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ON VAGUENESS

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Abstract

It seems to be a foregone conclusion that natural language meanings are vague. Much depends, however, on the way meaning is analyzed. For example, should vagueness of meaning be treated in terms of the truth- or denotation-conditions of expressions? Rather than proposing yet another 'fuzzy' or multi-valued logic, the present paper investigates the nature of **reference** *and* **truth**. *We consider two possible interpretations of the formal model structures used in formal semantics. One is called the paradigm I approach, according to which the model structure is interpreted as a representation of reality (such that the speaker/hearer is part of the model structure). The other is called the paradigm II approach, according to which the model-structure is interpreted as a representation of conceptual meaning structures (such that the model structure is part of the speaker/hearer). It is shown that the theoretical nature of vagueness is totally different in the two paradigms. In conclusion, a number of standard examples of vagueness are analyzed within the paradigm II approach, including the so-called Sorites paradox or paradox of the heap.*

0. Introduction

It is often claimed that one difference between natural languages, like English or German, and formal languages, like predicate calculus or intensional logic, is that the former are inherently vague and inconsistent. This view is not limited to logicians who regard formal languages as a means to escape what they perceive as the pitfalls and irregularities of natural languages, but may also be found among linguists whose primary concern is the analysis of natural languages. George Lakoff (1972), for example, claims that "natural language concepts have vague boundaries and fuzzy edges and that, consequently, natural language sentences will very often be neither true, nor false, nor nonsensical, but rather true to a certain extent and false to a certain extent, true in certain respects and false in other respects." (op.cit. p. 183).

What are the consequences of this widely accepted view? If sentences are not true or false simpliciter, but true or false to a certain degree, then the traditional two-valued logic systems do not suffice, but must be extended into many-valued logics. And indeed, when we look at different proposals to treat vagueness, such as Lakoff

(1972), Kamp (1975), Blau (1977), Pinkal (1981), Kindt (1982), and others, we find that the premises inherent in Lakoff's formulation quoted above are accepted. The concern of these authors is the construction of different multi-valued systems. These multi-valued logics differ insofar as they borrow motivation and/or formal proposals from different other areas, such as probability or measurement theory à la Kolmogorov (Kamp), mathematical topology (Kindt), supervaluations (Pinkal, Kamp), fuzzy logic à la Zadeh (G. Lakoff), or three-valued logic in the tradition of Lukasiewicz (Blau).

But what is the common premise underlying these formal approaches to vagueness? And does it adequately capture the intuitive nature of vagueness? Let us illustrate the common premise underlying the above mentioned proposals with a few examples: When we observe the process of slowly closing the door, then, we are told, this raises the question at what point the sentence *The door is open.* is still true and at what point the sentence is false. One may even feel impelled to ask to what *degree* the sentence is true or false at the various stages of closing the door. And similarly for the sentence *The door is closed.*

Another situation in which logicians and linguists have found vagueness is the classification of colours. If an object is called *red* in some context, but non-*red* in another context, does it not follow that the natural language concept of *red* is vague? Indeed, if we consider applying the predicate 'x is red' and 'x is orange' to the transition from red to orange on a colour spectrum, the problem is similar to the first example.

The same considerations may be applied in the evaluation of an adjective like *big*. How much bigger than the average fly must Xerxes be in order for the sentence *Xerxes is a big fly.* to be true? Note however, that the question of degrees of truth and the related question of vagueness of certain words must be clearly distinguished from certain other issues frequently brought into the discussion, namely the intensionality of certain adjectives. The fact that *Xerxes is a big fly.* does not entail *Xerxes is a big entity.* has nothing whatsoever to do with the vagueness of *big*. After all, there are also vague predicates like *red* which are completely extensional. Thus *Xerxes has red eyes.* clearly entails *Xerxes' eyes are red entities.* And conversely, there are adjectives like *alleged* or *fake* which are intensional but vague.[1]

The present paper deals solely with the intuitive nature of vagueness and the proper formal implementation o vagueness within model-theoretic semantics. As such it will be concerned with the nature of *reference*. The syntactico-semantic treatment of comparatives (e.g. 'x is bigger than y') the distinction between intensional and extensional predicates, and other questions of this kind will be left to other occasions.

Our treatment of vagueness proceeds from different basic assumptions than the aforesaid approaches in that for us vagueness is essentially a pragmatic phenomenon. We will show that the construal of semantic vagueness in the above examples is an artefact of a misguided ontological interpretation of model-theoretic semantics. For us, neither the literal meaning of *The door is open.* nor of *This stone is red.* is vague. Vagueness does not arise in the literal meaning concepts of natural language concepts (pace Lakoff), but rather in the pragmatic process of reference, which we define as the matching relation between the sharply defined concepts of natural language meanings (so-called icons) and the contextual objects to which these icons refer. Thus we propose to treat vagueness in terms of the pragmatic notion of language use (reference) rather than the semantic notion of truth- or denotation-conditions.

Our analysis of vagueness differs from the traditional treatments within formal logic in that it does not add yet another multi-valued system to those already in existence. This is not because we agree with certain conservative logicians who want to retain traditional two-valued systems and/or see no use in the logical analysis of natural language meaning. On the contrary, we believe firmly in the model-theoretic analysis of natural language meaning within the general framework of Montague grammar. Furthermore, we have been using non-bivalent logic (namely a presuppositional intensional logic based on partially defined functions and logical connectives defined à la Kleene) in order to describe so-called P-induced semantic presuppositions (Hausser 1976).

But whereas semantic presuppositions are a denotation-conditional property of natural surface expressions, vagueness is not. For this reason it is mistaken to treat presupposition failure and vagueness in terms of the same formal system, i.e. a semantics based on multi-valued logic. The origin of this mistake is the failure of traditional model-theoretic systems to distinguish between semantics and pragmatics. Semantics deals with the truth- (or rather denotation-) conditional analysis of the literal meaning of natural language expressions. Pragmatics, on the other hand, analyses the use of natural language expressions by a speaker/hearer relative to a context.

In order to give our alternative approach to vagueness a precise characterization within model theory, we consider in section 1 different possible interpretations of existing model-theoretic systems. One possibility is treating the model structure as a representation of reality, with the consequence that the speaker/hearer(s) are part of the model structure. This approach is the presently most widely accepted interpretation of the model structure and will be called the paradigm I approach. The other possibility is treating the model structure as something conceptual, with the consequence that the model structure is part of the speaker/hearer (formalized as a speaker simulation device or SID). This second ontological interpretation of the model structure has been advocated in Hausser (1980, 1981a, b, 1982) and will be called the paradigm II approach.

One important advantage of the paradigm II approach is the clear separation of the semantic and the pragmatic interpretation of a token. The semantic interpretation consists (roughly speaking, cf. section 3 for details) in the SID-internal construction of a model that makes the sentence true (the so-called token model). The pragmatic interpretation, on the other hand, consists in matching the token model with the so-called context model, defined as what the SID perceives and remembers at the moment of interpretation. It is this particular set up of the paradigm II approach that provides the basis for our alternative treatment of vagueness.

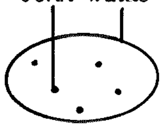
After describing the basic features of the paradigm I and the paradigm II approach in section 1, we turn in section 2 to a comparison of the two paradigms, especially with regard to the respective treatment of truth and vagueness. In section 3 we show that presupposition failure and vagueness are completely different phenomena in a paradigm II system. Section 4 discusses the treatment of several examples of vagueness in a paradigm II system and proposes a solution to the so-called Sorites paradox.

1. Formal model theory and its ontological interpretation

What is the nature and the function of a formal model in logic? Logic originated as a theory of deduction. The goal was and is to derive valid conclusions from given premises. Thereby, two types of sentences are distinguished. Those which are true (tautologies) or false (contradictions) solely on the basis of their syntactic structure. And those whose truth-value depends on the 'situation' to which they refer (contingent sentences). For example, the sentence *John walks or John does not walk.* is always true because of its tautological structure, but the sentence *John walks.* depends for its truth-value on the situation under consideration.

Model-theoretic semantics (in the tradition of Wittgenstein (1922), Carnap (1947), Kripke (1963), and Montague (1974)) provides a formal (set-theoretic) description of the situations relative to which contingent sentences may be interpreted. We say *John walks.* is 1 (true) relative to a model $@^n$ if the denotation of *John* in $@^n$ is an element of the set denoted by *walk* in $@^n$:

(1) *John walks*



In this sense, model theory provides for a truth-conditional (or denotation-conditional) characterization of the meaning of contingent sentences (as well as their parts). But it is obvious that this set-up does not provide for a distinction of *semantics* (literal meaning of expressions) and *pragmatics* (use of the expressions by a speaker relative to a context).

(1) illustrates the most basic type or model $@^n =_{def.} (A,F)$, where A is the set of individuals (or entities), and F is a denotation function which assigns each constant of the language (e.g. *John*, *walks*, *unicorn*,

etc.) an element of $A \cup 2^A$ whereby the semantic type of the denotation must correspond to the category of the constant.[2]

For the purposes of modal and tense logic, the basic model $@^n$ may be expanded into a *model structure* $@ =_{def.} (A,I,J,\leq,F)$ (e.g. Montague 1974, PTQ). Here, A and F are defined as in $@^n$, I is a second basic set, regarded as a set of possible words, J is a third basic set, regarded as a set of moments of time, and $\leq$ is the linear ordering on J (so that for any two moments j_1, j_2, we can say whether j_1 is earlier than j_2 or not).

Model structures permit not only the definition of modal and tense operators, but also a formal reconstruction of the Fregean distinction between sense (Sinn) and denotation (Bedeutung). This, in turn, permits the treatment of so-called intensional predicates (cf. Montague 1974, PTQ) or opaque contexts. As far as the distinction between *semantics* (literal meaning of expressions) and *pragmatics* (use of expressions by a speaker relative to a context) is concerned, however, 'intensional' model structures $@$ fail in the same way as the 'extensional' models $@^n$.

1.1 Reference and ontology

Model theory as described above is very well suited to account formally for certain aspects of natural language meaning, such as implication relations among sentenctes (under the assumption of their literal interpretation). But how should model theory be expanded to handle vagueness? In order to answer this question we must first clarify:

(3a) what the models $@^n$ and the model structure $@$ are supposed to stand for, and
(3b) how reference, i.e. the relation between an expression and the object referred to, is supposed to come about.

These two questions are clearly related. Reference is usually defined as the relation between the language expression and the corresponding object of the model structure. If the model structure is interpreted as a representation of (actual or - in modal systems - possible) reality, then reference constitutes the whole relation between the language expression and the objects of the (model-theoretically simulated) real world. If semantics deals with the complete meaning connection between expressions and the world, then there is no room for a separate pragmatic analysis and reference is part of semantics.

Alternatively, let us consider the possibility of a system where reference is not the only and whole connection between the language expressions and the objects of the world. In such a system, the model-theoretic objects could be interpreted as *concepts*, standing for the real things (at least in certain instances) but not identical with the real things. If we make this assumption, then reference may be defined as a subsegment of a complex mapping from expressions to objects of reality. Candidates for such a submapping are (i) the relation between the expression and the concept and (ii) the relation between the concept and real object.

Inasmuch as we are dealing with concepts, it seems natural to assume that part of the real-token/real-object mapping is constituted by the information processing inside the speaker/hearer. It will become apparent that this particular choice of an ontology for the model structure (i.e. this specification of what the model structure is supposed to stand for) is of great importance for the way the original deduction system is to be expanded to handle phenomena arising with natural language, such as non-literal uses, context-dependency, propositional attitudes, etc.

Our two assumptions, namely (i) that the model structure represents something conceptual, and (ii) that the model structure is regarded as part of the speaker/hearer (formalized as a speaker simulation device or SID), not only harmoniously complement each other, but also render a number of natural implications which immediately lead to a much more specific notion of which submappings the real-token/real-object mapping is composed of. One consequence is a distinction between the SID-external reality and its representation inside the SID, whereby the latter is called the (SID-internal) *context-model.* The correspondence of the context-model with the outside reality is described by the submapping called *perception.* The context-model is also determined by a second input component, called the SID-internal memory.

A second consequence of our SID-based ontology is the distinction between the real token and the SID-internal token representation. The correspondence between the real token and the token representation is described by the submapping called *verbal processing.* Verbal processing is called articulation if the real token is a replica of the SID-internal token representation. Verbal processing is called recognition if the roken representation is a replica of the external token. The SID-internal token representation differs from the real token in that (i) it incorporates only the linguistically relevant properties of the token surface and in that (ii) it includes in addition a logical (model-theoretical) representation of the *literal meaning* of the token surface, which we call the *token model.* We say that the surface of the token representation denotes its token-model(s). The token model will be defined in section 3.1 and is regarded as a set-theoretic *icon* of the token surface meaning.[3]

Verbal processing is obviously the first segment of the real-token/real-object mapping, while perception is obviously the last segment of this mapping (assuming an SID-based ontology). Each of these two segments provides us with an SID-internal conceptual structure, one called the token-model, the other called the context-model. We complete the real-token/real-object mapping by defining a subsegment relating the token-model and the context-model. This subsegment is called *pragmatics* and defined in terms of matching the token-model and the context-model. Part of this matching relation is reference. We distinguish different types of pragmatic matching, such as what we call *literal use* (defined as an exact correspondence between the token- and the context-model, i.e. there is a proper embedding of the token-model in the context-model), *ironic use* (defined as a correspondence with striking contrast between the token- and the context-model), *metaphoric use* (defined as a correspondence of analogy between the token- and the context-model), etc.[4]

Note that our SID-based reconstruction of the real-token/real-object mapping renders two notions of meaning (in accordance with Hausser 1979a, b, 1980, 1981). They are meaning^1, defined as the compositionally encoded literal meaning of the token surface, and meaning^2, defined as the speaker meaning of the utterance. The need to distinguish between these two types of meaning becomes obvious when we consider the literal and the ironic use of a sentence like *That's real nice weather today.* We say that this expression has the same literal meaning (icon) in both situations of use, but this icon is used to convey different speaker meanings. We relate meaning^1 and meaning^2 in terms of the following formula:

(4)
$$\text{use of} \left\{ \begin{array}{c} \textit{form} \\ | \\ \text{meaning}^1 \end{array} \right\} \text{ relative to a context = meaning}^2$$

Thereby, the *form* is the SID-internal representation of the token surface, *meaning*^{1} is the correlated token-model, *context* is the SID -internal context-model, and *use* is defined as the matching of the token- and the context-model (cf. section 3.1 below for details), whereby properties of the token surface may also play a role in the pragmatic interpretation (cf. Hausser 1981a: 127 for an example).

1.2 A comparison of paradigm I and paradigm II systems

Let us call a system based on the traditional (realistic) model-theoretic ontology a paradigm I system and a system assuming our SID-based ontology a paradigm II system. Paradigm I systems assume that the model structure is a representation of reality and that reference is a direct relation between the real token and the real object. Paradigm II systems assume that there are two model-structures, one for representing the literal meaning of the language token in question, the other for the representation of the SID-internal utterance context. As a consequence, paradigm II systems construct the real-token/real-object relation as a complex mapping, consisting of verbal processing, pragmatics (including reference), and perception. Consider (5a) and (5b), where the differences between paradigm I and paradigm II systems are represented schematically:

(5a)

Paradigm I	Paradigm II
	verbal processing
real token	*real token*⊣ ⊢*token representation*
denotation = reference	denotation
	token model
	pragmatics (reference)
	perception
real object (model theoretic reality)	*real object*⊣ ⊢*context model* (outside reality)

According to paradigm I, there is only one notion of truth, reference and denotation are the same, and there is no distinction between the objects denoted by language expressions and the objects of reality. According to paradigm II, on the other hand, there are altogether five notions of truth (as will be explained in section 2.1 below), reference is defined as part of the token-/context-model matching, and denotation is defined as the relation between the token surface representation and the token meaning, represented in terms of the token model.

1.3 Some problems of the paradigm I approach

The most pressing question raised by the paradigm I systems is: Where does the speaker/hearer come in? Since the model structure is interpreted as a representation of reality, the speaker(s) must be part of the model structure. But what about cases where the speaker enters into the model-theoretic interpretation of language, such as the interpretation of indexicals. The standard proposals to extend paradigm I systems to a treatment of personal pronouns like *I*, *you*, *we*, adverbs of time and space like *here*, *now*, etc., studiously avoid any specifics on the 'speaker/hearer question'.

This is exemplified by the so-called coordinates approach (Montague, Lewis), where the meaning of such pronouns as *I* and *you* is specified arbitrarily by additional model-theoretic parameters S (for speaker) and H (for hearer). Thus a sentence like *I am hungry.* is interpreted relative to a model-structure @ , a point of reference (i,j) (cf. section 2 above), and furthermore relative to a speaker s ($s \in S$) and a hearer ($h \in H$). (In the case of *I am hungry.*, only the value of s is truth-conditionally relevant, because only the pronoun *I* occurs in the sentence, not *you*).

On the one hand, this treatment of indexicals is clearly within paradigm I model-theory. But what is the theoretical nature of reference in this system? Intuitively, reference is sometimes equated with what we observe to be true (Carnap), but technically speaking the coordinates approach does nothing more than *assign* referents to context-dependent expressions. This assignment is by definition and thus arbitrary. Consequently, there is no natural way to treat contextual interrelations among indexicals within the coordinates approach. Such interrelations are constituted by the fact that, e.g. *I* means *you* in the ears of the hearer, while in the mind of the speaker *I* means *I;* and conversely, *you* means *I* in the ears of the hearer, but *you* means *you* in the mind of the speaker (for a more extensive discussion cf. Hausser 1980a: 197ff.).

Another problem with the absence of the speaker/hearer in paradigm I model theory is the analysis of so-called non-literal uses, such as ironic, metaphoric, etc., uses. Since there is only one notion of meaning (if at all), defined as a direct relation between expressions and the model-theoretic reality, the only way to treat such non-literal uses is by postulating syntactico-semantic ambiguities. But analyzing the ironic use of, e.g., *That's really nice weather.* logically as *The weather is not so nice.* amounts to overextending *ad absurdum* the notion of a syntactic ambiguity, i.e. an ambiguity caused by the syntactic structure of the surface expression, as in *Flying airplanes can be dangerous.* (Chomsky 1965) or *They don't know how good meat tastes.* (Chomsky 1966).[5]

A third problem characteristic of paradigm I model theory is the treatment of propositional attitudes. For example, the sentence *John believes that Cicero denounced Catiline.* implies *John believes that Tully denounced Catiline.* only if the sentence *John believes that Cicero is Tully.* is true. This means that in order to treat this inference adequately the paradigm I model structure must describe not only the objectively given real and possible worlds, but also the subjective belief-worlds of all speakers and hearers it contains. For an alternative solution withing the paradigm II see Hausser (1982: 39 ff., and section 7).

Last but not least, consider the problem of treating vagueness in the paradigm I model theory. One proceeds by assuming the vagueness of natural language concepts, treated in terms of different degrees of truth (or absence of truth), and then constructs systems which assign to a complex sentence a fuzzy truth-value, computed from the fuzzy truth-values of the parts (similarly in systems which use a third or undefined truth-value). This amounts to the same trivialization of reference as the treatment of indexicals (*I, you, this, now*) in terms of additional model-theoretic parameters. In either case, the emphasis is on the compositional aspect (i.e. on what happens if a word has a certain indexical interpretation or if a word has a certain vague extension), but the question of how an indexical or vague word obtains its particular value is treated as a matter of definition.

2. Simulation of communication in Paradigm II

Let us turn now to the paradigm II model theory (cf. (5b) in section

1.3 above). As explained in sections 1.2 and 1.3, paradigm II systems assume two model structures, one for the set-theoretic characterization of the literal meaning of the token, the other for the set-theoretic characterization of the speaker context. Both of these model structures are assumed to be part of a formalized speaker/hearer, also called a speaker simulation device or SID. Outside the SID we could define a third model structure, representing the real world (and thus corresponding to the paradigm I model structure).

But we are not primarily interested in a model-theoretic representation of the current notion of scientific truth or whatever else is considered to be really 'real'. Rather, we are interested in an operational simulation of natural language communication. Therefore, we would prefer the *construction* of a SID in order to observe its interaction with the real world (and not a model-theoretic representation of the real world). For such a construction, however, the efforts in Artificial Intelligence to design systems for artificial perception and perception analysis should advance beyond their present state. In the meantime let us consider the information processing inside the SID, specifically as it pertains to verbal communication. Thereby we take the process of verbal recognition and articulation as well as the construction of the context for granted and concentrate on the denotation-conditional characterization of the literal meaning of the tokens and their pragmatic interpretation relative to a presumed context-model.

2.1 What is truth?

The paradigm II systems retain the formal methods of truth-conditional semantics, as originally developed within the paradigm I model theory. However, while the truth-value "1" mentioned in the truth-conditions of a paradigm I system is intuitively identified with a philosophical notion of basic and absolute truth (cf. footnote 7 below), this is not the case in a paradigm II system, where we distinguish between the formal truth-values $\{0,1\}$ and what is intuitively regarded as a truth. For us, the formal truth-values $\{0,1\}$ are no more than model-theoretic objects which are mentioned in the definitions of the logic and used for the construction of the token-model (cf. section 3.1 for concrete examples) and the context-model. What is intuitively regarded as a truth, on the other hand, is not taken as absolute and basic within the paradigm II approach. Rather, the two models inside the SID, in their correlation to reality and to each other, yield a speaker-dependent and composite notion of truth. This composite notion of truth is based on altogether five different basic 'truth-factors'. Three of these truth-factors are based on processes of *matching structural patterns.*

The first of these SID-internal matching processes yields the truth-factor we will call *perception truth.* Perception truth is defined as proper matching of non-verbal concepts in the context-model with properties of the objects perceived (disregarding for the moment the proper storing and recall of memory, which is another factor in the build-up of a 'truthful' context model). The external objects of perception are called 'real' or 'objects of reality', whereas their representation in the form of (set-theoretically defined)[6] concepts in the context-model is something mental or conceptual. Accurate non-verbal perception is surely one prerequisite for arriving at truth in the philosophical sense.

The second SID-internal matching process yields the truth-factor we will call *verbal processing truth*. Verbal processing truth is defined as the proper matching of the SID-internal token surface with the relevant properties of the external token. The external token is the real token, whereas the SID-internal token representation (of a real or potentially real token) is something mental or conceptual. Accurate verbal recognition as well as articulation is surely another important prerequisite for communicating truth, i.e. for a sentence said or heard to be true.[7]

The third SID-internal matching process yields the truth-factor we will call *pragmatic* or *iconic truth*. Iconic truth is defined as the proper matching of the SID-internal token-model (i.e. the set-theoretic icon of the token) with the SID-internal context-model. We distinguish different characteristic types of iconic matching, such as the literal use, ironic use, metaphoric use, etc., which in turn underlie different types of iconic truth. The correct application of the pragmatic matching rules is surely a further prerequisite for communicating in a truthful way. This point is illustrated by those (not infrequent) situations where an ironic statement is interpreted as literal or vice versa.

The remaining two truth-factors are not based on the SID-internal processes of matching structural patterns, but concern the *logical consistency* of sequences of token-models and of context-models. Sequence of token-models are synthesized by the SID in the course of interpreting a longer text. Thereby, the meaning of each sentence is represented by a model making the sentence true (roughly speaking-cf. section 3.1). Since these token-models represent only the compositionally encoded literal meaning of the sentences in question, the consistency of a discourse on the level of the token-models can be checked only with regard to these literal interpretations.

If the models representing these literal meanings are logically compatible, they can be interpreted (as far as meaning^2 is concerned) in a pragmatically uniform way. Thus, all elements of a sequence of sentences may be uniformly interpreted as literal use or they may be uniformly interpreted as ironic use, depending on the utterance situation. If, on the other hand, the token-models of a piece of discourse are logically inconsistent, the SID has to decide which sentences should be interpreted literally and which should be interpreted non-literally. Another possibility is to draw the attention of the other speaker to the inconsistencies in the text and negotiate an explanation. A third possibility is to interpret the inconsistency of a text as an indication that the producer of that text is talking nonsense or lying. In any case, the detection of text-internal logical inconsistencies provides crucial clues for finding the intended pragmatic interpretation, in addition to the local matching of the icons with the momentary utterance context (cf. definition of iconic truth above).

A third element determining the use-interpretation of tokens is the nature of the context-models themselves. Since we define the SID-internal context in part as what the speaker perceives at a given moment, the context will be structured in terms of the input channels of perception. This speaker-internal picture provided by the senses will include in particular a representation of the momentary utterance or discourse situation. Thereby, a second context component, namely the SID's mid- and long-term *memory*, will play a crucial role. A further factor in the constitution of the internal context will be the individual wants, needs, interests, and aversions of the speaker. Finally, the momentary context must provide a representation of the previous discourse.

Assuming that the SID-internal context is represented in terms of model-theoretic structures which serve as denotations for a uniform logic (the context-language), we can posit a second consistency criterion as our fifth truth-factor, namely the logical consistency of different parts of the momentary context and the logical consistency of sequences of momentary context states. Of course, the context-structures of normal speakers are usually not consistent. Furthermore, the question arises as to what kind of logical deduction system would most adequately reflect the contextual intuitions of natural speakers. In particular, much of the contextual inferencing must be expected to be of a non-logical or pseudo-logical nature. Consider for example (6) (after Rieser 1983: 7).

(6) If one has to do A in order to achieve A', one has to do more than A in order to achieve more than A'.

(6) is not a valid logical inference, but on a practival level we appeal to inferences like this all the time in order to make our decisions and our discourse contributions *plausible*.

No matter how these difficult questions regarding the logical nature of the SID-internal context are answered, however, the fact remains that speakers frequently discover inconsistencies among their contextual assumptions which may lead to a re-evaluation of what is taken to be truth. Also, the discovery of such inconsistencies (sometimes caused by the acquisition of what is considered to be 'better' information) may lead to a reinterpretation of the intended meaning[2] of utterances perceived earlier.

We see that the truth-values $\{ 0,1 \}$, where 1 is interpreted in paradigm I systems as standing for some philosophical notion of basic and absolute truth, reappear in the paradigm II in a function that is reduced to the formal construction of set-theoretic models. These models, in turn, are employed for a reconstruction of what it means for a sentence to be true in a philosophical sense. The resulting notion of truth in the paradigm II is a speaker-dependent, composite notion, based on (i) three types of correspondence (pattern matching) and (ii) two types of logical consistency.

2.2 The paradigm I approach as a special case of the paradigm II approach

How do paradigm I systems and paradigm II systems relate? If we assume that verbal processing in the paradigm II system is so accurate that the distinction between the real token and the token representation can be neglected, and that perception is so accurate that the distinction between the real world situation and its representation in the context model can be neglected, and that the use of language is so simple-minded that it consists only of the most literal use so that the distinction between the token-model and the context-model can be neglected, then we end up with a paradigm I system. In other words, the paradigm I systems are nothing but a special case of the paradigm II approach.

It is characteristic of a theory which is a special case of a more general theory that certain distinctions which are clear and well-motivated in the general theory collapse in the context of the special case. This holds for the complex nature of truth, based on five truth-factors in paradigm II systems, which reduces to a basic and absolute notion represented by '1' in paradigm I systems. It also holds for the paradigm II distinction between semantics (theory of literal meaning of natural language expressions) and pragmatics (theory of language use), which collapses in paradigm I systems.

Another way of comparing paradigm I and paradigm II systems is the following. Both paradigm I and paradigm II systems relate the real token with the real object. But whereas in the paradigm I systems the real-token/real-object relation is treated as a direct relation (with the result that the model-structure is treated as a representation of reality of which the speaker/hearer(s) is (are) a part), paradigm II systems take this relation apart into several submappings by routing it through the speaker/hearer (with the result that the model structure is used to describe something conceptual which is part of the speaker/hearer).

The special case of a paradigm I system may be the proper choice when model theory is applied to systems of science, i.e. when reference (i.e. the relation between elementary constants and the corresponding objects in the model-theoretic simulation of the real world) is presupposed to be accurate and logic serves only to check the consistency of the theory. But paradigm I systems are inappropriate when the goal is a model-theoretic analysis of communication. This is also true in the case of vagueness. Properly speaking, the treatment of vagueness in paradigm I systems is an absurdity: first, formal logic and model-theory are developed to escape the vagueness of natural language; then, the same system is 'expanded' to handle vagueness, but without any change in the basic assumptions of the original program.

How can there be vagueness in a formal system where reference is fixed by definition?

3. Vagueness and presupposition failure

On the paradigm I approach, the model structure is defined as a complete representation of actual and potential reality. The interpretation of a sentence relative to the model structure and an index consists in *checking* whether the sentence is true or not in the situation at that index. In paradigm II, on the other hand, the model structure is partial in the sense that it characterizes only the semantic interrelations among logical constants (cf. Hausser 1981 for discussion) without providing complete model-theoretic situations given prior to the interpretation of sentences. Rather, the semantic interpretation of a sentence in the paradigm II approach consists in *synthesizing* or constructing a model-theoretic situation (on the basis of the partial model structure) which makes the sentence true. This so-called token-model is then pragmatically interpreted in terms of its match with the context-model.

3.1 The formal nature of the token model

But what exactly is the token-model? The most basic proposal (Hausser 1979a) is to define the token-model as a minimal model making the sentence in question true. By 'minimal' we mean a model that is based (a) on finite domains and (b) assigns the smallest extensions to the logical constants still suitable for defining the matching relation between token-model and context-model in a simple and intuitively natural way.

However, if there are several minimal models making the sentence true, which one should be chosen to serve as the set-theoretic icon? Furthermore, the basic proposal as formulated above does not work (i) for contradictory sentences and (ii) for the semantic characterization of presuppositions. In cases of contradiction, no models can be constructed which would make them true. And the semantic difference between, say, an existential assertion and an existential presupposition can be brought out only on the basis of models relative to which the sentence is false or undefined, but remains invisible if we limit ourselves to models which make the sentence true.[8]

Let us therefore revise the basic proposal as follows: the literal meaning of a sentence is formally represented by the set of minimal models relative to which the sentence (i) is true, (ii) is false, or (iii) is undefined. Furthermore, the minimal models in this set must all be relevantly different. This set of models constructed for a given sentence A is called the *token model* or the *characteristic model set* of A.

Consider for example sentence:

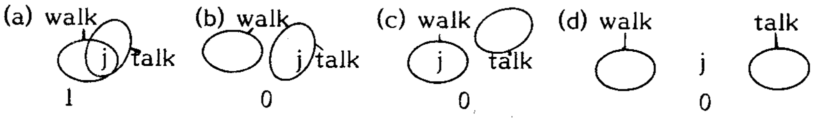
(7) John walks and talks.

which translates into:

(8) walk' (j') $\wedge$ talk' (j')

The characteristic model set of (8) consists of the following four minimal, relevantly different models:

(8'')



values: 1 0 0 0

In a more formal way, this characteristic model set may be defined as follows:

(8*) the model set $@^s =_{\text{Def.}} (A, F^s)$, for s=a,b,c,or d.

$A =_{\text{def.}} \{ a_0 \}$

	(a) F^a (j') $= a_0$	(b) F^b (j') $= a_0$	(c) F^c(j') $= a_0$	(d) F (j') $= a_0$
	F^a(walk') $= \{a_0\}$	F^b (walk') $= \emptyset$	F^c (walk') $= \{a_0\}$	F^d(walk') $= \emptyset$
	F^a (talk') $= \{a_0\}$	F^b (talk') $= \{a_0\}$	F^c (talk') $= \emptyset$	F^d(talk') $= \emptyset$
Values:	1	0	0	0

For reasons of simplicity and graphical vividness we will in the following use the graphical method illustrated in (8'') rather than the definition method illustrated in (8*).

As another example consider sentence:

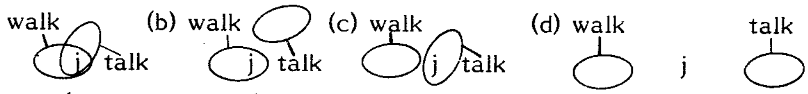
(9) John walks or talks.

which translates into:

(9') walk' (j') v talk' (j')

The characteristic model set of (9') is like (8''), except that (9') is 1 relative to three minimal models and 0 relative to one, as indicated in (9''):

(9'')



Values: 1 1 1 0

Next consider the characteristic model set of the contradiction:

(10) John walks and doesn't walk.

which translates into:

(10') walk' (j')$\wedge$ ~walk' (j')

(10'')

Values: 0 0

Thus a sentence is called a contradiction if its characteristic model set contains only 'false models', i.e. models relative to which the sentence is 0. And a sentence is called a tautology if its characteristic model set contains only 'true models'.

It is an interesting logical problem to define an exact and explicit procedure which assigns to any well-formed formula its characteristic model set.[9] The number of models in the characteristic set of a formula ϕ is a function of (i) the case distinctions in the definition of each operator occurring in ϕ. and (ii) the places of predicate constants occurring in ϕ. It is no accident, for example, that sentence (8) has 4 models in its characteristic set. They correspond to the 4 possible assignments to a formula of the form '$\phi \wedge \psi$'. And similarly in the case of example (9). For the moment we simply assume that there is exactly one characteristic model set for each well-formed surface expression (or rather its disambiguated IL-translation) and regard this model set as the *set-theoretic icon* of the expression, characterizing its compositionally encoded literal meaning (meaning^1).

The interpretation of the token model as a characteristic model set extends naturally to the semantic characterization of presuppositions within the paradigm II approach. Semantic presuppositions are a truth-conditional property of certain natural language expressions, as witnessed by the comparison of (11) and (12):

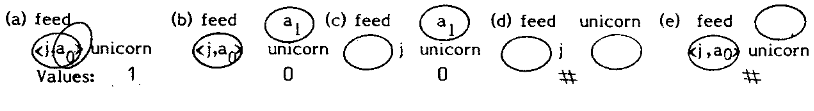
(11a) John fed the unicorn.
(11b) John didn't feed the unicorn.
(11c) There is at least one unicorn.

(12a) John fed a unicorn.
(12b) John didn't feed a unicorn.
(12c) There is at least one unicorn.

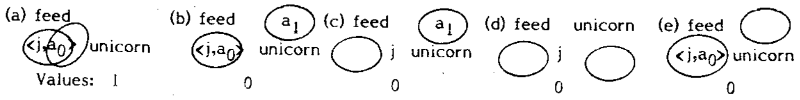
It is a simple fact of natural language that (11a) and (11b) both entail (11c), whereas (12b) - in contrast to (11a), (11b), and (12a) - does not entail (12c).[10]

Standard presuppositional analysis treats these facts by assigning the value # (undefined) to (11a) and (11b) if (11c) is 0. In contrast, (12a) is 0 and (12b) is 1 if (12c) is 0. These truth-conditional properties may be made explicit by the following characteristic model set (for the sake of simplicity, we leave the uniqueness condition associated with the singular of the existential P-inducer *the* (cf. Hausser 1976) in (11) untreated):

(11a'') John feeds the unicorn.



(12a'') John feeds a unicorn.



The construction of the characteristic model set for a token sentence constitutes the *semantic interpretation* of the sentence. The *pragmatic interpretation* of the token, on the other hand, consists in finding that model of the characteristic set which matches best with the context. If the best matching model happens to be a model relative to which the token sentence is false or undefined, then there is no literal interpretation and a non-literal interpretation is attempted.

Of course, the notion of matching the token and the context model must be differentiated depending on whether we are dealing with an SID in the speaker state or in the hearer state. Consider for example a hearer receiving information by means of a token meant literally. For him the matching with the context consists in *incorporating* those models of the characteristic set into his context relative to which the token sentence is true.

3.2 The role of the formal model in the two paradigms

Note that the models indicated in (8''), (9''), (10''), (11'') and (12'') are in no way a special feature of the paradigm II approach. Rather, exactly the same formal models are used in the paradigm I approach. Indeed, the models of the characteristic set of a token sentence and the value of the sentence relative to these models is motivated by presuming precisely that special situation which the paradigm I approach takes as paradigmatic, i.e. a situation where perception and verbal processing are abstracted from, and the pragmatic parameter is frozen to literal use.

Thus it is only the intuitive interpretation of these formal structures that differs in the two paradigms. However, in a paradigm I system, as a consequence of its peculiar ontology, a formal model will be imcomparably more complicated than those illustrated in (8''-12'') because the model must provide the extension of *all* constants of the language at a given index. On the paradigm II approach, on the other hand, the models in the characteristic set of a token assign extensions only to those constants which actually occur in the token sentence under semantic interpretation.

Furthermore, since on the paradigm II approach the models are interpreted as set theoretic icons it is sufficient to construct *m i n i m a l* models, i.e. models assigning extensions to the constants occurring in the token sentence under interpretation. The paradigm I approach, on the other hand, interprets the models as representations of reality. Therefore, the cardinality of the extension sets is not determined by the goal of generating all relevantly different models for a given token, but rather by the *situation* the model is supposed to simulate. Consequently, a paradigm I model is either a vastly simplified reproduction of reality, and therefore unrealistic. Or the paradigm I model attempts to be a realistic reproduction of reality, in which case its implementation would blow the mind of the largest computers presently available.

3.3 On the nature of presupposition failure versus vagueness

Let us turn now to the nature of presupposition failure and vagueness in the two paradigms. We noted in section 2.2 that it is characteristic of a theory which is a special case of a more general theory that certain distinctions which are well-motivated in the general theory collapse in the context ot the special theory. As examples, we mentioned the complex nature of truth in paradigm II systems, which reduces to a basic and absolute notion in paradigm I systems. Furthermore, we mentioned the notions of semantic versus pragmatic interpretation, which are completely distinct processes in a paradigm II system, but indistinguishable in a paradigm I system. A more special case in point is the notions of vagueness and presupposition failure.

In a paradigm I system vagueness and presupposition failure are essentially indistinguishable: both arise when a sentence cannot be evaluated as either really true or really false. Therefore, the assignment of no truth value or a third truth value is assumed in either case (by definition of the model structure) and all attention is directed towards the question of what deductions are valid from premises with an undefined or third value, or how component sentences with an undefined or third value figure in the value of a complex sentence. The assumption that vagueness and presupposition failure are logically the same is explicitly made in Blau (1977). Implicitly this assumption is made in Kamp (1975, 1981), Pinkal (1981), and others who use supervaluations, i.e. a system developed specifically for the treatment of presupposition failure (cf. Van Fraassen 1968), for the handling of vagueness.[11]

In the paradigm II system, on the other hand, presuppositions are a semantic phenomenon, while vagueness arises as a pragmatic phenomenon. The semantic nature of presuppositions (and presupposition failure) is captured in a paradigm II system in terms of the characteristic model sets (cf. (11) in section 3.1 above) of token sentences with P-inducers (i.e. presupposition inducing words like *the*, *every*, *regret*, *stop*, etc., cf. Hausser 1976). In contrast to presuppositions, which are a denotation-conditional property of expressions (as is obvious from the comparison of (11) and (12) above), vagueness comes about as a property of *utterances*. For concrete paradigm II analyses of examples involving vagueness see section 4 below.

3.4 Three types of vagueness

What kinds of vagueness are there? There is verbal processing vagueness, i.e. cases where the SID cannot recognize a token because of bad articulation or background noise, or where the SID cannot articulate properly. There is a perception vagueness, i.e. cases where the SID cannot recognize something clearly because of bad lighting or a hangover after a linguistics party. And there is what we might call iconic vagueness. Iconic vagueness is so called not because the icon is vague, but because it refers to an uncertainty regarding the intended matching relation between the token and the context model.

We have thus arrived at an intuitive concept of vagueness which is quite different from the widespread view that "natural language concepts have vague boundaries and fuzzy edges". We conclude furthermore that vagueness must be associated with the three SID-internal pattern matching procedures. Insofar as they contribute to the SID's notion of truth, vagueness is a truth-relevant factor. But the notion of truth in question is not semantic truth. What is at issue in connection with vagueness is the *truth of utterances* and not the *truth-conditions of sentences.* Presuppositions, on the other hand, have nothing to do with proper pattern matching. Rather, they are a semantic property of expressions which is to be treated in terms of the logical consistency of token-models. Presuppositions are a pragmatic phenomenon only in a trivial way; after all, *all* semantic properties of an expression contribute to its use-conditions and as such to its pragmatics.

It follows that attempts to treat vagueness in terms of extensions of traditional logic not only vastly complicate the logic, either by assuming a large number of truth values (fuzzy logic) or by assuming a large number of evaluations of predicates relative to the point of reference in question (supervaluations), but also completely miss the essential intuitions of linguistic vagueness. This is not to deny, however, a certain intrinsic value of these systems as sophisticated logical mechanisms.

4. Examples of vagueness and their paradigm II treatment

Let us now turn to the treatment of some concrete examples exhibiting vagueness. How should the slowly closing door be treated in a paradigm II system? The sentence *The door is open.* has a clearly defined literal meaning, formally represented by its token model synthesized on the basis of its standard IL-translation and defined as a characteristic model set. The characteristic set contains a model T, exhibiting a situation where the door is open, relative to which the sentence is 1 and a model F, exhibiting a situation where the door is closed, relative to which the sentence is 0. Observing the slowly closing door, at first model T will be the best match, then model F.

But what about the moment when model T and model F match equally well (or badly)? This is the situation considered in treatises on vagueness within the paradigm I approach. Within the paradigm II approach, on the other hand, it is not a problem concerning the literal meaning of the sentence *The door is open.*, and it is therefore not a logical problem. The question for us is rather how the sentence is *used* relative to the indicated situation. And there is seems that a normal speaker will simply use another sentence, like *The door is closing.*, or wait a few moments and then say *The door is closed.*

4.1 The iconic content of red

Next consider the sentence *Take the red stone!*, interpreted in the following two different situations. In one situation the hearer is confronted with a grey stone and a pale pink stone. Obeying the utterance *Take the red stone!*, he will pick the pale pink stone. In the other situation the hearer is confronted with a bright red stone and a pale pink stone. In this case he will not pick the pale pink stone but the bright red stone. Within paradigm I model theory it follows perfectly straightforwardly that the word *red* is vague: sometimes *red* is true of the pale pink stone and sometimes it is false of this same stone.

It has been suggested (Nunberg 1978) that predicates referring to different objects in different contexts should be handled in terms of 'context-dependent functions'. Thus the word *chicken* has the set of live chicken as its extension in one context, but the set of chicken meat batches in another context. This proposal remains firmly within the paradigm I approach in that it incorporates 'context-dependency' (of expressions which are clearly not indexicals) into the semantics and treats the relation between, e.g., *chicken* and its real referents as a direct semantic relation. In a paradigm II theory, on the other hand, the word *chicken* denotes one and the same icon in the two interpretation contexts and the different real world referents are accounted for in terms of different uses.

Similarly in the case of the pale pink and the red stones. The sentence *Take the red stone!* is not ambiguous (for denotation-conditional treatment of imperatives see Hausser 1978, 1983) and neither is the word *red*. But how should the iconic content of *red* be described? There are two aspects to the description of the literal meaning of an elementary constant like *red*. One is the set-theoretic interrelation with other logical constants of the same category (or semantic type). Thus the partial model structure of a paradigm II system will define that the extensions of *red*, *blue* and *green* have disjunct sets as their extensions which are all subsets of the extension of the constant *colour*. The other aspect concerns the specific difference between *red* and *green* . Within the paradigm II approach, these distinctions may be treated naturally in terms of specific types of SID-perceptions. Thus the iconic content of *red* may be defined in terms of matching a certain wave-length of the electro-magnetic spectrum.

For the sake of simplicity let us assume that the iconic content of *red* is represented in form of a little card of bright red colour (regarded as the SID-internal prototype of *red*). Then the interpretation of the sentence *Take the red stone!* relative to the two situations described above may be indicated as in (13) and (14):

(13) token: Take the *red* stone!

token-model: $\boxed{\text{bright red card}}$ (iconic content of red)

context-model: grey stone pale pink stone

If we change to a context where the grey stone is replaced by a dark red stone, the pale pink stone ceases to be the one that matches the bright red card best. Thus we have a situation as indicated in:

(14) token: Take the *red* stone!

token-model: $\boxed{\text{bright red card}}$

context-model: red stone pale pink stone

So what happens to be the 'red stone' in (13) turns out to be the 'non-red stone' in (14). The point is that it is not the meaning of red that is vague or which changes, but rather it is the context which changes and thus the instances of the best match.

4.2 The Sorites paradox

Next let us consider a classical paradox, the so-called Sorites paradox or paradox of the heap. This paradox brings out the essence of the paradigm I approach to vagueness. Thus it is not surprising that it received considerable attention from contemporary paradigm I logicians interested in vagueness. The paradox is described as follows. One grain of sand does not form a heap. If we add one grain, we still don't have a heap. If n grains don't form a heap, then adding an n+1th grain will not result in a heap. Yet at some point, when enough grains are added, we arrive at something which is undeniably a heap.

The recent proposals to resolve this paradox all accept it as a semantic paradox and thus stay within the traditional framework of semantics. But the price paid for these different kinds of so-called semantics of vagueness is considerable. Kamp (1981) arrives at a notion of semantic inference which is so far removed from the traditional notion that he himself doubts as to whether his system may still be called logic. Kindt (1981) on the other hand, proposes to incorporate the heavy machinery of mathematical topology into formal semantics, whereas Pinkal's (1981) approach of 'precisification' constitutes a sophisticated development of the method of supervaluations.

These proposals have in common that they accept the premisses which lead to the paradox. But when we look at another ancient paradox, that of Achilles and the turtle, which today is regarded as solved, we see that one acceptable solution of a paradox is to revise its premisses in an intuitively convincing way. Indeed, this may be the only way to solve a genuine paradox. The moment we accept that a heap is to be defined in terms of a certain number of grains (e.g. 1 grain: no heap, 100,000 grains, properly arranged: heap) we are trapped. For now comes the inevitable question: how many grains exactly make the difference between a heap and a non-heap?

4.3 The icon of the heap

So let us look at the problem in a different way. As was illustrated by our discussion of the slowly closing door and the pale pink versus dark red stones, the crucial question within our paradigm II approach with regard to the paradox of the heap is: what is the icon of the word *heap*? And then: how is this icon used? Regarding the proper definition of the icon 'heap' we submit that it should not be defined in terms of a certain number of grains, not even upper or lower limits of this number. Rather the icon of a heap is a prototype involving (i) a certain form (cone-like), (ii) a certain subsistence (loosely packed smaller parts), and (iii) certain proportions (the size of the smaller parts in relation to the size of the heap and the size of the heap in relation to the rest of the context).

Consider for example two people, called A and B, flying at an altitude of 10,000 feet over a farm and A says to B: "That heap wasn't there yesterday.", pointing to what looks like a tiny speck on the ground. In such a case, A would violate the proper use of the icon 'heap', even if it should turn out later that the speck on the ground was indeed a heap of sand. The speaker A may be *construed to be right* in a narrow, pseudo-scientific or pseudo-semantic sense, but that does not mean that A communicated in a natural or reasonable way.

Of course, if A were to say to B: "Do you see that tiny speck down there? That must be a heap of sand. I don't think it was there yesterday.", the situation would be different (from a communication point of view). In the second case, the speaker A introduces a context-change. A leads B from point of view (i) (at 10,000 feet altitude) to point of view (ii) (at the ground level close by). In the second (imagined) context the speck in question may well be a proper heap. It is of no consequence that B cannot *verify* A's conjecture. All that is required is that B is a cooperative partner in this communication in the sense that B is willing to *provide* a context which accommodates the icon 'heap' (on the literal interpretation intended by A).

4.4 Summary

The difference between the paradigm I and the paradigm II approach to the Sorites paradox may now be summarized as follows. The paradigm I approach assumes a model-theoretic reality which provides various samples of heaps and non-heaps, starting from one lone grain and going up to a 100,000 grains, say. The supposed problems is to find a semantic definition of the logical constant *heap*, such that *heap*(α) is evaluated 0 (false) if α denotes only one grain; *heap*(α) is valuated 1 (true) if α denotes the 100,000 grains. It must, furthermore, assign the right truth-values in the critical transition from non-heap to heap. However, no semantic theory can fulfill this last desideratum, because the transition from non-heap to heap is intuitively unclear in a non-trivial sense. This intuitive problem with the traditional approach to vagueness is unsolvable because it derives from asking the wrong questions on the basis of the oversimplified and thus mistaken assumptions of the paradigm I approach.

On the paradigm II approach, on the other hand, there is no attempt to characterize the transition from non-heap to heap in the semantics. Rather, the icon *heap* is semantically defined in a fixed way as a prototype, just as the icon *red* was defined in terms of a little red card. The question of whether something is properly referred to as a heap or not is left to the pragmatic process of matching the icon with the context. What counts as a proper heap in one context, may be a definite non-heap in another context (just by changing the relative proportions of the objects relative to each other and relative to the context frame). This is similar to our example of a pale pink stone, which turned out to be the red species in (13) and the non-red species in (14). A further possibility, never even discussed in the paradigm I approach, is the metaphoric use of the icon *heap*, such as when an old car is referred to as a 'heap of scrap'. In this case, the icon invokes an imagined future state of disintegration which is felt to be so immediately pending as to justify this manner of speaking.

On the whole, we have argued that the paradigm II approach does more justice to the actual functioning of natural language than the paradigm I approach. The reason is that the paradigm II approach provides the distinction between the literal meaning of expressions (meaning^2). This distinction collapses in the paradigm I approach, due to its being a special case of the paradigm II approach (as was shown in section 2.2). According to the paradigm II approach, it is not the concepts of natural language (i.e. the meaning^1 of expressions) which are vague. Rather, vagueness originates with the *use* of these concepts and is thus a meaning^2-phenomenon. The distinction between meaning^1 and meaning^2 in the paradigm II approach not only eliminates vagueness as a semantic problem, but also explains the flexibility and descriptive power of natural language: due to the fixed meaning^1 of language expressions (the so-called icons) we can describe phenomena and situations which have never been known or described previously.

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Footnotes

1 We call those adjectives 'extensional' which may be defined in terms of *intersection functions* (cf. Montague 1974, p. 211). All other adjectives are called 'intensional'. This terminology differs from that of Kamp (1975).

2 2^A is defined as the power set over A. For the sake of simplicity we consider only one-place predicates P^1 (where $F(P^1) \in 2^A$). For n-place predicates P^n, $F(P^n)$ is definable as an element of 2^{A^n}, where A^n is the set of all n-tuples in A.

3 An icon is traditionally regarded as a symbol that has some similarity with the object it stands for. In our case, the object in question is the *literal meaning* of expressions, which we define as the truth- or denotation-conditions of expressions under their literal interpretation. As the set-theoretic icon of such a literal meaning of a given sentence we take, roughly speaking, a formal model relative to which the sentence is true (though the actual definition of a 'token model' is more complicated, as shown in 3.1 below). Intuitively, it seems quite straightforward to use models making a sentence true as representations of the meaning of the sentence. The reason why our notion of a set-theoretic icon is nevertheless difficult to grasp seems to reside in the *abstractness* of the (i) icons (i.e. formal models), (ii) the things represented by the icons (i.e. literal meanings defined in terms of denotation conditions), and (iii) of the similarity relation between the icons and what they represent.

Apart from our concept of a set-theoretic icon, it is often questioned whether meanings exist as objects of some kind. We have argued in a number of papers (1980, 1981a, 1981b, 1982) that there are two distinct notions of meaning, namely the literal meaning of expressions (meaning^1) and the speaker meaning of utterances (meaning^2). Furthermore, we argue that the speaker meaning is to be analyzed as a derived notion (pace Grice), and is to be defined in terms of the *use* of the literal meaning relative to a context (see also below). Once the existence of literal meanings is accepted, we are faced with the question: How should these literal meanings be formally represented? Here our answer is the construction of what we call set-theoretic icons. The question of whether literal meanings should be treated as conceptual objects of some kind is a special case of the more general question of whether thoughts should be treated as objects, and if so, what kinds of objects.

For an excellent discussion of this difficult and far-reaching philosophical question see Moravscik (1983).

4 The basis for this pragmatic matching process is the assumption that the token-model and the context are both speaker-internal conceptual structures (defined for reasons of generality, tradition, and convenience in model-theoretic terms, cf. footnote [6]). This pragmatic matching process provides a second motive (cf. footnote [3]). for calling the token-model an *icon*: in the case of a successful literal interpretation the token-model is a set-theoretic icon of the set-theoretically represented contextual referent. In the case of, e.g. a metaphoric interpretation, however, the similarity relation between the token-model and the context-model is of a more indirect, analogical nature. In the case of idioms, finally, reference does not depend at all on the similarity between the token-model and the context-model, but is solely based on frozen use-conditions.

5 Similar considerations apply to metaphoric use, as in 'The old fox quietly left the room', where *fox* refers to our favourite inspector and not to an animal of the genus Vulpes. If one works within paradigm I and rejects the multiple ambiguity treatment for the handling of non-literal meanings, one would have to specify some alternative solution. So far, however, I don't know of any. Appeal to some unspecified theory of pragmatics withing paradigm I is not a convincing argument, because there is no room for a pragmatic component in a system that defines semantics as a direct relation between the expression and its real world referent (as shown in Hausser 1980; see also section 2.2 below).

6 That we use set-theoretically based model theory for these representations, rather than, e.g. net-work semantics or procedural semantics, is at the present point mainly a matter of convenience and tradition. One may argue, however, that set-theory is the most general and most elementary form of semantics, and that net-work and procedural semantic analyses may be translated into set-theoretic representations. Unfortunately, very little is known so far as to how these three types of systems compare (cf. Anderson 1976: 231 ff., where the net-work grammar ACT is translated into first order predicate calculus).

7 Someone working within paradigm I may point out here that it is simply inconceivable what *correct understanding* of a token could have to do with *truth* (in the absolute and holistic sense of paradigm I semantics). Isn't it a fact, it will be argued, that sentences have a truth-value completely independently of any speaker/hearer? Take for example: *The temperature at the North pole is 6 degrees at moment t.* The point is not whether or how one could verify or falsify this sentence. Rather, according to this argument, the point is that a sentence like this *has* a definite truth value.
This line of reasoning seems to be convincing, at least at first

glance. But things are not that simple. The assumption of truth-definiteness of sentences or propositions presumes that the concepts of natural language actually fit the phenomena relative to which they are supposed to be truth-definite. Take for example: *Three yards from the center of a black hole the temperature is 6 centigrades.* Here it is not at all clear whether the sentence has a definite truth value or not, because a specialist in astro-physics may tell us that the notions 'temperature' or 'yard' do not make any sense, or cannot be defined, under the extreme circumstances of a black hole. For additional arguments against truth-definiteness in the context of a presuppositional logic, see Seuren (forthcoming).

We conclude that the assumption of truth-definiteness of sentences or propositions is a very strong assumption indeed. Since paradigm II semantics manages to define truth without this assumption it is the task or paradigm I semanticists to show the *empirical necessity* of their assumption of truth-definiteness (in line with Occam's razor). Of course, the matter at hand is very complex and communication between adherents of different paradigms is notoriously difficult. In answer to the initial question, however, we point out the following: Correct understanding of a token is important for our notion of truth because we treat truth as a speaker-dependent, composite notion and reject the principle of truth-definiteness as empirically untenable and semantically superfluous.

8 This problem was first pointed out in Hausser (1981a), footnote 2. The following proposal to define the token-model as a set of characteristic models is a first informal solution of the issue raised by the footnote above.

9 Such a procedure would consist of constructing all possible models for a sentence for a given domain A containing n elements. The procedure would begin with n = 1 and stop at a point where the addition of further elements to A ceases to result in any further differentiation of the truth-conditions of the sentence.

10 With regard to presuppositions, I continue to hold the Strawsonian view articulated in Hausser (1973, 1976), though in the modified context of a paradigm II system. This view has been challenged by proponents of an 'entailment analysis' of presuppositions, who interpret examples like (a) (from Kempson 1975: 86):

(a) The King of France didn't visit the exhibition - France hasn't got a king.

as proof that definite noun phrases do not always require existence for the sentence to be true. The fact that sentences like:

(b) The King of France didn't visit the exhibition.

carry a 'strong suggestion' of existence is explained by this school as a *pragmatic* phenomenon (in the sense of Gricean principles of cooperation).

However, the appeal to pragmatics may also be turned into an argument in favour of semantic presuppositions. Contrary to the entailment view, I hold that both (a) and (b) presuppose semantically the existence of a king of France. The fact that (a) may be *used* in a non-contradictory way has a pragmatic explanation: the sentence can be used only in a very specific type of speech act which we might call a *corrective speech act.* Note in this connection that even contradictory sentences (i.e. sentences whose characteristic model set contains no 'true models) can be used in a pragmatically sensible way (for an example, see footnote 11). What a semantic notion of presupposition amounts to descriptively will depend very much on the general semantico-pragmatic framework presumed. Note, for example, that the status of semantic *existence* is of a completely different nature in a paradigm II system as compared to a paradigm I system. In a paradigm II system, semantic existence is meant in the very weak sense of existence in the 'true' models of the characteristic model set. All we are after is the construction of a set-theoretic icon which reflects the truth-conditions of the sentence (in its literal, compositional sense) and thus captures its literal meaning.

Considerations similar to those concerning 'existence' apply also to our use of the notion 'extension'. In a paradigm I system, 'extension' of, e.g. a name means the real world individual at a given index. In a paradigm II system, on the other hand, 'extension' means the formal denotation in the models of the characteristic model set serving as the set-theoretic icon of the sentence under interpretation. The real world object referred to (via pragmatics and perception) is called the *referent* in our paradigm II approach.

11 From a logician's point of view, the advantage of supervaluations is that reference may be defined bivalently. Thus, a predicate is always either true or false with regard to its argument(s) relative to a model-theoretic situation on its so-called 'classical valuations'. The price, however, is the assumption that a predicate is to be evaluated *several times* relative to the same index. If the formula is true in some such valuations and false in others, then the supervaluation (i.e. the valuation of the classical valuations) is undefined. Once we get to the level of supervaluations, van Fraassen's system works like the three-valued system of Kleene (cf. Rescher 1969), except that a sentence of tautological form, e.g. $A \vee \neg A$, is undefined for Kleene if A is undefined, whereas for van Fraassen the so-called classical tautologies are valid no matter whether their constituents are defined or not (and accordingly for contradictions).

The question of whether the classical tautologies should be always true or only if their constituents are defined seems particularly important within the paradigm I approach with its absolute notion of elementary truth. In a paradigm II system, on the other hand, the truth of a statement depends on the accuracy of verbal processing, the accuracy of perception and memory, and the proper pragmatic interpretation (i.e. the intended *use* of the expression relative to the context). It is a fact of nature that even a logical contradiction may be used to make a true statement. Consider the sentence *It is raining and it is not raining.* , uttered in the dry desert where rain drops reach the hand but evaporate before they reach the ground. Statements like this are common and nobody would accuse the speaker of saying something nonsensical or false. Now, if a logically contradictory sentence may be pragmatically true, nothing much seems to be lost (as far as the characterization of truth in an intuitive sense is concerned) if logical tautologies and contradictions are defined semantically only if their constituents are defined (i.e., are undefined if their constituents are undefined). We assume within the paradigm II approach that a sentence is a tautology if it is 1 relative to all those models in its characteristic model set which fulfill the presuppositions of its constituent sentences. In other words, a sentence is a tautology if its characteristic model set contains no models relative to which it is 0.

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