intended meaning (attributable to a determinate author). However, in most literary works and especially in poetry, authors may aim, for assorted reasons, at more than one intended meaning. The richness of a literary work may be rooted in its being ambiguous or multifaceted. All the parameters in the previous constraint are at the writer's disposal. He or she can play with them, as long as the constraint is satisfied. (Obviously, if the writer experiments with R – a fitting example would be *Finnegans Wake* – he has less chance of being understood.) Thus, the reader of a literary text S is faced with one equation in three unknowns: R, c, and P. Usually, the solution is not unique. The task of literary interpretation is to use the available information about the unknowns (e.g., biographical material, information about the culture in which the writing took place, etc.) to circumscribe the range of their possible values.[23]

Let the right-hand side of Barwise's equation be a set of possible intended meanings. These are clear to the author – we presume – during the writing activity but may be cumbersome to discover later.[24] An author of fiction creates an artificial circumstance at first and builds his or her work around that. The author has something in mind and wants to share this with readers; the author has an intended meaning P. To achieve P, the author determines the elements of circumstance that fit best to his or her needs. Here, the author can choose to play with the rules of language. This is also the point where the author makes either implicit or explicit assumptions about the language conventions (Percy, 1975).

A reader, picking up the written material in his hand, normally reads it from beginning to the end. Therefore, ideas frequently descend on him as they are written (sequentially). And more often than not, a reader understands the text at first pass; the reader does not go through the text over and over again to bind variables, rewrite portions, reorder passages, make optimizations, and so on.

From the perspective of a reader, the author could have intended almost any meaning. This can be denoted with the cardinality of intention space being large. If a reader is familiar with the language conventions, we assume that he or she can read say, a book. Here, if the text is accessible, we can claim that the world the book presents can be built in the intention space of the reader. The reader may read sequentially, may skip pages or chapters, or may choose to browse. The intention space, with every element that is added, acquires new restrictions. The reader in turn begins to understand what the author is saying in the book.

Ambiguity comes in two kinds. The first is due to large intention spaces and the other to incompatible intentions. The former can be exemplified by the so-called open texts (Eco, 1979). In such texts, the openness stems from size: the intention space cannot be fully circumscribed in a reader's mind. The author does not write something to mean something definite in an open text. Rather, the author writes to keep his or her intention space large so that reader can consume only a portion of that. (And just what that portion might be is up to the reader.)

The second kind of ambiguity is in fact an incompatibility problem. In general, being a reader makes one divide the intention space into parts and discard irrelevant parts. The criterion to discard some part in favor of another seems to be the exact problem of understanding texts.

Authors must also assume some familiarity on the part of a reader with the concepts they write about, and this assumption lies between the borders of R and c. Because this kind of familiarity is usually counted among the language knowledge, there will not be a clear distinction between c and R in these cases. If the author is telling us about some planet and assumes that a reader knows the meaning of the word *planet*, does he or she assume something for R, as the author assumes the reader must know what a planet is? Or does the author assume something about c, that is, if the reader knows what a planet is, the reader must be able to infer some knowledge about the circumstances mentioned in the work?

To cope with this problem, we can accept R and c as mutually exclusive, and define c as the special part of circumstances that are used in the work and R as the remaining part of the language. This is a hard-and-fast solution but does not present us with a standard about separating c and R. (Thus, the assumptions underlying children's books and Shakespeare's plays are not the same.) To produce some standard about the separation of c and R, one must come up with explicit definitions. Definitions may be reader oriented and follow the rules in the mind of a generic reader (i.e., the model reader of Eco) or writer oriented and follow the rules of the author.

9. Brief Guide to the Literature

Two book-length treatments of STASS are Barwise and Perry (1983) and Devlin (1991a). Although somewhat dated, the former is packed with excellent semantic common sense.[25] The latter proposes a standard vocabulary and pays close attention to the foundations; it is the only modern introduction to STASS, together with the most recent (Devlin, n.d.). Devlin also wrote accounts of STASS, mostly oriented toward the layperson (cf. Devlin, 1998, 2001). Seligman and Moss (1997) is a survey of situation theory that is mathematically demanding; it also has a good bibliography of technical papers.

Various versions of situation theory have been applied to a number of linguistic issues arising in English (Stucky, 1989). Barwise (1986, 1987) has written especially important papers in that they study classical areas of semantics such as conditionals, quantifiers, and anaphora. The ideas emerging from research in situation semantics have also been combined with well-developed linguistic theories, leading to rigorous formalisms (Fenstad, Halvorsen, Langholm, & van Benthem, 1987).

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) focus on the semantics of pronominal anaphora and quantification. They argue 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) offers detailed studies of linguistic problems to which situation semantics has been applied with some success. Tin and Akman (1996) show how situation theory can be given a computational twist. They offer

a prototype to study practical problems, including anaphora resolution. Devlin and Rosenberg (1996) explore applications of situation theory to human-computer interaction.

Three early conference proceedings specifically devoted to developments in STASS are Cooper, Mukai, and Perry (1990), Barwise, Gawron, Plotkin, and Tutiya (1991), and Aczel, Israel, Katagiri, and Peters (1993). Today it is possible to find situation-theoretic work dispersed in conferences on logic, language, and information. Thus, despite what Partee (2005) asserts in her intellectual autobiography, today STASS is alive and well.[26]

10. Conclusion

For an expression to have meaning, it should convey information. On the basis of this fundamental insight, situation semantics develops a theory of meaning that is based on relations between situations. In analyzing a speech act S, situation semantics looks at various situations (e.g., discourse situations, resource situations) that contribute to the meaning of S. Doing so makes it possible to describe the meaning of both expressions and mental states in terms of the information they carry about the external world.

Situation semantics provides a fundamental framework for realistic semantics. The ideas emerging from research into situation semantics have been combined with linguistic work and have led to numerous useful proposals. This chapter gave only a glimpse of this exciting activity. Interested readers should consult the literature for a deeper appraisal.

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Notes

1 William Isaac Thomas argued that so-called social reality is essentially the totality of these constructions. He thought that social situations never repeat themselves. Every situation would be more or less novel in that it would include new human activities differently put together.

2 Not surprisingly, the word *situated* has also been used in artificial intelligence. Humans, delivery robots, and automated factories are all systems that have an intelligent, ongoing interaction with environments that are dynamic and imperfectly predictable. Such systems are often called "situated agents" (Rosenschein & Kaelbling, 1995). Rosenschein and Kaelbling present a particular approach to the design of situated agents. The approach is based on situated-automata theory and permits designers to use high-level language constructs to describe the informational content of agents.

3 Conversely, if a remark, statement, and so on, is taken or quoted out of context, it is considered only on its own and the circumstances in which it was said are ignored. It, therefore, seems to mean something different from the meaning that was intended.

4 Manfred Pinkal says this about the potential size of a context:

> *Aside from the surrounding deictic coordinates, aside from the immediate linguistic co-text and accompanying gestural expressions at closer view, the following determinants can influence the attribution of sense: the entire frame of interaction, the individual biographies of the participants, the physical environment, the social embedding, the cultural and historical background, and – in addition to all these – facts and dates no matter how far removed in dimensions of time and space. Roughly speaking, 'context' can be the whole world in relation to an utterance act. (Asher & Simpson, 1994, p. 733)*

5 Leech (1981): "The effect of context is to attach a certain probability to each sense (the

complete ruling-out of a sense being the limiting case of nil probability)" (p. 67).

6 In the beginning, the development of situation theory was hampered by a lack of appropriate modeling tools. Later, the theory assembled its foundations from innovations coming from nonstandard set theory (for a clear account, see Barwise & Etchemendy, 1987). Barwise and Seligman (1997) further advanced the theory by introducing the idea of an information channel, which preserves information as it is transmitted through a system. Historically, this idea can be said to originate from Dretske's (1981) groundbreaking work on information content.

Devlin (2004) gives a general appraisal of STASS. This work may be consulted to get a better feel of the historical developments that shaped STASS. Many of the papers cited by Devlin can be found in Barwise (1989b).

7 In the rest of this chapter, we will use "situated semantics" and "situation semantics" interchangeably.

8 Barwise and Perry (1983) thought that "notions like logical form, logical constant, proper name, quantifier, variable, quantifier scope, opaque or transparent contexts, de dicto and de re readings, sense and reference, intension and extension, meaning postulate, possible world, rigid designator, truth conditions and T-sentences, and tense operator are all technical or pseudo-technical notions introduced by philosophers and logicians" (pp. xi–xii).

9 When Alfred Tarski invented model-theoretic semantics for first-order logic, he in a way opened the road to the semantics of natural language. In the Tarskian approach, logical sentences are interpreted in terms of a model. Because of the nature of classical logic, this implies that sentences come out true or false in such a model. Richard Montague believed that the techniques of formal semantics, as applied to systems of logic, were also suitable to ordinary language. In Montague's theory, syntax of language is modeled via a grammar. Syntactic rules are then associated with semantic rules that deliver the interpretation of a sentence from the interpretations of its parts (Kamp & Reyle, 1993). The Montagovian approach is a three-stage process (the upcoming description is somewhat crude but not incorrect). First, language expressions are syntactically analyzed using a categorial grammar. Then the outcome of this analysis is massaged into expressions in a tensed intensional logic. Finally, the latter expressions are interpreted with respect to a model. The oft-cited problem with this approach is that the truth conditions of a sentence are relative – to an interpretation, a world, and a time (Lepore, 1982).

10 Newcomers to linguistics are frequently surprised that linguists regard language as a living organism and thus invariably prefer to study spoken language.

11 Ambiguity is another aspect of the efficiency of language. Some natural language expressions have more than one meaning. There are factors such as intonation, gesture, the place of an utterance, and so on, which 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 a full-fledged theory of linguistic meaning.

12 Butterworth (1998):

> *On the ecological view, perception is necessarily situated within the ecology since it consists in obtaining information from the active relation between the organism and a structured environment. Indeed, it is a process of perception that situates the organism in the environment. The evidence from infancy suggests that perception is a 'module' or component of the cognitive system that is antecedent to thought and language and that may contribute to the mastery of reasoning. (p. 29)*

13 If R is an n-place relation and $a_1, \ldots, a_m$, $m \leq n$, are objects appropriate for the argument places R, and if the filling of these argument places is sufficient to satisfy the minimality conditions for R, then $\langle R, a_1, \ldots, a_m, p \rangle$ is a well-defined infon. Minimality conditions for a particular relation are the collection of conditions that determine which particular groups of argument roles need to be filled to produce an infon. If $m < n$, the infon is said to be unsaturated; if $m = n$, it is saturated.

14 We are slightly abusing the notation here. In fact, s▶f is shorthand for the factual, parameter-free infon <involve,s,f,1>.

15 Consider a man meeting with a real-estate agent who is going to show him an apartment for rent. When they enter the building, he

smells gas and warns the agent, a smoker, not to light a cigarette. What happened? This scenario is taken from Hunt (1999):

> *My brain contained an internal representation of the physical state of the room and the habits of my companion. Processes internal to the brain constructed a second brain state that depicted a potential explosion. For each brain state there was an interpretation in terms of correspondence between properties of the brain state and a property of the external world. Further brain processes operated on the first and second states to produce a third state that initiated the external warning to my companion. (p. 9)*

We can restate the story in terms of situated cognition. When something is situated, it is put in a certain position or circumstances. Conversely, to situate something is to establish or indicate the place of it, or to put in a context. Thus, Hunt was placed in a particular circumstance where his thinking clearly depended on a specific response to the demands of the environment.

16 In making this claim, Davis (2003) offers the caveat that he is interpreting belief descriptions opaquely (rather than transparently).

17 Davis (2003, pp. 352–353) is also careful to point out that Frege's and Russell's problems still arise in classical possible-world semantics, where propositional attitudes are characterized as relations between individuals and sets of possible worlds (and where propositions are defined as world sets).

18 Using $\models$, a technical definition of oracles is possible. Let the term *G-infon* denote any infon that results from anchoring the parameters in an infon in G. Then O(G,s) is the minimal situation s such that $s \models i$ for any factual, parameter-free G-infon i that genuinely involves s.

19 This is crucial in the case of celebrities, as Crimmins (1992) observes: "Agents who are normal members of our society are almost certain to have notions of very famous individuals" (p. 92).

20 Here, context is a psychological construct that represents an individual's assumptions about the world at any given time and place and is supposed to include information of the following kinds:

Logical: the inference rules (according to Sperber and Wilson, these rules are deductive)

Encyclopedic: information about objects, properties, and events

Lexical: rules that allow us to interpret the natural language utterances and sentences.

21 The measurement of contextual effects and processing effort is difficult (Sperber & Wilson, 1986):

> *The problems involved in measuring contextual effects and processing effort are, of course, by no means specific to relevance theory or to pragmatics. They affect psychology as a whole. However, for relevance theory these problems take on a more specific form. Within relevance theory, the problem is not so much to assess contextual effects and processing effort from the outside, but to describe how the mind assesses it own achievements and efforts from the inside, and decides as a result to pursue its efforts or relocate them in different directions. (p. 130)*

22 Mental operations of humans are, in general, similar to what an anchoring function does: humans individuate relations and objects and fill the gaps in the relations with appropriate individuals, and reason over them. On the other hand, finding an appropriate anchoring function that creates the desired contextual effects might be difficult.

23 This approach can be generalized to coherent multisentence discourse. Allen (1995) explains:

> *A discourse is coherent if you can easily determine how the sentences in the discourse are related to each other. A discourse consisting of unrelated sentences would be very unnatural. To understand a discourse, you must identify how each sentence relates to the others and to the discourse as a whole. It is this assumption of coherence that drives the interpretation process. (p. 465)*

The idea is that each new sentence should be interpreted (as a minimum) in the context provided by the sentences neighboring it.

24 This applies even to an author himself. Many of us have suffered in those situations where we see a note we have scribbled a month ago and spend a lot of time just to recover our original intention in writing it.
25 Lindström (1991) offers a thorough critique of this book.
26 We thus find the following claim in Partee (2005) unnecessarily harsh:

> *Barwise and Perry's work, on the other hand, while starting off from some very interesting ideas about "scenes" and "situations" as ontologically important categories to include in the foundations of semantics . . . suffered from . . . problems that made it become less attractive to many of us than it seemed like it was going to be. . . . Some scholars have continued to develop Barwise and Perry's situation semantics, and certain of its ideas were readily borrowed into other approaches, but it soon became peripheral as a wholesale theory.*

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