JOURNAL OF SEMANTICS

Volume 2
1983

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2005

JOURNAL OF SEMANTICS

VOL. II - 1983

JOURNAL OF SEMANTICS

AN INTERNATIONAL JOURNAL
FOR THE INTERDISCIPLINARY STUDY OF THE SEMANTICS OF
NATURAL LANGUAGE

ADDRESS: Journal of Semantics,
Nijmegen Institute of Semantics,
P.O. Box 1454, NL-6501 BL Nijmegen, Holland

Published by the N.I.S. Foundation, Nijmegen Institute of Semantics, P.O. Box 1454, NL-6501 BL Nijmegen, Holland

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ISSN 0167 - 5133

Printed in the Netherlands

Review article

Book reviews

JOURNAL OF SEMANTICS

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PUBLICATIONS RECEIVED

Trechsel, Frank R., *A Categorial Fragment of Quiche.* (Texas Linguistic Forum 20). Dept. of Linguistics, The University of Texas at Austin, Austin, 1982.

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A FUZZY-SET-THEORETIC APPROACH TO THE COMPOSITIONALITY OF MEANING: PROPOSITIONS, DISPOSITIONS AND CANONICAL FORMS *

L.A. Zadeh

Abstract

In its traditional interpretation, Frege's principle of compositionality is not sufficiently flexible to have a wide applicability to natural languages. In a fuzzy-set-theoretic setting which is outlined in this paper, Frege's principle is modified and broadened by allowing the meaning of a proposition, p, *to be composed not from the meaning of the constituents of* p, *but, more generally, from the meaning of a collection of fuzzy relations which form a so-called* explanatory database *that is associated with* p. *More specifically, through the application of test-score semantics, the meaning of* p *is represented as a procedure which tests, scores and aggregates the elastic constraints which are implicit in* p. *The employment of fuzzy sets in this semantics allows* p *to contain fuzzy predicates such as* tall, kind, much richer, *etc.; fuzzy quantifiers such as* most, several, few, usually *etc.; modifiers such as* very, more or less, quite somewhat, *etc.; and other types of semantic entities which cannot be dealt with within the framework of classical logic.*

The approach described in the paper suggests a way of representing the meaning of dispositions, e.g., Overeating causes obesity, Icy roads are slippery, Young men like young women, *etc. Specifically, by viewing a disposition,* d, *as a proposition with implicit fuzzy quantifiers, the problem of representing the meaning of* d *may be decomposed into (a) restoring the suppressed fuzzy quantifiers and/or fuzzifying the nonfuzzy quantifiers in the body of* d; *and (b) representing the meaning of the resulting dispositional proposition through the use of test-score semantics.*

To place in evidence the logical structure of p *and, at the same time, provide a high-level description of the composition process,* p *may be expressed in the canonical form* "X is F" *where* X=(X1,...,Xn) *is an explicit n-ary variable which is constrained by* p, *and* F *is a fuzzy n-ary relation which may be interpreted as an elastic constraint on* X. *This canonical form and the meaning-composition process for propositions and dispositions are illustrated by several examples among which is the proposition* p≜ Over the past few years Naomi earned far more than most of her close friends.

1. Introduction

It is widely agreed at this juncture that Frege's principle of compositionality has a rather limited validity in application to the natural languages (Hintikka (1982)). However, as is well known, its applicability may be extended, as it is done in Montague semantics (Partee (1976)), by the employment of higher-order type-theoretical constructs.

A different approach which is described in this paper is based on a broader interpretation of compositionality which allows the meaning of a proposition to be composed not from the meaning of its constituents, but, more generally, from the meaning of a collection of fuzzy relations in what is referred to as an *explanatory database*. With this interpretation of compositionality, Frege's principle regains much of its validity and, in its modified form, provides a basis for representing the meaning of complex propositions and other types of semantic entities. In particular, it may be used to represent the meaning of propositions containing fuzzy predicates exemplified by *tall*, *kind*, *much younger*, *close friend*, etc.; fuzzy quantifiers such as *most*, *many*, *few*, *several*, *not very many*, *frequently*, *rarely*, *mostly*, etc.; modifiers such as *very*, *quite*, *more or less*, *somewhat*, etc.; and qualifiers such as *quite true*, *very unlikely*, *almost impossible*, etc.

An especially important application of the approach described in this paper relates to the representation of the meaning of *dispositions*, that is, propositions with implicit fuzzy quantifiers. For example, the disposition *Overeating causes obesity* may be viewed as a result of suppressing the fuzzy quantifier *most* in the proposition *Most of those who overeat are obese*. Similarly, the disposition *Young men like young women* may be interpreted as an abbreviation of the proposition *Most young men like mostly young women*. On the other hand, the proposition *Anne tells a lie very rarely* may be interpreted as the *dispositional* proposition *Anne tells a lie very rarely*, in which the fuzzy quantifier *very rarely* may be viewed as a fuzzified version of the nonfuzzy quantifier *never*. In general, a disposition may have a number of different interpretations and the restoration or explicitation of fuzzy quantifiers is an interpretation-dependent process.

2. Test-Score Semantics

The modified Frege's principle underlies a fuzzy-set-based meaning-representation system termed *test-score semantics* (Zadeh (1981)). In this system, a semantic entity such as a proposition, predicate, predicate-modifier, quantifier, qualifier, command, etc., is regarded as a system of elastic constraints whose domain is a collection of fuzzy relations in a database - a database which describes a state of affairs, a possible world, or more generally, a set of objects or derived objects in a universe of discourse. The meaning of a semantic entity, then, is represented as a test which when applied to the database

yields a collection of partial test scores. Upon aggregation, these test scores lead to an overall vector test score, τ, whose components are numbers in the unit interval, with τ serving as a measure of the compatibility of the semantic entity with the database. In this respect, test-score semantics subsumes both truth-conditional and possible-world semantics as limiting cases in which the partial and overall test scores are restricted to {pass, fail} or, equivalently, {true, false} or {1, 0}.

In more specific terms, the process of meaning representation in test-score semantics involves three distinct phases. In Phase 1, an *explanatory database frame* or *EDF*, for short, is constructed. *EDF* consists of a collection of relational frames, i.e., names of relations, names of attributes and attribute domains whose meaning is assumed to be known. In consequence of this assumption, the choice of *EDF* is not unique and is strongly influenced by the knowledge profile of the addressee of the representation process as well as by the objective of explanatory effectiveness. For example, in the case of the proposition $p \triangleq$ *Over the past few years Naomi earned far more than most of her close friends*, the *EDF* might consist of the following relations: *INCOME [Name; Amount; Year]*, which lists the income of each individual identified by his/her name as a function of the variable *Year*; *FRIEND [Name,*μ*]*, where μ is the degree to which *Name* is a friend of Naomi; *FEW [Number;*μ*]*, where μ is the degree to which *Number* is compatible with the fuzzy number *few*; *MOST [Proportion;*μ*]* in which μ is the degree to which *Proportion* is compatible with the fuzzy quantifier *most*; and *FAR MORE [Income 1; Income 2;*μ*]* where μ is the degree to which *Income 1* fits the fuzzy predicate *far more* in relation to *Income 2*. Each of these relations is interpreted as an elastic constraint on the variables which are associated with it.

In Phase 2, a test procedure is constructed which acts on the relations in the explanatory database and yields the test scores which represent the degree to which the elastic constraints induced by the constituents of the semantic entity are satisfied. For example, in the case of p, the test procedure would yield the test scores for the constraints induced by the relations *FRIEND*, *FEW*, *MOST* and *FAR MORE*.

In Phase 3, the partial test scores are aggregated into an overall test score, τ, which, in general, is a vector which serves as a measure of the compatibility of the semantic entity with an instantiation of *EDF*. As was stated earlier, the components of this vector are numbers in the unit interval or, more generally, possibility/probability distributions over this interval. In particular, in the case of a proposition, p, for which the overall test score is a scalar, τ may be interpreted as the degree of truth of p with respect to the explanatory database *ED*(i.e., an instantiation of *EDF*). It is in this sense that test-score semantics may be viewed as a generalization of truth-conditional and model-theoretic semantics.

In summary, the process described above may be regarded as a

test which assesses the compatibility of a given proposition, p, with an explanatory database, *ED*. What is important to note is that the meaning of p is the test itself rather than the overall test score, τ, which it yields.

In effect, the test in question may be viewed as the process by which the meaning of a proposition is composed from the meaning of the constituent relations in the associated explanatory database. As was stated earlier, the essential difference between this approach to compositionality and that of Frege is that, in general, the meaning of a proposition, p, is composed not from the meaning of the constituents of p but from those of a database, *EDF*, which is constructed for the explicit purpose of explaining or representing the meaning of p in terms of fuzzy relations whose meaning is assumed to be known to the addressee of the representation process.

In some instances, the names of constituent relations in the explanatory database may bear a close relation to the constituents or the proposition. In general, however, the connection may be implicit rather than explicit.

In testing the constituent relations in *EDF*, it is helpful to have a collection of standardized rules for computing the aggregated test score of a combination of elastic constraints $C_1,\ldots, C_k$ from the knowledge of the test scores of each constraint considered in isolation. For the most part, such rules are *default rules* in the sense that they are intended to be used in the absence of alternative rules supplied by the user.

In test-score semantics, the elementary rules of this type are the following:[1]

Rules pertaining to unary modification

If the test score for an elastic constraint C in a specified context is τ, then in the same context the test score for

(a) *not* C is $1 - \tau$ (negation).
(b) *very* C is τ^2 (intensification or concentration).
(c) *more or less* C is $\tau^{\frac{1}{2}}$ (diffusion or dilation).

Rules pertaining to composition

If the test scores for elastic constraints C_1 and C_2 in a specified context are τ_1 and τ_2, respectively, then in the same context the test score for

(a) C_1 and C_2 is $\tau_1 \wedge \tau_2$, where $\wedge \triangleq \min$ (conjunction).
(b) C_1 *or* C_2 is $\tau_1 \vee \tau_2$ where $\vee \triangleq \max$ (disjunction).
(c) *If* C_1 *then* C_2 is $1 \wedge (1 - \tau_1 + \tau_2)$ (implication)

Rules pertaining to quantification

Let Q be a fuzzy quantifier (i.e., a fuzzy number) which is characterized by its membership function μ_Q.

Let A and B be fuzzy subsets of a universe of discourse $U=\{u_1,\ldots,u_n\}$,

with respective membership functions μ_A and μ_B.

Define the *sigma-count* (i.e., the cardinality) of A as the real number

$$\Sigma \text{ Count } (A) \triangleq \Sigma_i \mu_A(u_i)$$

where $\mu_A(u_i)$, $i = 1,\ldots, n$, is the grade of membership of u_i in A.[2]

Define the *relative sigma-count* of B in A as the ratio

$$\Sigma \text{ Count } (B/A) = \frac{\Sigma \text{Count } (A \cap B)}{\Sigma \text{Count } (A)}$$

$$= \frac{\Sigma_i \mu_A(u_i) \wedge \mu_B(u_i)}{\Sigma_i \mu_A(u_i)}$$

Then, the overall test score for the generic proposition

$$p \triangleq Q \text{ } A\text{'s are } B\text{'s},$$

where *A's* and *B's* are generic names of the elements of A and B, is given by

$$\tau = \mu_Q(\text{ Count } (B/A))$$

In effect, this expression indicates that the compatibility of p with the denotations of A and B is equal to the degree to which the proportion of *B's* in A - or, more generally, the degree of containment of A in B - fits the denotation of Q.

As an illustration of the use of some of these rules in test-score semantics, consider the proposition cited earlier, namely, $p \triangleq$ *Over the past few years Naomi earned far more than most of her close friends.* In this case, we shall assume, as was done earlier, that the constituent relations in the explanatory database are:

EDF $\triangleq$ *INCOME [Name; Amount; Year] +*
FRIEND [Name; μ] +
FEW [Number; μ] +
FAR MORE [Income 1; Income 2; μ] +
MOST [Proportion; μ].

Note that some of these relations are explicit in p; some are not; and that most of the constituent words in p do not appear in *EDF*.

In what follows, we shall describe the process by which the meaning of p may be composed from the meaning of the constituent relations in *EDF*. Basically, this process is a test procedure which tests, scores and aggregates the elastic constraints which are induced by p.

1. Find Naomi's income, IN_i, in $Year_i$, i=1,2,3,..., counting backward from present. In symbols,

$$IN_i \triangleq {}_{\text{Amount}}\, INCOME\,[Name=Naomi;Year=Year_i]$$

which signifies that *Name* is bound to Naomi, *Year* to $Year_i$, and the resulting relation is projected on the domain of the attribute *Amount*, yielding the value of *Amount* corresponding to the values assigned to the attributes *Name* and *Year*.

2. Test the constraint induced by *FEW*:

$$\mu_i \triangleq {}_{\mu}FEW\,[Year=Year_i],$$

which signifies that the variable *Year* is bound to $Year_i$ and the corresponding value of μ is read by projecting on the domain of μ.

3. Compute Naomi's total income during the past few years:

$$TIN=\Sigma_i \mu_i IN_i,$$

in which the μ_i play the role of weighting coefficients. Thus, we are tacitly asuming that the total income earned by Naomi during a fuzzily specified interval of time is obtained by weighting Naomi's income in year $Year_i$ by the degree to which $Year_i$ satisfies the constraint induced by *FEW* and summing up the weighted incomes.

4. Compute the total income of each $Name_j$ (other than Naomi) during the past few years:

$$TIName_j=\Sigma_i\, \mu_i IName_{ji},$$

where $IName_{ji}$ is the income of $Name_j$ in $Year_i$.

5. Find the fuzzy set of individuals in relation to whom Naomi earned far more. The grade of membership of $Name_j$ in this set is given by

$$\mu_{FM}\,(Name_j)= {}_{\mu}FAR\ \ MORE[Income1=TIN;\ \ Income\ \ 2=TIName_j\ ].$$

6. Find the fuzzy set of close friends of Naomi by intensifying (Zadeh (1978)) the relation *FRIEND* :

$$CF \triangleq CLOSE\ FRIEND \triangleq {}^2FRIEND.$$

which implies that

$$\mu_{CF}(Name_j)=({}_{\mu}FRIEND[Name=Name_j])^2,$$

where the expression

$${}_{\mu}FRIEND[Name=Name_j]$$

represents $\mu_F(Name_j)$, that is, the grade of membership of $Name_j$ in

the set of Naomi's friends.

7. Count the number of close friends of Naomi. On denoting the count in question by $\Sigma Count\ (CF)$, we have:

$$\Sigma Count(CF) = \Sigma_j \mu^2_{FRIEND}(Name_j)$$

8. Find the intersection of FM with CF. The grade of membership of $Name$ in the intersection is given by

$$\mu_{FM \cap CF}(Name_j) = \mu_{FM}(Name_j) \wedge \mu_{CF}(Name_j),$$

where the min operator $\wedge$ signifies that the intersection is defined as to the conjunction of its operands.

9. Compute the sigma-count of $FM \cap CF$:

$$\Sigma Count(FM \cap CF) = \Sigma_j \mu_{FM}(Name_j) \wedge \mu_{CF}(Name_j).$$

10. Compute the relative sigma-count of FM in CF, i.e., the proportion of individuals in $FM \cap CF$ who are in CF:

$$\rho \triangleq \frac{\Sigma\ Count\ (FM \cap CF)}{\Sigma\ Count\ (CF)}$$

11. Test the constraint induced by $MOST$:

$$\tau = {}_{\mu} MOST\ [Proportion = \rho],$$

which expresses the overall test score and thus represents the compatibility of p with the explanatory database.

In general, the relations in EDF are context-dependent. As an illustration, consider the proposition

$$p \triangleq Both\ are\ tall,$$

in which the standards of tallness are assumed to be class-dependent, e.g., depend on whether an individual is male or female. To reflect this, we may express the EDF for p in the following form:

$$\begin{aligned} EDF \triangleq\ & POPULATION\ [Name;\ Height;\ Sex;] + \\ & Indexical \rightarrow Name_{\alpha} + \\ & Indexical \rightarrow Name_{\beta} + \\ & TALL\ [Height;\ Sex;\ \mu], \end{aligned}$$

in which the notation $Indexical \rightarrow Name_{\alpha}$ indicates that $Name_{\alpha}$ is an *indexical* object, i.e., is pointed to by the context. More specifically, we assume (a) that $Name_{\alpha}$ and $Name_{\beta}$ are the names of two individuals in $POPULATION$ who are pointed to by the context in which p is assert-

ed; and (b) that the relation *TALL* is sex-dependent, with μ representing the degree to which an individual whose height is *Height* and whose sex is *Sex* is *tall*.

For the *EDF* in question, the steps in the test procedure which leads to the overall test score and thereby represents the meaning of *p* may be described as follows:

1. Find the height and sex of $Name_\alpha$ and $Name_\beta$:

   Height ($Name_\alpha$) *POPULATION* [*Name*=$Name_\alpha$]
   Sex ($Name_\alpha$) *POPULATION* [*Name*=$Name_\alpha$]
   Height ($Name_\beta$) *POPULATION* [*Name*=$Name_\beta$]
   Sex ($Name_\beta$) *POPULATION* [*Name*=$Name_\beta$]

2. Find the degrees to which *Name* and *Name* are tall:

   $\tau_\alpha \triangleq \mu$|*TALL* [*Height*=*Height* ($Name_\alpha$); *Sex*=*Sex* ($Name_\alpha$)],
   $\tau_\beta \triangleq \mu$|*TALL* [*Height*=*Height* ($Name_\beta$); *Sex*=*Sex* ($Name_\beta$)]

3. Aggregate the test scores found in 2:

   $$\tau = \tau_\alpha \wedge \tau_\beta$$

   in which we use the min operator ($\wedge$) to combine the test scores τ_α and τ_β into the overall test score τ.

As an illustration of the compositionality of meaning in the case of dispositions, we shall consider, first, the following simple disposition:

d $\triangleq$ *Claudine is a better tennis player than Michael.*

For concreteness, *d* will be assumed to have the interpretation expressed by the proposition

p $\triangleq$ *When Claudine* and *Michael play tennis, Claudine usually wins.*

The *EDF* for *p* is assumed to consist of the relations

EDF $\triangleq$ *PLAY TENNIS* [*Outcome*]+
USUALLY [*Proportion*;μ].

The relation *PLAY TENNIS* represents a tally of the outcomes of n plays between Claudine and Michael, with the variable *Outcome* ranging over the set {*Win*, *Lose*}, and with *Win* implying that Claudine won the game. The relation *USUALLY* is a temporal fuzzy quantifier with μ representing the degree to which a numerical value of *Proportion* fits the intended meaning of *USUALLY*.

The steps in the test procedure are as follows.

1. Find the proportion of plays won by Claudine:

   $$p = \frac{1}{n} Count\ (PLAY\ TENNIS\ [Outcome=Win]).$$

2. Test the constraint induced by *USUALLY*:

$\tau = {}_{\mu}USUALLY\ [Proportion=\rho]$.

This expression for τ represents the overall test score for d.

We can make use of the above result to represent the meaning of a more complex disposition, namely,

$d \triangleq$ *Men are better tennis players than women.*

which will be assumed to be interpreted as the proposition

$p \triangleq$ *Most men are better tennis players than most women,*

with the associated *EDF* consisting of the relations

EDF $\triangleq$ *POPULATION [M. Name; F. Name; μ]+*
MOST [Proportion; μ].

For simplicity, we assume that there are n men and n women in *POPULATION*, with μ representing the degree - computed as in the above example - to which *M. Name* is a better tennis player than *F. Name*. (More specifically, $\mu_{i,j}$ is the degree to which *M. Name*$_i$ is a better tennis player than *F. Name*$_j$, $i,j=1,\ldots,n$.)

The steps in the test procedure are as follows:

1. For each *M. Name*$_i$, find the proportion (i.e. the relative sigma-count) of women tennis players in relation to whom *M. Name*$_i$ is a better tennis player:

$$\rho_i \triangleq \frac{1}{n}\Sigma_j \mu_{ij}$$

2. For each *M. Name*$_i$, find the degree to which *M. Name*$_i$ is a better tennis player than most women:

$$\tau_i \triangleq {}_{\mu}MOST\ [Proportion=\rho_i].$$

3. Compute the proportion of men who are better tennis players than most women:

$$\rho = \frac{1}{n}\Sigma_i \tau_i$$

4. Compute the test score for the constraint induced by *MOST*:

$$\tau = {}_{\mu}MOST\ [Proportion=\rho].$$

This τ represents the overall test score for d.

As an additional illustration, consider the disposition

$d \triangleq$ *Young men like young women*

which, as stated earlier, may be interpreted as the proposition

$p \triangleq$ *Most young men like mostly young women.*

The candidate *EDF* for p is assumed to consist of the following relations:

EDF $\triangleq$ *POPULATION [Name; Sex; Age]+*
LIKE [Name 1; Name 2; μ]+

MOST [Proportion;μ],

in which μ in *LIKE* is the degree to which *Name 1* likes *Name 2.*

To represent the meaning of p, it is expedient to replace p with the semantically equivalent proposition

$q \triangleq$ *Most young men are P,*

where P is the fuzzy *dispositional* predicate

$P \triangleq$ *likes mostly young women.*

In this way, the representation of the meaning of p is decomposed into two simpler problems, namely, the representation of the meaning of P, and the representation of the meaning of q knowing the meaning of P.

The meaning of P is represented by the following test procedure.

1. Divide *POPULATION* into the population of males, *M. POPULATION*, and population of females, *F. POPULATION*:

   M. POPULATION $\triangleq$ $_{Name,Age}$ *POPULATION [Sex=Male]*
   F. POPULATION $\triangleq$ $_{Name,Age}$ *POPULATION [Sex=Female],*

   where $_{Name,Age}$ *POPULATION* denotes the projection of *POPULATION* on the attributes *Name* and *Age.*[3]

2. For each $Name_j$, $j=1,\ldots,l$, in *F. POPULATION*, find the age of $Name_j$:

   $A_j \triangleq$ $_{Age}$ *F. POPULATION [Name=*$Name_j$*].*

3. For each $Name_j$, find the degree to which $Name_j$ is young:

   $\alpha_j \triangleq \mu$*YOUNG [Age=*A_j*],*

   where α_j may be interpreted as the grade of membership of $Name_j$ in the fuzzy set, *YW*, of young women.

4. For each $Name_i$, $i=1,\ldots,k$, in *M. POPULATION*, find the age of $Name_i$:

   $B_i \triangleq$ $_{Age}$*M. POPULATION [Name=*$Name_i$*].*

5. For each $Name_i$, find the degree to which $Name_i$ is young:

   $\delta_i \triangleq \mu$*YOUNG [Age=*B_i*],*

   where δ_i may be interpreted as the grade of membership of $Name_i$ in the fuzzy set, *YM*, of young men.

6. For each $Name_j$, find the degree to which $Name_i$ likes $Name_j$:

   $\beta_{ij} \triangleq \mu$*LIKE [Name 1=*$Name_i$ *; Name 2=*$Name_j$*],*

   with the understanding that β_{ij} may be interpreted as the grade of membership of $Name_j$ in the fuzzy set, WL_i, of women whom $Name_i$ likes.

7. For each $Name_j$ find the degree to which $Name_i$ likes $Name_j$ and $Name_j$ is young:

$$\gamma_{ij} \triangleq \alpha_j \wedge \beta_{ij}$$

Note: As in previous examples, we employ the aggregation operator min ($\wedge$) to represent the effect of conjunction. In effect, γ_{ij} is the grade of membership of *Name* in the intersection of the fuzzy sets WL_i and *YW*.

8. Compute the relative sigma-count of young women among the women whom $Name_i$ likes:

$$\rho_i \triangleq \Sigma Count\ (YW/WL_i)$$

$$= \frac{\Sigma Count\ (YW \cap WL_i)}{\Sigma Count\ (WL_i)}$$

$$= \frac{\Sigma_i\ \gamma_{ij}}{\Sigma_j\ \beta_{ij}} \qquad = \frac{\Sigma_j\ \alpha_j \wedge \beta_{ij}}{\Sigma_j\ \beta_{ij}}$$

9. Test the constraint induced by *MOST*:

$$\tau_i \triangleq {}_{\mu}MOST\ [Proportion = \rho_i].$$

This test score, then, represents the degree to which $Name_i$ has the property expressed by the predicate

$$P \triangleq likes\ mostly\ young\ women$$

Continuing the test procedure, we have:

10. Compute the relative sigma-count of men who have property *P* among young men:

$$\rho \triangleq \Sigma Count\ (P/YM)$$

$$= \frac{\Sigma Count\ (P \cap YM)}{\Sigma Count\ (YM)}$$

$$= \frac{\Sigma_i\ \tau_i \wedge \delta_i}{\Sigma_i\ \delta_i}$$

11. Test the constraint induced by *MOST*:

$$\tau = {}_{\mu}MOST\ [Proportion = \rho]$$

This test score represents the overall test score for the disposition *Young men like young women*.

3. *Canonical Form*

The test procedures described in the preceding section provide, in effect, a characterization of the process by which the meaning of a proposition, *p* , may be composed from the meaning of the constituent relations in the *EDF* which is associated with *p* . However, the

details of the test procedure tend to obscure the higher-level features of the process of composition and thus make it difficult to discern its underlying modularity and hierarchical structure.

The concept of a *canonical form* of p, which plays an important role in PRUF (Zadeh (1978)), provides a way of displaying the logical structure of p and thereby helps to place in a clearer perspective the role of the consecutive steps in the test procedure in the representation of meaning of p. Specifically, as was stated earlier, a proposition, p, may be viewed as a system of elastic constraints whose domain is the collection of fuzzy relations in the explanatory database. In more concrete terms, this implies that p may be represented in the *canonical form*

$$p \rightarrow X \text{ is } F$$

where $X=(X_1,...,X_n)$ is an n-ary *base variable* whose components $X_1,...,X_n$ are the variables which are constrained by p; and F- which is a fuzzy subset of the universe of discourse $U=U_1 \times ... \times U_n$, where U_i, $i=1,...,n$, denotes the domain of X_i - plays the role of elastic constraint on X. In general, both the base variables and F are implicit rather than explicit in p.

As a simple illustration, consider the proposition

$$p \triangleq \textit{Virginia is slim.}$$

In this case, the base variables are $X_1 \triangleq$ *Height (Virginia)*, $X_2 \triangleq$ *Weight (Virginia)*; the constraint set is *SLIM*; and hence the canonical form of p may be expressed as

(Height (Virginia), Weight (Virginia)) is SLIM,

where *SLIM* is a fuzzy subset of the rectangle $U_1 \times U_2$, with $U_1 \triangleq [0,200cm]$ and $U_2 \triangleq [0,100\,kg]$.

If the assertion "X *is* F" is interpreted as an elastic constraint on the possible values of X, then the canonical form of p may be expressed as the *possibility assignment equation* (Zadeh (1978))

$$\Pi(X_1,...,X_n) = F,$$

in which $\Pi(X_1,...,X_n)$ denotes the *joint possibility distribution* of $X_1,...,X_n$. In more concrete terms, this equation implies that the possibility that the variables $X_1,...,X_n$ may take the values $u_1,...,u_n$, respectively, is equal to the grade of membership of the n-tuple $(u_1,...,u_n)$ in F, that is,

$$Poss\{X_1=u_1,...,X_n=u_n\} = \mu_F(u_1,...,u_n),$$

where μ_F denotes the membership function of F.

As an illustration, consider the disposition

$d \triangleq$ *Fat men are kind,*

which may be interpreted as an abbreviation of the proposition

$p \triangleq$ *Most fat men are kind.*

Let *FAT* and *KIND* denote the fuzzy sets of *fat men* and *kind men*, respectively, in *U*. Now, the fuzzy quantifier *most* in *p* may be interpreted as a fuzzy characterization of the relative sigma-count of *kind men* in *fat men*. From this, it follows that the canonical form of *p* may be expressed as

$$\Sigma Count\ (KIND/FAT)\ is\ MOST$$

or, equivalently, as the possibility assignment equation

$$\Pi_X = MOST$$

where

$$X = \Sigma Count\ (KIND/FAT),$$

and *MOST* is a fuzzy subset of the unit interval [0,1].

Along the same lines, consider the proposition

$$p \triangleq Most\ big\ men\ are\ not\ very\ agile.$$

As in the previous example, *BIG* will be assumed to be a fuzzy subset of the rectangle [0,200 cm] x [0,100 kg]. As for the fuzzy predicate *not very agile*, its denotation may be expressed as

$$not\ very\ agile \rightarrow (^2AGILE)'$$

where ^2AGILE represents the denotation of *very agile* and ' denotes the complement. More concretely, the membership function of ^2AGILE is given by

$$\mu_{^2AGILE} = (\mu_{AGILE})^2$$

and thus

$$\mu_{(^2AGILE)} = 1 - (\mu_{AGILE})^2$$

By relating the denotation of *not very agile* to that of *agile*, the canonical form of *p* may be expressed compactly as

$$p \rightarrow \Sigma Count\ ((^2AGILE)'/BIG)\ is\ MOST$$

As expected, this canonical form places in evidence the manner in which the meaning of *p* may be composed from the meaning of the fuzzy relations *AGILE*, *BIG* and *MOST*.

As a further example, consider the proposition

$$p \triangleq Peggy\ lives\ in\ a\ small\ city\ near\ San\ Francisco,$$

with which we associate the *EDF*

EDF $\triangleq$ *RESIDENCE [Name; City]+*
SMALL CITY [City;μ*]+*
NEAR [City 1; City 2;μ*].*

In *RESIDENCE*, *City* is the city in which *Name* lives; in *SMALL CITY*, μ is the degree to which *City* is small; and in *NEAR*, μ is the degree to which *City 1* is near *City 2*.

The fuzzy set of *cities which are near San Francisco* may be expressed as

$$CNSF \triangleq {}_{City_1}NEAR\ [City\ 2=San\ Francisco],$$

and hence the fuzzy set of *small cities which are near San Francisco* is given by the intersection

$$SCNSF \triangleq SMALL.\ CITY \cap CNSF,$$

which is, in effect, the fuzzy constraint set F in the canonical form "*X is F*." In terms of this set, then, the canonical form of p may be expressed as

$$p \rightarrow Location\ (Residence\ (Peggy))\ is$$

$$SMALL\ CITY \cap_{City_1} NEAR\ [City\ 2=San\ Francisco].$$

To illustrate a different aspect of canonical forms, consider the proposition

$$p \triangleq Mia\ had\ high\ fever.$$

In this case, we have to assume that the base variable

$$X\ (t) \triangleq Temperature\ (Mia,\ t)$$

$$\triangleq Temperature\ of\ Mia\ at\ time\ t$$

is time-dependent. Furthermore, the verb *had* induces a fuzzy or, equivalently, elastic constraint on time which may be expressed as

$$had \Rightarrow t\ is\ PAST$$

with the understanding that *PAST* is a fuzzy subset of the interval $(-\infty$, present time) which is *indexical* in the sense that it is characterized more specifically by the context in which p is aserted. Using this interpretation of *PAST*, the canonical form of p may be written as

$$p \rightarrow Temperature\ (Mia,\ t\ is\ PAST)\ is\ HIGH$$

To conclude our examples, we shall construct canonical forms for two of the propositions considered in Section 2. We begin with the proposition

$$p \triangleq Most\ young\ men\ like\ mostly\ young\ women.$$

As before, we represent p as the proposition

$$p \triangleq Most\ young\ men\ are\ P,$$

where P is the dispositional predicate *likes mostly young women*. In this way, the canonical form of p may be expressed as

$$\Sigma Count\ (P/YM)\ is\ MOST,$$

where P is the fuzzy set which represents the denotation of *likes mostly young women* in *M. POPULATION*, and *YM* is the fuzzy subset of *young men* in *M. POPULATION*.

To complete the construction of the canonical form, we must show how to construct P. To this end, we shall express in the canonical form the proposition

$$p_i \triangleq Name_i \text{ is } P,$$

where *Name* is the name of ith man in *M. POPULATION*.

As before, let WL_i and YW denote, respectively, the fuzzy set of women whom $Name_i$ likes and the fuzzy set of young women in *F. POPULATION*. Then, the canonical form of p_i may be represented as

$$Name_i \text{ is } P \rightarrow \Sigma Count\ (YW/WL_i) \text{ is } MOST.$$

In the above analysis, we have employed a two-stage process to represent the meaning of p through the construction of two canonical forms. Alternatively, we can subsume the second form in the first, as follows.

First, we note that, for each $Name_i$, the relative sigma-count $\Sigma Count\ (YW/WL_i)$ is a number in the interval [0,1]. Let R denote a fuzzy subset of *M. POPULATION* such that

$$\mu_R(Name_i) = \Sigma Count\ (YW/WL_i).$$

Then, the fuzzy set of *men who like mostly young women* may be represented as

$$P \triangleq MOST\ (R),$$

with the understanding that *MOST (R)* should be evaluated through the use of the extension principle (Zadeh (1978)). This implies that the grade of membership of $Name_i$ in P is related to the grade of membership of $Name_i$ in R through the composition

$$\mu_P(Name_i) = \mu_{MOST}(\mu_R(Name_i)),\ i=1,\ldots,k.$$

Using this representation of P, the canonical form of p may be expressed more compactly as

$$p \rightarrow \Sigma Count\ (MOST\ (R)/YM) \text{ is } MOST.$$

Using the same approach, the canonical form of the proposition

$p \triangleq$ *Over the past few years Naomi earned far more than most of her close friends*

may be constructed as follows.

First, we construct the canonical form

$$p \rightarrow \Sigma Count\ (FM/^2F) \text{ is } MOST,$$

where

$$CF \triangleq {}^2F \triangleq \textit{fuzzy set of close friends of Naomi}$$

and

$$FM \triangleq \textit{fuzzy set of individuals in relation to whom Naomi earned}$$

far more during the past few years.

Second, we construct the canonical form for the proposition which defines *FM*. Thus,

$$Name_j \text{ is } FM \rightarrow (TIN, TIName_j) \text{ is } FAR\ MORE,$$

in which the base variables are defined by

$$TIN \triangleq \text{total income of Naomi during the past few years.} = \Sigma_i \mu_{FEW}(i) IN$$

and

$$TIName_j \triangleq \text{total income of } Name_j \text{ during the past few years.} \triangleq \Sigma_i \mu_{FEW}(i) IName_{ji},$$

where IN_i is Naomi's income in year $Year_i$, $i=1,2,3,...$, and $IName_{ji}$ is $Name_j$'s income in $Year_i$.

It is possible, as in the previous example, to absorb the second canonical form in the first form. The complexity of the resulting form, however, would make it more difficult to perceive the modularity of the meaning-representation process.

Concluding Remark

The fuzzy-set-theoretic approach outlined in the preceding sections is intended to provide a framework for representing the meaning of propositions and dispositions which do not lend themselves to semantic analysis by conventional techniques. The principal components of this framework are (a) the explanatory database which consists of a collection of fuzzy relations; (b) the procedure which tests, scores and aggregates the elastic constraints, and thereby characterizes the process by which the meaning of a proposition is composed from the meaning of the constituent relations in the explanatory database; and (c) the canonical form which represents a proposition as a collection of elastic constraints on a set of base variables which are implicit in the proposition.

Notes

*To Walter and Sally Sedelow.

Research supported in part by the NSF Grants ECS-8209679 and IST-8018196.

1. A more detailed discussion of the rules in question may be found in Zadeh (1978).

2. The concept of cardinality is treated in greater detail in Zadeh (1982 b).

3. To obtain the projection in question, all columns other than *Name* and *Age* in the relation *POPULATION [Sex=Female]* should be deleted.

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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 prag-

matic 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.

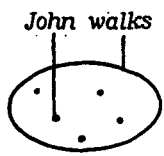
After describing the basic features of the paradigm I and the paradigm II approach in section 1, we turn in section 2 to a comparison of the two paradigms, especially with regard to the respective treatment of truth and vagueness. In section 3 we show that presupposition failure and vagueness are completely 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)



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* $@ =_{def.} (A,I,J,\leqslant,F)$ (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 $\leqslant$ 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 token 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:

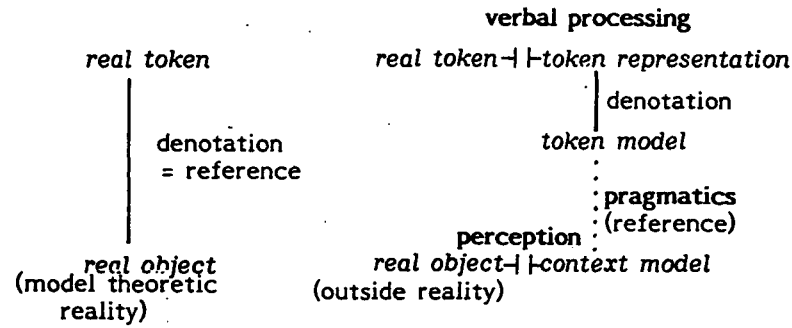
(4) $$\text{use of} \left\{ \begin{array}{c} form \\ | \\ \text{meaning}^1 \end{array} \right\} \text{relative to a context} = \text{meaning}^2$$

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)



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') ∧ talk' (j')

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

(8'') (a) walk j talk (b) walk j talk (c) walk j talk (d) walk j talk

values: 1 0 0 0

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

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

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

(a) $F^{a}(j') = a_0$ $F^{a}(walk') = \{a_0\}$ $F^{a}(talk') = \{a_0\}$

(b) $F^{b}(j') = a_0$ $F^{b}(walk') = \emptyset$ $F^{b}(talk') = \{a_0\}$

(c) $F^{c}(j') = a_0$ $F^{c}(walk') = \{a_0\}$ $F^{c}(talk') = \emptyset$

(d) $F(j') = a_0$ $F^{d}(walk') = \emptyset$ $F^{d}(talk') = \emptyset$

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') ∨ 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'') (a) walk j talk (b) walk j talk (c) walk j talk (d) walk j talk

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') ∧ ~walk' (j')

(10'') (a) walk j (b) walk j

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):

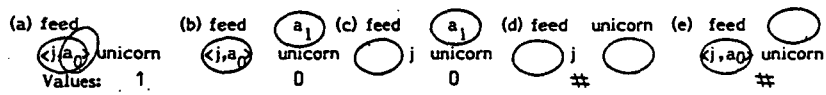
(11a) John fed the unicorn.
(11b) John didn't feed the unicorn.
(11c) There is at least one unicorn.

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

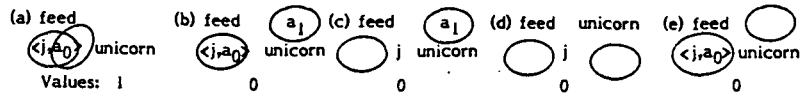
It is a simple fact of natural language that (11a) and (11b) both entail (11c), whereas (12b) - in contrast to (11a), (11b), and (12a) - does not entail (12c).[10]

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 *minimal* 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 repro-

duction 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 *T h e d o o r is closing.*, or wait a few moments and then say *The door is closed.*

4.1 The iconic content of red

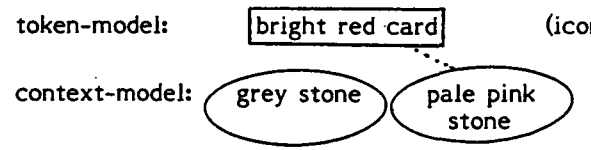
Next consider the sentence *Take the red stone!*, interpreted in the following two different situations. In one situation the hearer is confronted with a grey stone and a pale pink stone. Obeying the utterance *Take the red stone!*, he will pick the pale pink stone. In the other situation the hearer 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.

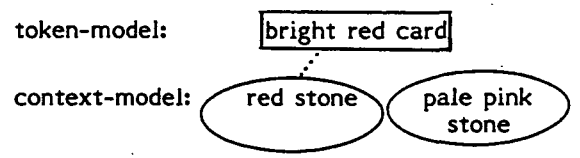
For the sake of simplicity let us assume that the iconic content of *red* is represented in form of a little card of bright red colour (regarded as the SID-internal prototype of *red*). Then the interpretation of the sentence *Take the red stone!* relative to the two situations described above may be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

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



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!



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.

Acknowledgements

This paper is a revised version of 'Vagueness and Truth', which appeared

in CONCEPTUS XVII (1983), no. 40-41, S. 29-52. I am indebted to Pieter Seuren and an anonymous reviewer of the JOURNAL OF SEMANTICS for valuable criticism and suggestions. I also benefited from discussions with Ulrich Blau, Christian Dreher, and Dietmar Zaefferer. The responsibility for all inadequacies and mistakes remains with the author.

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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PRONOUNS WITHOUT EXPLICIT ANTECEDENTS?

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Abstract [1]

Yule (1982) has argued that examples from speech show that pronouns may be interpreted nonreferentially. In the present paper, it is argued that pronouns elicit procedures for the identification of referents which are in explicit focus (Sanford and Garrod, 1981). Three experiments are offered in support of this view. The discussion centres on the need for carefully assessing the knowledge-states of listeners when pronouns are used in the absence of antecedents. It is proposed that felicitous use of pronouns without antecedents can occur only when listeners have particular things in mind which serve as 'effective antecedents'. If the listeners do not have these in mind, then it is argued that such usage is infelicitous. It is also argued that speakers may have particular antecedents in mind even if listeners do not.

The purpose of this article is to reconsider the thesis that pronouns are interpreted with reference to explicitly mentioned parts of discourse. It is stimulated largely by Yule's (1982) recent claim that under some circumstances, notably in conversation, listeners may not interpret pronouns referentially if the circumstances are right. The paper is arranged in two distinct sections. In the first part, three experiments are described which provide evidence that pronouns are interpreted referentially in *written* discourse. These experiments offer more substantial data than has been available hitherto. In the second part, Yule's examples and arguments are examined in some detail. In particular, we try to examine the processing implications of the two claims, and shall draw attention to the differences between the processing states of people playing the roles of producers of spoken or of written discourse, and the states of those playing the role of understanders of spoken utterances or written discourse. The distinction seems essential to a full discussion of the conditions of pronoun usage.

Let us begin with the claim that, except where used deictically, personal pronouns occur when there is an explicit antecedent for them in the discourse where they appear (e.g. Carpenter & Just, 1977; Clark & Clark, 1977; Garrod & Sanford, 1982). This implies a state of affairs in which a pronoun may be thought of as pointing to a procedure for the identification of a *referent structure* in the working memories of the users. Such a notion appears to be the intention behind part of Chafe's (1972) treatment of foregrouding, and motivates

the views of Garrod and Sanford (1982; Sanford & Garrod, 1981).

In terms of mental procedures, a pronoun would thus be viewed as essentially a search directive. For the moment we shall deal with only one aspect of the search formulation, and that is the distinction between explicit and implicit focus structures in memory. Garrod and Sanford, 1982 made the claim that "pronouns can only be used anaphorically to refer to *explicit* representations" (p. 29). The full argument is to the effect that what is represented in explicit focus derives directly from the structure of written text itself, and so, *in general* "*explicit* representations" in the quote above means explicitly mentioned entities.

The claim is based on a distinction which Sanford and Garrod (1981) make between two aspects of the working-memory representation of a piece of discourse - explicit and implicit focus. The distinction can be made clear by considering the following couplet:

(1) Harry drove to London.
(1') The car broke down half-way.

With this pair, sentence (1) contains no mention of *car*, although use of a vehicle (probably a car) would appear to be an entailment of the proposition that Harry drove to London. That some representation corresponding to 'car' is in the memory representation is consistent with the way in which a definite referring expression, *The car*, can be used despite the absence of an *explicit* antecedent. Sanford and Garrod (1981) report reading time data showing that sentence (1') takes no longer to read following a sentence in which *car* is implied than it does following a similar one in which *car* is stated explicitly. In the present paper, when we refer to implied antecedent conditions, we are referring to sentences which enable definite references to be made to something which is implied, without causing any processing difficulty.

If sentence (1) has been "Harry went by car to London", then "car" is explicit, and according to the theory, would be represented in *explicit focus*. As it is, some representation of car would be represented in *implicit focus*. Various arguments were put forward by Sanford and Garrod (1981; Garrod and Sanford, 1982) suggesting that the two *types* of representation, implicit and explicit, are accessible in different ways, and do not constitute an undifferentiated representation. Of particular importance to the present paper is the claim that *pronouns can only be used to refer to explicit representations*. Up to now, the only evidence presented in direct support has been anecdotal, based upon the apparent infelicity of discourse such as the following:

(2) Harry drove to London.
(2') It broke down half-way.

and

(3) Mary dressed the baby.
(3') They were made of pink wool.

There are three points to be made here. First, pairs (2) and (3)

seem infelicitous. Second, substituting the definite noun-phrases "The car" and "The clothes" would lead to no processing difficulty, indicating that there is a representation of these things in implicit focus. Finally, numerous informal comments from people viewing these materials were to the effect that these pairs sound strange because they convey the impression that *London broke down* and *Mary and the baby were made of pink wool* respectively.

The three experiments which follow are intended to provide new data relating directly to these points. We begin, then, by offering further justification for the claims made earlier (Garrod and Sanford, 1982). Later, we shall extend into a more general discussion of Yule's points.

The observations made above suggest that pronouns may perhaps only be used without an antecedent if conditions are such that there is nothing in the preceding material to which the pronoun could "bond" itself on purely syntactic grounds.[2] However, if such bonding is indeed a problem to be considered, then it would appear as though the pronoun is acting in accordance with the search formulation wherever possible. We shall refer to a situation where attachment of this type seems possible as 'bond-enabling', and cases where it does not as 'bond-excluding', presupposing nothing about the exact nature of the bonding at this point.

Experiment 1 is aimed at determining whether bonding always occurs during reading. The rationale behind the experiment is as follows: should bonding always occur then reading time for sentences containing pronouns without appropriate explicit antecedents should be longer under 'bond-excluding' ones, since the inappropriate bond so formed would have to be subsequently discarded and the sentence reevaluated.

Experiment 1

Bonding to irrelevant entities and antecendentless pronouns

Materials

Sixteen sets of bond-enabling and sixteen bond-excluding materials were produced, making up a total of 32 example materials. Each example consisted of three sentences, *antecedent*, *target* and *third*. An example of one bond-enabling and one bond-excluding material is shown in Table 1.

Table 1
Examples of materials showing a bond-enabling and bond-excluding case, together with explicit antecedent (EA) and no-explicit antecedent (NEA) options:
* denotes EA, + denotes NEA

(a) Bond-enabling

1	Ronald parted his long hair.	{with a comb* / {+

2	(Target)	It was twisted with many teeth missing.
3		He had had it since childhood.
		Question
Question		Did Ronald part his hair with a brush? (No)

(b) Bond-excluding

1	(Being arrested by the police*) (Being arrested+)	was embarrassing for Andy
2	(Target)	They took him to the station in a van.
3		He was charged with breach of the peace.
		Question
Question		Was Andy embarrassed by his arrest? (Yes)

For each material, two versions were produced by manipulating the *antecedent* sentence structure: in one case an explicit antecedent was stated (EA condition), and in the other, no explicit antecedent was stated (NEA). Materials were declared bond-enabling if there was some entity (or set of entities) introduced in the antecedent sentence which matched the pronoun in number (e.g. they) or gender and number (e.g. he, she, it). Bond-excluding materials were those in which the pronoun did not match any entity in the antecedent sentence in these respects.

The third sentence was added to ensure that subjects did not simply pause on the target sentence in order to seek an antecedent, but rather could just 'read on' if they so wished. Following the third sentence, a simple Yes/No question was added, so that subjects could be told that their aim would be to answer the question as quickly as possible.

The antecedent sentences all began with a nominalisation of the action or event being depicted. This was intended to topicalise the action as far as possible, hence any 'implicit antecedent' onto which the pronouns might map. This should have the effect of minimising any EA/NEA difference due to topicalisation effects.

Subjects

Subjects were 32 undergraduates from the University of Glasgow, who were naive about the aims of the experiment, and about psycholinguistics in general.

Design and Procedure

Each subject was presented with 32 trials. Of these, 16 were bond-excluding: in half of the bond-excluding cases there was an explicit antecedent for the pronoun (EA), and in the other half there was no

explicit antecedent (NEA). Of the 16 bond-enabling materials, half of them were also in the EA condition, and half of them in the NEA. Thus any one subject contributed 8 readings to each of the four possible conditions. For 16 of the subjects, one half of the materials were thus of the explicit antecedent variety; this was counterbalanced such that for the remaining 16 subjects, the *other half* of the materials were shown in the EA form. In this way, any one subject saw a particular material only once, but across the entire experiment, each material was represented an equal number of times in its two forms (EA or NEA). The order of presentation of trials was randomised.

The procedure was that of standard self-paced reading. The subject was seated in front of an Imlac visual display unit on which the sentences and questions were exposed one at a time. At the start of each trial, the subject pressed a space key to bring on the first sentence. After reading it, he pressed the same key for the next sentence, and so on until the question appeared. The subject then pressed one key to indicate a *yes* response, or another to indicate a *no* response. To initiate a new trial, on which the next complete material would be seen, the subject pressed the space key again. The time intervals between key presses were recorded automatically by a NOVA 2/10 computer, which also controlled the display.

The sequence of events for any subject was as follows: first there were ten three-sentence-plus-question materials shown which used either pronouns referring to explicitly introduced antecedents, or straightforward noun-phrase anaphora. This was intended purely as practice. Then the main experimental sequence started, beginning with two dummy (discardable) items, one of which was of the bond-enabling type, the other of the bond-excluding type. Then came the sequence of 32 test trials. Interleaved in these were 32 trials consisting of materials from an experiment completely unrelated to the present one. These materials were of comparable length and structure to the 32 trials of interest, and embodied various straightforward noun-phrase anaphora patterns. From the point of view of the current study, they were fillers, serving to add variety to the materials presented. This reduces the possibility of subjects developing specific, artificial strategies for processing the experimental materials. Subjects were free to take a break at any point; none chose to do so.

Subjects were instructed to read at a pace compatible with comprehension, and to respond as quickly as possible to the questions as was compatible with accuracy.

Results

Mean reading times under the four conditions of the experiment are shown in Table 2. Analyses of variance by subjects and materials showed a main effect for explicit antecedent/no antecedent, with min $F'(1,37) = 10.27$, $p < .001$. It is clear that this effect is caused, in the main, by the bond-enabling condition: the interaction of bond-

Table 2

Mean reading times for target sentences in Experiment 1, in msecs:

	EA	NEA
Bond-enabling	2259	3163
Bond-excluding	2317	2456

enablement with explicit antecedent/no antecedent is reliable, with min F' (1,34) = 5.79, $p < .05$. Independent tests carried out on the bond-enabling materials reveals that the effect of antecedent type, at some 904 msecs, is highly reliable, with min F' (1,33) = 12.4, $p < .001$. The much smaller effect of antecedent type under bond-excluding conditions, of 138 msecs, was not statistically reliable, although of a magnitude where effects can usually be detected using the reading time paradigm.

Conclusions and Continuing Discussion

Under the circumstances of the present experiment, it is apparent that bond-enabling conditions are disruptive to the process of interpreting sentences containing antecedentless pronouns. One is forced to conclude that the pronouns will bond to explicit representations which agree in gender and number, even when such bonding is inappropriate. This observation offers clear support for some version of the search formulation. However, when bonding is not possible, the difference in reading time for target sentences under 'implicit antecedent' circumstances is only 138 msecs slower than it is under explicit antecedent circumstances, and this is not statistically reliable.

At this point it could be argued that search for an explicit antecedent is the primary procedure associated with pronouns, and that when this fails, either a search for implied antecedents takes place, or pronouns are not interpreted through search, perhaps as Yule has argued. Either way, one might anticipate that under the implied antecedent condition, the target sentences would take longer to process, since nothing can happen until the explicit search has failed. It is unsatisfactory to obtain a 138 msec. effect in this direction which is statistically unsound: it could either mean that there is no real effect, the apparent effect being due to statistical noise, or it could mean that the experiment lacked the power to detect a real effect. This is directly addressed in the next experiment.

There is an additional problem with the bond-excluding materials. Bond-enablement was defined for the purposes of Experiment 1 in terms of possible mappings between entities (number, gender) and pronouns (number, gender). However, with the cases in which the pronoun 'it' was used, bonding might be possible to the *event* depicted by the context sentence. For instance, in the case below, the sentence-initial 'It' could be tested against the entire action, italicized below, and would be quite mappable:

(4) *Driving* proved difficult for Fred.
(4') It broke down half-way.

Given the clear effect of bonding obtained in the experiment, it is possible that event-bonding is responsible for obtaining the numerical effect of 138 msec under conditions hitherto described as bond-excluding. Control over this possibility is built into Experiment 2.

Experiment 2

Implied Antecedents and Event-bonding
Method

Materials

Twelve sets of potentially event-bonding materials and twelve event-bond excluding materials were constructed. The criterion of potential event-bonding was that the target sentence pronoun agreed in number with the event as shown in Table 3.

Table 3
Examples of materials for Experiment 2, showing a potential event-bonding case, and a bond-excluding case, each with EA and NEA options: * denotes EA, + denotes NEA.

(a) Potential event-bonding

1		(Driving the car*) / (Driving+) was very tiring.
2	(Target)	It had extremely poor air conditioning.
3		None of the ventilators seemed to work.
		Question
Question		Was the air conditioning working well? (No)

(b) Bond-excluding

1		(His second marriage*) / (Marrying his second wife+) made John happy.
2	(Target)	She certainly is compatible with him.
3		His first marriage was not so happy.
		Question
Question		Was John happy in his second marriage? (Yes)

The criterion for event-bond exclusion was that the target sentence pronoun differed in number from the event, or was gendered marked, and therefore inapplicable to event description in English.

For each set of materials, two versions were produced, one in

which there was explicit antecedent for the pronoun (EA), and one in which there was not (NEA). Materials were otherwise constructed in the same way as for Experiment 1, the target sentence being sentence 2, and the fourth sentence being a simple question.

Subjects

64 subjects took part, all of them undergraduates from the University of Glasgow. They were naive about the aims of the experiment, and about psycholinguistics in general.

Design and Procedure

Each subject saw 24 main trials for the present experiment. Of these, 12 were event-bond excluding, and 12 were potentially event-bonding. In each case, 6 materials were of the NEA and 6 of the EA type. For 32 of the subjects, one half of the materials were of the EA variety, while for the other 32, this same half of the materials was shown in the NEA condition. The order of presentation was randomised.

The standard self-paced reading paradigm was used, exactly as with Experiment 1.

The sequence of events for each subject began with two sorts of practice. In the first, subjects read a piece of narrative text, one line at a time. In the second, subjects saw 10 practice trials of a type similar to those used in the main experiment.

Results and Discussion

The mean reading times under the four conditions of the experiment are shown in Table 4.

Table 4
Mean reading times for target sentences in Experiment 2, in msecs.

	EA	NEA
Potential Event-Bonding	2022	2193
Bond-Excluding	1986	2104

In contrast to the findings of the first study, there was no significant bonding effect, but there was a reliable effect of EA/NEA, as revealed by analyses of variance (min F' (1,48) = 9.45; $p < .01$). No other effects approached significance.

It appears, therefore, that bonding is restricted to entities, and does not occur with actions. Secondly, it appears that target sentences which contain pronouns do indeed take longer to process under NEA conditions than under EA conditions, even when bonding of any type is precluded. Let us briefly consider each of these findings in turn. That bonding is restricted to entity-bonding is interesting. It suggests that pronouns activate procedures which seek out explicit entity re-

presentations, rather than action representations. Now in Experiment 1, any bonding of a pronoun to an irrelevant entity could be repaired by the content of the predicate. Suppose the pronoun *it* to bond to *London* when the pronoun is encountered - that is, at the stage indicated by the first bracket:

Keith drove to London.
It)$_1$ broke down half way)$_2$.

On evaluating the predicate (bracket 2) against pragmatic knowledge, *It* would be remapped onto some implicit < CAR >. The fact that a bonding effect was obtained *at all* necessitates this kind of early bonding. Now, consider the following, which demands a pronoun-event mapping:

Keith drank a lot and drove.
It was a rash thing to do.

On the account built up to now, *It* will fail to find an entity referent, and the parse will go through into the predicate, and the pronoun-event mapping will be the result.[3] Thus event-mappings should occur only after pronoun-entity mappings have failed. In terms of the Sanford-Garrod model (e.g. Garrod & Sanford, 1982), pronoun-event mappings are secondary processes.

The main finding that target sentences containing pronouns are read more slowly under NEA conditions is especially interesting. Suppose that subjects decided not to bother to make a mapping between pronoun and antecedent when this started to prove difficult. This would explain why the NEA condition was slower - they would only give up *after trying to make a mapping*. If search continued until a mapping was made, then this could perhaps be explained by the fact that the antecedent was *implicit*, and thus of a representation type which is normally outwith the range of the pronoun search procedure. We shall return to this point in the general discussion.

As it stands, the results of Experiment 1 and 2 imply that pronouns activate procedures which attempt to make mappings onto entities (or perhaps entity sets), and not onto events, and that the mapping may occur before the predicate has been parsed or evaluated.

Experiment 3

Rephrase Invitations

We might argue that the use of pronouns under NEA conditions, at least in written discourse, produces material that people believe to be poorly written, and that readers would paraphrase it into something easier to process given the opportunity. Indeed, paraphrasing techniques have been used to illustrate the difficulties which people have with strained anaphora in another context (Sanford & Garrod, 1981). It seems likely, *a priori*, that readers would certainly want to rephrase the clearly bond-excluding cases of Experiment 2. For example, would subjects really want to rephrase the following?

(5) Being arrested was humiliating for Andy.
(5') They took him to the police station in a van.

This experiment investigates the acceptability number of sentence pairs, some of which contain various types of antecedentless pronouns (bond-enabling, event bond-enabling, bond-excluding). The question is that of the degree to which the various types are judged as acceptable or are rephrased.

Method

Materials

Five sets of 10 materials were made up as follows. Each consisted of two sentences:

Set 1	Cases of simple noun-phrase anaphora to explicit entities in the first sentence.
2	Cases of simple pronoun anaphora to explicit entities in the first sentence.
3	Cases of bond-excluding pronoun references with no explicit referent in the first sentence.
4	Cases allowing event bond-enablement.
5	Cases allowing entity bond-enablement.

The total of 50 2-sentence passages thus produced were cast in a random order, and each one assigned a page of a small 10-page booklet.

Procedure

Each subject was given a booklet, and instructed to read each sentence - pair, and decide if they wished to rephrase the materials in order to make them 'sound better'. If they did so wish, then they were asked to write in their suggested rephrasing. The time taken to work through all 50 materials was about 30 minutes. Subjects were tested individually, or in groups of two or three.

Subjects

The subjects were 30 undergraduate Arts-faculty students from the University of Glasgow. They were completely unaware of the hypotheses under investigation.

Results and Discussion

Only rephrasings in which the pronouns were replaced by noun-phrases, were counted as rephrasing for the purposes of analysis. The average proportions of rephrasing for the four pronoun conditions were:

Set 2	EA,	7 %
Set 3	NEA, Bond-Excluding	83 %
Set 4	NEA, Event-Bond-Enabling	84 %

Set 5 NEA, Entity-Bond-Enabling 92%

Set 1 (noun-phrase anaphora) is omitted, since it is irrelevant, having been used only as a filler. The results are unequivocal-*all* antecedentless pronoun conditions showed a very high proportion of rephrasing (87 %) average), while the average for pronouns with antecedents was only 7%. An analysis of variance on the arc-sin transformed proportions shows a highly reliable effect of conditions, with min F' (3,58) = 45.39; $p < .0001$. Additional t-tests showed the difference between each one of the no-antecedent conditions and the pronouns with antecedent conditions to be highly reliable, while other comparisons were unreliable.

The rephrasing study clearly demonstrates an unprompted judgement that pronouns without antecedent are unacceptable - at least in materials of the type used here.

General Discussion

The results of these experiments are consistent with some version of the search formulation, in which pronouns are construed as calling procedures to seek representations in current explicit focus. Not only will pronouns bond to irrelevant representations (Experiment 1), but the absence of an explicit discourse string from which a bonding could occur results in slower reading for a sentence containing a pronoun (Experiment 2). Finally, people seem to have a marked preference for pronouns being used only when some current explicit focus representation is available. If one is not, they produce paraphrases putting one there, or else they replace the pronouns with a noun phrase. Thus measures of processing difficulty and a direct test of felicity conditions converge.

None of this denies the existence of discourse in which pronouns are introduced without any obviously identifiable explicit antecedent - Yule's paper illustrates a number of such examples. The problem is to determine what can be concluded about processing requirements from such examples. First of all there seem to be two distinct conclusions; one relates to production requirement *per se* and the other to comprehension. In terms of production the question is whether or not a speaker or writer only uses a pronoun to designate some referent which is specified explicitly in his own mental representation, a question about which it is very difficult to find conclusive evidence. In terms of comprehension of pronouns, presumably the assumption is that a speaker or writer in constructing his utterances is sensitive to the processing requirements of his listener or reader (See e.g. Marslen-Wilson, Levy and Tyler, 1982), and consequently will not in general produce 'inconsiderate discourse' (see Sanford and Garrod 1981). However, before any clear conclusion can be drawn, one has to take into account both the circumstances under which interpretation is to occur (e.g. whether it is spoken or written discourse) and the relationship between the producer and his audience (e.g. Is it dialogue or monologue, one-to-one or one-to-many?). This is of some importance if the produc-

er is to make any reasonable assessment of what entities might be explicitly represented in the focus of his audience. Garrod and Sanford's (1982) argument about explicit representation originates in the assumption that 'explicit focus' corresponds to the current limited focus of attention, and there are a veriety of sources of information which might enter such a focus of attention. First there is information from the immediate text itself, and in Garrod and Sanford (1982) it was this source which was given exclusive consideration. In fact, in the case of written discourse where the audience is remote from the producer, this is effectively the only source available. However, under other circumstances as for example in spoken dialogue, the immediate perceptual environment may also contribute to what is explicitly represented. Hence one is able to use pronouns demonstratively to pick out entities in the shared perceptual field. A third and perhaps less obvious source for explicit information comes from memory for experienced episodes. In one-to-one dialogue it is not uncommon for the speakers to be discussing some episode at which they were both present and consequently have common experience, in which case one might expect the shared memory to act as an explicit representation and so contribute to explicit focus. Such circumstances might underlie the use of an antecedentless pronoun in a case like the following. Suppose Max has borrowed a sum of money from John, and Max goes into a cafe in which he finds John sitting. He might then say, shamefacedly, "Don't worry I haven't forgotten *it*" and in so doing produce considerate discourse.

The relationship between different circumstances of utterance and what might be available within an explicitly focussed memory representation can perhaps be most easily demonstrated with reference to our use of deictic expressions, which, like pronouns seem to rely upon shared attention. The paradigm examples of deictic usage come from situations in which the speaker uses a linguistic expression to make an explicit gesture within the immediate shared perceptual field (Buhler, 1982). All the personal pronouns can be used in this fashion, 'I' pointing to the speaker, 'you' to the listener, 'he' to prominent others etc. Nevertheless it is also possible to use deictic expressions in relation to what we have called explicit focus in the case of reading: for instance use of 'this' to refer to the currently prominent discourse referent and 'that' to the nearest distal referent. As Davey (1978) observed in building his production simulation, it is often preferable to use the deictic 'that' as a substitute for the pronoun 'it' in examples such as the following:

> You began the game by taking a corner, I took an adjacent one, and you took the one adjacent to *that*.

Such examples illustrate the use of deictics to make gestures within a textual field of representation.

Finally it is also possible to use spatial deictics to pick out referents in a memory representation; what Buhler (1982) colourfully describes as 'deixis at phantasma'. A number of examples of this type of usage

are cited in Klein (1982), where a speaker in giving route directions will employ the machinery of spatial deixis in describing areas of a town remote from the speaker and listener, and consequently only representable in memory.

The point of this discussion is that under certain circumstances of language use the range of 'antecedents' available in explicit focus may go beyond what is identifiable in the substance of the text itself, and this is especially likely in just those cases cited by Yule, where we can assume that the speakers were engaged in dialogue. An important consideration under such circumstances is whether or not it is reasonable for the speaker to assume an available explicit representation in his listener's focus, and presumably prominence would play a role. For instance to take Yule's (1982) example (5): 'the last time he was here they got antlers - and he was writing he learned that this was the time *they* cast'. For this to be an example of considerate discourse (which out of context, it does not seem to be) one would expect that the speaker and listener were sufficiently familiar with the episode in question to have 'deer' in some generic sense explicitly in mind at the time the pronoun is encountered. Similarly in his example (8) the speaker seems to be employing a kind of *deixis at phantasma*:

> "the average working class man - the wages were very small - the rents run from anything from about five shillings to seven shillings which was about all *they* could've possibly afforded in *these* days - *we* just had to live - so it didn't matter how many of a family *you* had ... " (our italics)

What is striking about this example is that the speaker uses a deictic demonstrative 'these days' between his use of 'they' and 'we' or 'you'. This might suggest that he is indicating a shift in focus to a kind of subjective present which enables him to use the deictic pronouns 'we' and 'you' over a constructed memory domain. Consider for instance how the passage changes when 'they' is substituted throughout. Much of its immediate 'personal' impact seems to disappear. Of course, accounting for particular examples which arise in dialogue is bound to be speculative, in the absence of detailed contextual information. However, we would argue that any conclusion which one might draw from the occurrence of antecedentless pronouns in natural speech must be evaluated with care and done so in the light of the intersubjective circumstances of speaker and listener.

One final point which should be raised about Yule's discussion concerns the nature of the antecedent representation to which a pronoun might bond. Clearly it is often the case that pronouns identify non-specific antecedents which may be restricted in complex ways, as in:

(6) If Wolfgang likes *a painting* he usually buys *it*.

and in many of Yule's examples the pronouns would seem to be identifying such non-specific representations. Nevertheless the non-speci-

ficity of a pronouns interpretation should not necessarily be equated with failure to search for and find an antecedent representation *in explicit focus*, whether it arises directly from the prior text (as in 6) or originates from the other sources considered above.

Summary and final Conclusions

The experiments presented add to the argument that the primary procedure associated with pronouns is to seek a representation in explicit focus, and map onto it. Further, with written discourse, rephrasing patterns suggest that the use of pronouns without antecedents is judged infelicitous. In the general discussion, we tried to suggest ways in which pronouns might be used by speakers without obvious antecedents. We have concentrated on felicitous usage, leading to considerate discourse, which seem most ideally to fit Yule's test example situation.

For completeness, it should not be forgotten that not all discourse *is* felicitous. Thus young children frequently use pronouns in situations where it is impossible for listeners to pick out a referent (Karmiloff-Smith, 1980), a pattern which also appears to be a characteristic of the so-called 'restricted code' of children from lower socio-economic backgrounds (Bernstein, 1962). Similar patterns may be observed in the elderly (Sanford, unpublished data). Furthermore, the infelicitous use of pronouns may sometimes be observed in the uncorrected writing of literate adults. To explain such occurrences, it would be necessary for us to suppose that the things referred to by pronouns in such ways are prominent in the mind of the producer (in his explicit focus system), but that he is not evaluating the structure of his productions from the receiver's point of view. Such a speculation is far from unreasonable, but at present psychological studies of selection in production lag behind studies of comprehension. Our case is, then, that while Yule's examples add richness to the phenomena of pronoun usage, they do not appear to force a rejection of the conventional analyses, including our own version; and they do not provide a convincing argument for an alternative mode of processing pronouns. Nevertheless, they do illustrate a range of occurrences of pronouns which demand an explanation. We have tried to show that explanations are possible within a traditional framework.

Footnotes

1 Part of this research was sponsored through a grant from the SERC (GB); Experiment 3 was carried out by Leslay Hall and Mary Wilson.
We would like to thank Gillian Brown and George Yule for bringing these issues to our attention.

2 We choose the word 'bonding' rather than the more familiar 'binding' to emphasise no necessary connection with the theoretical assump-

tions underlying variable binding accounts of anaphora.

3 The argument does not depend upon the assumption that no predicate information is utilised during the mapping process, but the bonding result indicates that all of the information available in the verb is not used prior to mapping.

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ON THE NOTION OF THE MEANING OF THE SENTENCE

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Many linguists and logicians agree that two sentences often differ in their linguistic meaning, though they share their intensions (truth conditions), i.e. though they correspond to a single proposition (more exactly, to a single set of propositions with different reference assignments, see below). However, the research concerning the notion of linguistic meaning is still scattered, and much remains to be done to clarify this notion. Our approach is based on the existence of an operational criterion for synonymy, which has been presented elsewhere[1] and may be summarized as follows:

Two expressions (lexical or grammatical morphs, or syntactic constructions) **a** and **b** are synonymous (i.e. share one of their meanings) if and only if in every sentence **A** containing **a** the substitution of **b** for **a** (if grammatically possible) yields a sentence **B** having the same intension as **A** (i.e. for every possible world and reference assignment both **A** and **B** are true, or both are false, or both are inappropriate).

Two reservations should be made in connection with this criterion:

(i) it works in one direction only: if a pair of sentences related by such a substitution and not sharing their truth conditions has been found, then the two expressions **a** and **b** are not synonymous; however, if such a pair has not yet been found, it is always possible that a counterexample will emerge; only a more or less plausible hypothesis is present, as is always the case in empirical domains;

(ii) if **A** or **B** is ambiguous, then only one of its meanings should be compared with a meaning of the other sentence; the apparent circle contained in this point is also connected with the necessary presence of empirical hypotheses (in this point they concern the number of meanings of **A** or of **B** and the boundaries between them).

It can be checked that the criterion characterizes e.g. the morphophonemic difference between *lit* and *lighted* or *formulae* and *formulas* as synonymous. The same holds for such surface syntactic differences as those illustrated by (1) and (2):

(1) (a) He permitted to smoke there.
(b) He permitted smoking there.

(2) (a) He expects that Mary takes that train.
(b) He expects Mary to take that train.

On the other hand, our criterion gives a negative result for such examples as *John sold a car to Tom* vs. *Tom bought a car from John*. The

expressions N_1 *sell* N_2 *to* N_3 and N_3 *buy* N_2 *from* N_1, involved in these sentences, are not synonymous, and thus the sentences as wholes also differ in their meaning, though they share their truth conditions. As a matter of fact, there are two semantically relevant differences involved here:

(i) the verbs *sell* and *buy* do not fully correspond to each other: from *He is selling refrigerators to the inhabitants of northern Greenland* it does not follow that the inhabitants of northern Greenland are buying refrigerators from him;[2]

(ii) also the topic-focus articulation is semantically relevant, and *Few painters sell paintings to many businessmen* is a different assertion than that of *Many businessmen buy paintings from few painters.*

These and other examples (e.g. *English is spoken in ALASKA* vs. *ENGLISH is spoken in Alaska*) show that the topic-focus articulation, though being pragmatically based, belongs to the level of linguistic meaning.[3] Also other pragmatic elements have to be accounted for as included in linguistic meaning (e.g. the meaning of *today* includes *now* as well as *day*), and thus we do not consider pragmatics and semantics to constitute two separate levels of the language system (Sgall, 1977). From this it does not follow (as Schank et al., 1982, assume) that there is no 'dictionary', only an 'encyclopedia', or that there is no substantial difference between linguistic knowledge and common-sense knowledge. Linguistic systems, including linguistic meaning, should be distinguished from cognitive content, or truth conditions (intension, see above). However, it also appears as crucial to distinguish meaning (of a sentence) and sense (of its occurrences).

A sentence may have more than one meaning; each meaning of a sentence together with a specific reference assignment yields what may be called a sense (of an utterance). It is only a specific sense that can be assigned specific truth-conditions, i.e. a Carnapian proposition corresponds to a sense of an utterance, but the differentiation determined by 'sense' is more subtle than than based on 'proposition', as our examples above illustrate; thus the relationships between sentences and propositions can be described by means of the following framework:

The semantic system of natural language may be specified as a 9-tuple of the form (Expr, Sent, Mean, Ref, Sense, Prop, U, W, T), where - if for every f (x) we denote by f (X) the union of all f (x) for every $x \in X$:

Expr is a set of elementary expressions;

Sent is a set the elements of which are composed in a complex way (described by the grammar) from the elements of Expr; Sent is interpreted as the set of the (outer forms of) sentences of the language described;

for every $s \in$ Sent, Mean(s) is a set of labelled trees, interpreted as the set of the meanings of s, so that Mean (Sent) is the set of all meanings of the sentences of the language;[4]

U is a class containing as its elements all entities that can be referred to (also linguistic expressions, cf. above), i.e. U is much more

than the 'universe of discourse' known from many approaches to semantics; however, there are sets $U_i \subset U$, for $1 = i = n$, $n \in N$; the sets U_i are interpreted as the sets of objects to which a referring expression can refer (the set of all dogs, of all English irregular verbs, etc.);

for every $m \in$ Mean (Sent), Ref (m) = $U_1 x U_2 x U_3 x \ldots x U_{k(m)}$, where k (m) is the number of the referring elements in m, and an element of Ref (m) is interpreted as an assignment of reference;

Sense (m) = {m} x Ref (m);[5]

W is the set of possible worlds;

T is the set {true, false};

for every $h \in$ Sense (Mean(Sent)), Prop (h) is a partial fuction from W into T.

The partial function Prop (h) allows an assertion not to assign a possible world a truth value, if the presuppositions of the assertion are not satisfied in that world.

The more subtle differentiation determined by 'sense' can be useful in describing the semantics of the so-called hyper-intensional contexts (e.g. belief sentences). The identity of intensions is a necessary condition for two expressions to be interchangeable 'salva veritate' in intensional (e.g. modal) contexts; thus e.g. *four* and *the square of two* are interchangeable in such sentences as the following:

(3) The square of three is necessarily greater than four.
(4) It is not necessary that the number of the planets is greater than four.

On the other hand, in belief sentences the identity of intensions is not sufficient; in the general case identity of sense is necessary here,[6] cf. the following sentence, some occurrences of which certainly are true:

(5) I believe that the number of chairs in this room is greater than ten, but I doubt whether it is greater than the square root of the product of the squares of two and of five.

It is sometimes argued that (at least with one of the meanings of *believe*) if a person believes e.g. that (s)he has two eyes, then (s)he necessarily also believes that the number of her/his eyes equals the single even prime number; and similarly with other intensionally equivalent assertions, or even with all consequences. If the given person admits that (s)he believes a sentence S, while denying to believe another sentence S' corresponding to the same proposition, then, according to the mentioned approach, the believer is mistaken, (s)he does not realize that S' corresponds to the same proposition as S and that in fact (s)he thus believes S' as well as S. However, we still prefer to understand the verb *believe* (and other verbs of attitudes, such as *think*, *feel*, *doubt*), in such a sense that if someone sincerely states her/his attitude, it is hardly possible for her/him to be mistaken.[7] If Mr. N does not believe that 2 is a prime number (i.e. that the above mentioned sentences correspond to the same proposition), then a better mathematician can persuade him that his belief was mistaken; this leads to

a change of belief rather than to a recognition that the (new) belief was already present. If Mr. N is told that from his belief that S holds it follows that he also believes that S' is true, then he may truly answer: "Oh no, I may be inconsistent, if judged by your theories, but I am the only person who knows directly what I believe and what I don't."

These difficulties may be overcome if an attitude is understood as concerning neither a sentence (with its ambiguities), nor a proposition (which is not always identified by the believer), but a sense of a sentence, as characterized above.[8] It is true that this approach makes it necessary to include 'meaning' and 'reference assignment' in some not yet specified way into the frameworks of intensional logic. But only in such a way will it be possible to give an explicit account of natural language with its paradoxes (sentences the meaning of which is such that there is no reference assignment for which the utterance of such a sentence were true for any possible world), synonymies, ambiguities and metalinguistic expressions.

Notes

1 Sgall, Hajičová and Procházka (1977), see also Hajičova and Sgall (1978).

2 This treatment of the progressive mood (which plays the role of a relevant contextual item in our analysis) seems to be preferable to a characterization including a 'conative element': *John was working on his dissertation yesterday* does not imply *John wanted to finish the work on his dissertation yesterday* or some similar assertion; *John was rolling down the hill* probably should not be understood as ambiguous (with and without the 'conative element'). Also the meaning of the imperfective aspect in Slavonic languages can be described without a 'conative element', see e.g. Panevová and Sgall (1972).

3 The articulation plays a similar role in the meanings of sentences as the order of prenex quantifiers plays in various formal languages, but it is not adequate to describe the 'logical form' or 'underlying structure' of natural language sentences immediately by means of such languages. As for the relationship between topic-focus articulation and the assignment of reference, see Hajičová and Vrbová (1982).

4 A generative description with a 'semantic base' specifies first the set Mean (Sent) and then the inverse function of Mean as well as the composition of sentences and their meanings from elementary units.

5 'Sense' can be interpreted as a meaning of a sentence plus a **x**-tuple of lexically restricted reference assignments that are available; this **x**-tuple is understood as ordered in accordance with the left to right order of the **n** referring elements of **m**, so that Sense (**m**) determines a reference assignment for **m**.

6 It should be recalled that in metalinguistic contexts (which are not easily distinguishable from others) even the identity of sense is not sufficient for free interchangeability; in the general case no two different expressions x, y are interchangeable 'salva veritate' in such contexts as *The expression x is longer than the expression y*, and also in such as *The intension of x is identical with that of y*.

7 Any sane human being is supposed here to be able to tell what her/his opinions are; hesitations are possible (*I am not quite certain whether I approve Mike's choice*), but mistakes can occur only in cases where an external factor, not relevant for the present discussion, is present, e.g. if the referent of an expression was not duly identified, or if the limitations of the believer's knowledge of the language used are concerned, cf. *He believes that every chipmunk is a groundhog*, or *She believes that her son ran away with Ann but she doubts whether her son eloped with Ann*.

8 If Tom believes that Jim sold a car to Jack, then Tom also believes that Jack bought a car from Jim, though the two assertions do not share their sense. Tom infers one of this beliefs from the other as a reasonable human being, not exactly as a speaker of English: if Jim's selling a car to Jack was completed (which follows from the use of *sold* vs. *was selling*), then Jack bought the car, and vice versa. In other words, not only linguistic meaning and reference assignment, but also an elementary amount of inferencing is necessary in deriving the equivalence of such two assertions.

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Review article

James D. McCawley, *Thirty Million Theories of Grammar*. The University of Chicago Press, Chicago / Croom Helm, London, 1982. Pp. 223. Hardcover. Price: £ 14,00.

Reviewed by: Pieter A.M. Seuren

This book contains four studies by McCawley (McC) and a nine-page introduction. The four papers were written in the 1970s and deal, for the most part critically, with theories and descriptions proposed, in that period by Chomsky or linguists closely associated with him. The first, and by far the largest paper (118 pages) was written in 1973 and published in the relatively inaccessible *Studies in English Linguistics 3*; 209-311 (1975). It is an extensive critique of Chomsky (1972) (surprisingly not included as a separate item in the References). The second paper is a corrected version of an article which appeared in 1976 in *Linguistic Inquiry* under the title 'Notes on Jackendoff's theory of anaphora', but is entitled here 'How to get an interpretive theory of anaphora to work'. Then follows 'Language universals in linguistic argumentation', McC's forum lecture at the 1978 Linguistic Institute held at the University of Illinois at Champaign-Urbana. And lastly, there is 'The nonexistence of syntactic categories', a revised and expanded version of a paper read at the Second Annual Michigan State Linguistic Metatheory Conference, in 1977.

In these four papers McC vindicates, in principle, the major tenets of what has become known as generative semantics against alternatives proposed by Chomsky and associates. He carefully avoids, however, being drawn into artificial camp distinctions or school labellings. His strategy throughout is to concentrate on issues, not on what are considered 'schools of thought'. He is remarkably silent on aspects of professional behaviour. Yet the reader cannot help noticing, on going through McC's text, that not infrequently a theoretical position advanced by linguist A was not accepted in Chomskyan circles, whereas an identical or crucially similar position advanced by linguist B was warmly welcomed there. And he will infer that this had to do with the fact that B belonged to the 'right' school. But McC is hardly ever explicit on this count. An exception is p. 153, where he states explicitly that certain theoretical positions associated with certain linguists have too often been evaluated on the grounds of such associations rather than of their intrinsic merits. Negative value judgments are studiously avoided. If they are found they are never tied to a name, at most to a group, as on p. 160 where McC speaks of 'cheap arguments' developed by linguists on the basis of ad hoc universals of grammar, proposed only to support favourite analyses: "Those argu-

ments have given the illusion of significance only because their alleged role in the war effort against 'excessive power' has obscured important respects in which they are extremely implausible." Positive value judgements, on the other hand, are made with delicate moderation.

Stylistically, McC shows himself, again, a master. Not only does he have an extraordinary command of the English lexicon, he also shows that the old dictum that English does not like long sentences is wrong. His style is thoroughly English and yet abounds with very long sentences rolling themselves out agreeably before the reader's eye. It apparently just takes a better hand to write such sentences in English than in other languages better known for their pliability to lengthy periods. As a result there is a certain highly personal baroqueness about his style, reflected also in the somewhat extravagant title of this book (as well as of one or two other books by the same author).

More importantly, however, his arguments are generally forceful and lavishly peppered with references to existing literature. They excel in showing common sense and a feeling for well-balanced proportions. Only rarely does an argument fall flat, as on p. 164-5, where McC argues against "the putative universal that no quantifiers need be used in formulating transformational rules". Bach uses this universal to argue for an underlying VSO-order in Amharic, despite the surface SOV-order, in an article (1970) which is otherwise highly praised by McC. McC's objection (p. 165) is that scanning procedures involving the spotting of first, second, ..., last occurrences of certain phenomena in perceptual fields are well-attested in perceptual mechanisms (he refers to Miller & Johnson-Laird (1976)), and he concludes that there is therefore no a priori reason to exclude such procedures from grammars: "I hold that it is implausible to suggest that organizational features that figure widely in perception and in non-linguistic knowledge are systematically excluded from language." This may be so on a priori grounds, but it fits in badly with McC's repeated insistence that rules of grammar are not to be regarded as formulations of psychologically real procedures under any direct process interpretation. Moreover, if in the practice of relatively successful grammatical description it is found that rules tend to conform to a certain (perhaps not yet clearly definable) pattern or format which never involves quantification over nodes or categories, then it is certainly preferable, and thus arguably better, to adopt descriptions that follow the established format. As has been said, however, the great bulk of the arguments developed by McC in this book are not of this nature. I have mentioned the argument against Bach only because of its rarity value.

Reading the first paper, McC's extensive critique of Chomsky (1972), is like leafing through an old photograph album. The whole gamut of once familiar issues is gone through again, and one can't help smiling at the thought of those old debates, which for the most part have led to so surprisingly little. One relives the discussions on nominalizations, *respectively*, contrastive stress and focus, on quanti-

fiers, on anaphora, on the present perfect versus the simple past tense, on questions of lexical decomposition and lexical insertion, - to mention but the most outstanding among the issues at hand. And a certain melancholy is unavoidable when one realizes how limited, on the one hand, the terms and insights were within which these discussions took place and how restricted the knowledge of the factors and parameters involved, and, on the other hand, what far-reaching conclusions were drawn. It is remarkable that McC's comments on the issues discussed are still relatively fresh and considerably less faded then the arguments he criticises. His reliance on good common sense and on normal proportions in intellectual discourse made him see quite clearly, even then, the abyss of ignorance and thus the relativity of the arguments and the conclusions.

This does not mean that McC is in any way 'soft' with his opponent, Chomsky. On the contrary, he makes tasty mincemeat of virtually all the arguments proposed in Chomsky (1972). Every single issue is reviewed, and on practically all counts Chomsky is shown to be crucially wrong. McC shows in particular that Chomsky's proposals regarding nominalizations in 'Remarks on nominalizations' do not warrant the distinction as drawn by Chomsky between a 'lexicalist' and a 'transformationalist' approach. As is borne out by later developments, this distinction was artificial and inconsequential.

In Chomsky's own words (1972: 54), "the strongest and most interesting conclusion that follows trom the lexicalist hypothesis is that derived nominals should have the form of base sentences, whereas gerundive nominals may in general have the form of transforms". If this claim were correct, it would be an interesting one, but in no way opposed to anything deserving the name of 'transformationalist position'. The claim, however, is multiply falsified. The most pervasive class of counterexamples consists of cases of Equi-deletion: we find subject-to subject deletion in nominals such as *Harry's refusal to leave*, *your wish to succeed*, and object-to-subject deletion in cases like *Mary's permission to go*, *Monty's order to attack*. Then there are cases like *John's tendency to be rude*, displaying subject-to-subject raising, an example quoted by McC in a note on p. 111. (One should note, however, that the lexicon does not seem to follow the syntax on all points, witness the impossibility of **its tendency to rain in Spain*, despite the normal *It tends to rain in Spain.*) Surprisingly, these obvious problematic cases are not discussed at all by Chomsky. Later, the theory was developed, in his school, that Equi-deletions are not part of the syntax at all, but 'only' of the semantics. The problem of subject-to-subject raising has never been treated seriously. Another important and obvious class of counterexamples is provided by those nominals that incorporate a passive: *the destruction of the city by the enemy*. Here Chomsky resorts to the amazing tactic of proposing that the Passive rule applies both to sentences and to noun phrases containing nominals. It is difficult not to be impressed by this stark violation of what Chomsky calls the lexicalist hypothesis.

What remains of Chomsky's claim is that some transformations

are seen to operate both in sentences and in nominals, whereas others are not. Thus, for example, the so-called rule of *tough*-movement *(Harry is easy to convince)* never seems to be reflected in nominals: * *Harry's ease to convince.* The Chomsky approach is to find ways of showing that those transformational rules that do manifest themselves also in nominals do not, after all, really belong to syntax. The opposite approach would be to try to show that those rules that do not occur in nominals are not, after all, really syntactic. Both approaches are misdirected unless there is powerful independent evidence that either position is fruitful and therefore justified. But such evidence has not been forthcoming. In these circumstances it seems most sensible to leave grammar (syntax) as it stands, and try to find some rationale for the fact that some transformational rules do occur within the lexicon while others do not.

Instead, the Chomsky school insisted on upholding the extreme position labelled 'lexicalist', and it thus became necessary to graft semantic interpretation rules onto surface structures, as well as on deep structures, - the development known as 'Extended Standard Theory' (EST). The two remaining papers in Chomsky (1972) are devoted to an exposé and a defence of EST. McC (p.78) observes correctly:

> "Chomsky grossly exaggerates when he indicates that the EST involves a narrow departure from standard theory:
>
> > Then the standard theory asserts that the rules include transformations, the base rules, and the output condition noted < the condition that a surface structure may not contain # or Δ > , along with the rules that map deep structures onto semantic representations. EST identifies certain aspects of semantic representation that are determined by deep structure, or others that are determined by surface structure, but otherwise permits no new sorts of rules. (Chomsky (1972: 141))
>
> His use of 'otherwise' brings to my mind the line 'Aside from that unfortunate incident, how did you enjoy your evening at the theater, Mrs. Lincoln?'"

McC then illustrates the enormous changes that are needed if the semantics is grafted on the surface structures as well as on the deep structures.

This illustrates a remarkable feature in Chomsky-type linguistics: all the action is taken to be in the syntax, whereas the semantics is considered a sideshow of a sideshow. Commenting on the rush for 'universal' constraints on rules which made Chomskyan linguistics quite feverish during the 1970s, McC notes (p. 72): "There is, incidentally, a striking gap in Chomsky's list of things that must be restricted: he does not mention placing any restriction on the category of 'admissible semantic interpretation rules'." This point is illustrated by McC on p. 58-9, where he comments on Chomsky's criticism of the rule of *can*-raising in English sentences of the type *I can't seem to find my hat.* Since this rule applies only to cases where *can* means 'be able',

and not to cases with the epistemic modal meaning 'possible' (**This can't seem to be true*), it must be sensitive to this semantic difference (Chomsky 1972: 108-9). This is, in Chomsky's words, "an otherwise unmotivated complication". McC reacts (p. 59) by saying: "it cannot be simply the drawing of the distinction that Chomsky is calling an 'unmotivated complication'; evidently he finds it an 'unmotivated complication' only if it appears in a syntactic rule."

A further factor is Chomsky's insistence that rules of semantic interpretation have a "filtering function" (p. 109), in the sense that the rules of syntax will allow for structures which under any reasonable criterion must be considered unwellformed, but which will then be "filtered out" by the interpretation rules. The latter thus have to prop up the syntax in determining wellformedness. Chomsky speaks of "ungrammaticality" when structures are rejected by whatever syntax he is considering at any given moment, but of "deviance" when the rejection is (supposedly) done by the semantic rules. In the absence of any independent criterion for "determining in advance what the factual domains of 'syntax' and of 'semantics' are, any restriction on 'syntax' can be met simply by calling rules that violate it 'semantic', if 'semantic' rules are left unconsidered" (McC p. 72). On p. 89 McC demonstrates a consequence of Chomsky's position in this respect: since for Chomsky the semantic rules filter our violations of gender agreement, there is no reason why they should not do the same for violations of person, case, and number agreement. This would brand as grammatical (but deviant) sentences like:

(1) a. *Le plume de mon tante sont sur le table de mes oncle.
b. *Omnibus Gallia sum in tria partes divisum.

But even if we take Chomsky literally, and let the semantic rules filter out only violations of gender agreement, it would follow that Italian syntax would be happy to assign to (2a) the structure of (2b) and vice versa:

(2) a. Nelle città italiane antichi palazzi abbondano.
(In Italian cities ancient palaces abound.)
b. Nelle città italiane antiche palazzi abbondano.
(In ancient Italian cities palaces abound.)

It would be easy to carry on in this vein, but we would then do nothing but shadow McC's discussions of all the various points. Suffice it to say that, when judged on their merits, Chomsky's theories and analyses sadly collapse. Under McC's guidance we witness a succession of faulty or defective observations, inconsistencies, misunderstandings of issues, tendentious phraseology, misrepresentations of issues and positions, non-sequiturs.

In the second paper in the book under review McC takes a close and competent look at Jackendoff's (1972) treatment of anaphora and in particular VP-anaphora. McC shows himself as sympathetic as possible, trying to avoid false generalized oppositions, such as the false opposition between a 'generativist' and an 'interpretivist'

approach. McC's argument is that if Jackendoff's semantic interpretation rules are to do the work they are supposed to do, then either they are themselves rules of syntax or the syntax must at least be supplemented with rules that Jackendoff wishes to ban from it. Thus, a VP-deletion rule would have to be reinstated, but under conditions of syntactic *and* semantic identity with the antecedent VP.

The discussion as a whole makes for very pleasant reading. And although I would be inclined to declare McC the winner (but then I am obviously open to a charge or partiality), I have the definite feeling that the debate has lost some (but certainly not all) of its relevance, due to a lack of insight into what lies beyond the rules and the semantic representations. After all, the semantic representations of both McC and Jackendoff are themselves *linguistic* objects, which therefore have their own meaning. It would of course be circular to try and specify *those* meanings again in semantic representations, and one is thus left with the uncomfortable conclusion that all that has been achieved so far is a paraphrase from surface structures into some hopefully analytically significant language of semantic representations. But the phenomenon of meaning itself remains obscure. Here and there, McC makes noncommittal references to notions developed in so-called formal semantics, but the support coming from possible world semantics is clearly insufficient. While defending his VP-deletion rule (and the same goes for rules like Gapping and other forms of coordination reduction), McC appeals to a criterion of 'semantic identity'. Yet it is not clear what this is meant to involve. Even if we take the notion of semantic representation in as wide a sense as Jackendoff does, so that it includes a constituent structure tree with references to the lexicon, a coreference table, a 'modal structure' (specifying scopes of operators), and a topic-comment structure, - even then the semantic identity criterion is not clear.

In the case of VP-deletion, coreferentiality between NP's in the antecedent VP and NP's in the deleted VP is generally not necessary:

(3) Harry knew the answers, but Bill didn't.
(4) Harry cut himself, but Bill didn't.

In (3) the answers Bill did not know may be those Harry did know, but they might just as well have been different answers to different questions. The natural reading of (4) involves Bill not cutting himself, not not cutting Harry. Both Jackendoff's and McC's discussion of, in particular, VP-deletion is based on the assumption that, as a rule, coreferentiality is required, or at least identity of variables (manifesting themselves as pronouns or as zero), as in (4), or:

(5) Harry wants to leave, but Bill doesn't.

where the subject of *leave* in the antecedent VP is *Harry*, but in the deleted VP *Bill*. This assumption is, however, erroneous, even for cases where the antecedent VP contains an 'ordinary' referring pronoun, as in (6), amply discussed by McC:

(6) Fred got Sally to kiss him, but Sue refused to.

Both Jackendoff and McC take it as a condition for, respectively, anaphora and VP-deletion that what is involved is Sue refusing to kiss Fred. This, however, only appears to be so, probably for pragmatic reasons. If this were a condition, then a text such as:

(7) Fred left the party with Sally, and Bill with Sue. Both wanted the girl they left with to kiss them. Now Fred got Sally to kiss him, but Sue refused.[1]

would have to be marked as deviant, ungrammatical, unwellformed, or whatever label one wishes to use for rejects of the theory. The same applies to cases like:

(8) Harry drives a Cadillac, and Bill a Volkswagen. Now Bill takes good care of it but Harry doesn't.

(An appeal to 'sloppy identity' will, of course, not do for such cases.)

In general it seems to be the case that referential identity, though not excluded *per se*, is not at all required for VP-deletion, - except, of course, where referential identity is ensured by independent means, as with proper names (in most cases), or by the express addition of a phrase ensuring strict coreferentiality (as when I add *the same answers, I mean* to (3)). Both Jackendoff and McC, therefore, are in error on this issue. The problem now is that, if we drop their unjustified requirement of coreferentiality (or identity of variables), it is no longer clear what the semantic identity, which is obviously required under some formula, actually involves. Identity expressible in terms of deep structure trees, as in:

(9) John was amazed at the shooting of the hunters, and so was Bill.

(McC p. 143) is clearly required. But reference relations are unclear. Some 'identity', or at least analogy, seems required, but it is not clear under what formula.

It seems to me that the observational inadequacy we find with both Jackendoff and McC is to be ascribed to a certain myopic preoccupation with sentence-internal anaphora, characteristic for all discussions on anaphora in linguistics up till very recently. On the rare occasions where external anaphora is mentioned, it is glossed over one way or another. The real reason why external anaphora was never seriously discussed was, of course, the fact that no analytical or descriptive apparatus was available. Nowadays, there is a growing insight that external anaphora is part of discourse semantics, and that any semantic theory of natural language will have to incorporate not only a truth-conditional part but also a part which specifies the role of discourse in semantic interpretation. It is, one would expect, here that sentence-external anaphora would find its place. In any case, the neglect of external anaphora seems to be have blinded linguists, including McC, for observational material where precisely this form of anaphora disturbs the peace, - as in (7) and (8) above, and in those interpretations of (3) and (6) where there is no corefe-

rentiality. It must be said, in all fairness, that McC comes very close to a discussion of discourse factors involved on p. 145-6, where he comments on cases such as:

(10) a. Frank didn't buy a car, but Shirley did, and she paid $ 3000 for *it*.
b. Frank bought a car, and so did Shirley, and *they* both cost over $3000.

He there refers to work by Karttunen, as well as by himself, for further elaboration.

The third paper in this book is on questions of language universals. McC's position in this respect is characterized by the natural point of view that if one speaks of linguistic universals it is useful to look at a variety of languages, including languages or uses of language that make no use of sound as a medium, such as written language use, or American Sign Language. He thus comes to the reasonable conclusion that all linguistic universals are implicational universals, even if some of them may have the trivial implicational form "if x is a language, then ...". He stresses, furthermore, that one should take into consideration quite seriously the possibility that individuals speaking the same language have nevertheless different competences. If universals are genetically determined, as Chomsky has it, then that means that there is room for individual variation within the universal categories, just as humans are genetically determined not only to have two ears but also to differ from individual to individual in the size and other morphological details of those organs. He also puts out a warning against the unwarranted use of proposed universals whose only function is to prop up theories or analyses which are otherwise "extremely implausible" (p. 160). He makes it clear that the simful use of putative but in fact totally unsupported 'universals' is characteristic of the Chomsky school of linguists.

The really interesting aspects of this paper, however, all have to do with specific issues. Among these, some are to do with phonology, others with grammar. I shall concentrate on the latter.

The most notable feature in McC's discussion of grammatical universals is his insistence that it makes sense to consider the theory that there is no left-to-right ordering in deep structure. McC does not present this point of view as a clearly formulated and testable theory. Rather, one has the impression that he is toying with the idea. The idea is that the structural relations necessary for a proper functioning of the transformational rules are all expressible in relational terms (subject of, object of, etc.), more or less as proposed in work by Postal and others in the mid-1970s. McC would like to be able to establish that no transformational rule ever makes crucial use of order in its underlying structures, although a complete or partial ordering may be imposed on the output structures. This raises the question of how and when and under what constraints order is introduced into the structure trees, and this question is not answered.

McC realizes that his proposed route is littered with mines. He

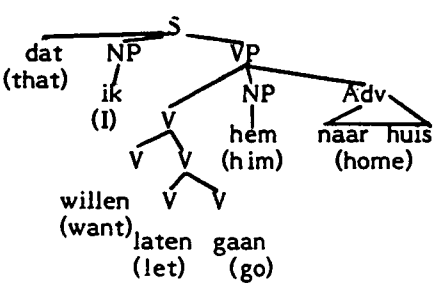
mentions (p. 167-8) Bach's (1970) splendid argument for underlying VSO-order in Amharic, despite the surface SOV-order (the theory McC puts a feeble protest up against on p. 164-5, as I mentioned before). Bach's argument rests on the behaviour of a couple of morphological elements in Amharic which are affixed to whatever happens to be the first word of an NP except when the NP contains a relative clause. In that case the morphological element is affixed to the verb of the relative clause, which comes last in that clause. Since Amharic relative clauses precede the head noun, the hypothesis of underlying verb-first order re-establishes the generalization that the morphological elements in question are simply affixed to whatever happens to be the first word in the NP. If the NP contains a relative clause, that first word is the verb. A later transformation then shifts the verb to the far right of the clause, and it takes its affix with it. This neat theory is lost when we postulate that a transformational rule may never make use of underlying order.

Other cases abound. Thus, the English sentence (11a) has a variant (11b):

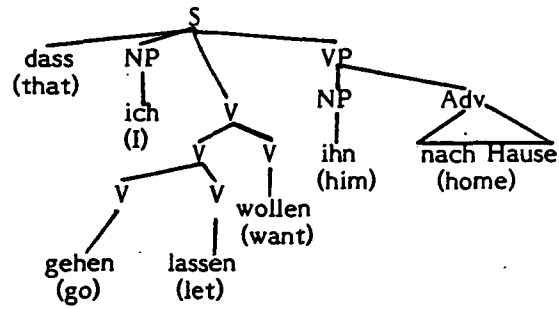
(11) a. He didn't post the letter until four o'clock.
b. Not until four o'clock did he post the letter.
c. *Until four o'clock he didn't post the letter.

If we wish to keep up the reasonable idea that (11a) and (11b) are transformationally related, it cannot be a relation expressible purely in terms of constituents, without an appeal to fixed positions of elements in the underlying structure, since *not until* is not a constituent in (11a). Another case is provided by the by now well-known rule of Predicate Raising (also called Verb Raising) in German and Dutch. This rule, which is most easily demonstrated for subordinate clauses, is associated with certain verbs (which are therefore marked as such in the lexicon) which take an embedded S as one of their arguments. The rule is cyclic and lifts the verb from the lower clause to sister-attach it to the verb of the clause whose cycle is on, under a newly created identical category node (the 'mother'). German and Dutch are virtually identical in this respect, except that Dutch has right-attachment and German has left-attachment, so that repeated application of the rule yields mirrored orderings in both languages. (12a) gives a Dutch derived structure (before V-Final), and (12b) gives the same for German:

(12) a.



(12) b.



Both sentences mean: '... that I wanted to let him go home', assuming past tense. In the final surface form of the Dutch and German sentence, the V-cluster is shifted to the far right:

(13) a. ... dat ik hem naar huis wilde laten gaan.
(13) b. ... dass ich ihn nach Hause gehen lassen wollte.

The point here is that the rule of Predicate Raising (one of the neatest and most successful transformational descriptions available) would be badly complicated if the order of the elements involved were to be left out of account, as the careful reader will be quick to detect.

McC rests his case mainly on the ways verbs are placed in Dutch sentences. He refers to Koster (1974, 1975), who defends the theory that Dutch has underlying SOV-order (contrary to what I have assumed in (12a)). Koster argues, to McC's and my mind successfully, against underlying SVO-order, but he fails to take into consideration the hypothesis of underlying VSO-order, which I favour. McC's point of view is that Koster's analysis and his arguments can be fully upheld, even improved, if we assume that Dutch has unordered underlying structures. He even goes so far as to provide a (summary) description of Dutch verb-placement without any appeal to underlying order, using exclusively features of constituent structure (McC p. 168-70). This description is directly based on that given by Koster, and it seems to carry some conviction. I nevertheless believe it to be wrong. Perhaps it is worth our while to take a closer look at this issue.

McC takes the following observations from Koster:

(14) a. Jan dacht tijdens de pauze aan zijn vader.
b. Jan dacht aan zijn vader tijdens de pauze.
(both: Jan thought of his father during the intermission)

(15) a. Piet zei dat Jan tijdens de pauze aan zijn vader dacht.
b. Piet zei dat Jan aan zijn vader dacht tijdens de pauze.
c. Piet zei dat Jan tijdens de pauze dacht aan zijn vader.
d. Piet zei dat Jan dacht aan zijn vader tijdens de pauze.
e. *Piet zei dat Jan aan zijn vader tijdens de pauze dacht.
f. *Piet zei dat Jan dacht tijdens de pauze aan zijn vader.
(all: Piet said that Jan thought of his father during the intermission)

Two odd phenomena ask for an explanation: first, allowing for movements of constituents in main and subordinate clauses, why should it be that (14b) is fully grammatical whereas (15e) is clearly ungrammatical? If there is a rule of V-Final in subordinate clauses, this looks anomalous. Secondly, if V-Final is optional, as would appear from (15d), then why should (15f) be so clearly ungrammatical?

Koster's explanation is that the verb comes last in underlying order, and that there is an optional rule moving a prepositional constituent on the left of V to the far right, moving cyclically through the VP. Thus, from the underlying:

(16) $_{NP}$[Jan] $_{VP}$[$_{PP}$[tijdens de pauze] $_{VP}$[$_{PP}$[aan zijn vader] $_{V}$[dacht]]]

we may get the variants in (17):

(17) a. [Jan] [tijdens de pauze] [dacht] [aan zijn vader]
b. [Jan] [dacht] [aan zijn vader] [tijdens de pauze]
c. [Jan] [aan zijn vader] [dacht] [tijdens de pauze]

but not those in (18):

(18) a. *[Jan] [aan zijn vader] [tijdens de pauze] [dacht]
b. *[Jan] [dacht] [tijdens de pauze] [aan zijn vader]

Koster takes the word order of Dutch subordinate clauses as defined (in part) by this system. In fact, (18) corresponds with (15e, f). In main clauses he assumes an extra rule moving the finite verb form (*dacht*) to second position, which yields (14a, b) via multiple paths.

McC now observes that Koster's explanation is simplified if we assume no ordering at all, except the requirement that in main clauses the finite verb comes in second position and that in subordinate clauses the subject-NP comes first. (Other surface ordering constraints are left out of account.) Within the highest VP of (16) all orderings are admitted, provided the constituent structure given remains unaffected. This solution works well enough for the simple examples given, but, unfortunately, it fails to work generally.

I have three arguments to offer against McC's rephrasing of Koster's description. First, the facts are different when the verb has one or more nominal arguments:

(19) a. Jan las tijdens de pauze het boek.
b. Jan las het boek tijdens de pauze.
(both: Jan read the book during the intermission)

(20) a. Piet zei dat Jan tijdens de pauze het boek las.
b. Piet zei dat Jan het boek las tijdens de pauze.
c. *Piet zei dat Jan tijdens de pauze las het boek.
d. *Piet zei dat Jan las het boek tijdens de pauze.
e. Piet zei dat Jan het boek tijdens de pauze las.
f. *Piet zei dat Jan las tijdens de pauze het boek.
(all:Piet said that Jan read the book during the intermission)

Note that the sentences of (19) and (20) are exact counterparts of those of (14) and (15), respectively. Let the underlying structure be as in (16):

(21) $_{NP}$[Jan] $_{VP}$[$_{PP}$[tijdens de pauze] $_{VP}$[$_{NP}$[het boek] $_{V}$[las]]]

If McC's description were correct, (20c, d) should be grammatical, and (20e) should be ungrammatical. (20e), in particular, violates the constituent structure of (21), and should be inadmissible, whereas it is clearly wellformed. Notice that the ungrammatical sentences all have the verb *las* precede the direct object *het boek*. It thus appears that order is relevant when nominal constituents are involved in the VP. The same goes for cases of greater lexical coherence between the verb and some PP, as in *in de rondte draaien* (turn round and round) or *op z'n plaats zetten* (put in its place):

(22) a. Jan draaide tijdens de pauze in de rondte.
b. Jan draaide in de rondte tijdens de pauze.
(both: Jan turned round and round during the intermission)

(23) a. Piet zei dat Jan tijdens de pauze in de rondte draaide.
b. Piet zei dat Jan in de rondte draaide tijdens de pauze.
c. *Piet zei dat Jan tijdens de pauze draaide in de rondte.
d. *Piet zei dat Jan draaide in de rondte tijdens de pauze.
e. *Piet zei dat Jan in de rondte tijdens de pauze draaide.
f. *Piet zei dat Jan draaide tijdens de pauze in de rondte.
(all: Piet said that Jan turned round and round during the intermission)

(Note that (23e) is ungrammatical.) One of the things that seem to be at work here is a criterion of 'degree of lexical coherence': the greater the degree, the stronger the ban on V preceding the PP (or other constituent category).

Secondly, McC's description fails to account for the fact that not all grammatical sentences are equally acceptable or unmarked. In (15), for example, there is a descending degree of preferability from (a) to (d).

Thirdly, some orderings are topic-sensitive. If instead of the PP *tijdens de pauze* in (14) and (15) we take the adverb *gisteren* (yesterday), we get the same grammaticalities and ungrammaticalities, but in all cases where *gisteren* stands in final position it must be entirely unaccented, i.e., pronounced with a flat low tone, indicating that what happened yesterday is (part of) the topic under discussion. If we assume definite movement rules (which must involve underlying word order), we can make these rules sensitive to topic-comment distinctions, at least in principle (since no formal account of this distinction has yet been made available). But if no such rules are formulated in the grammar, the topic-sensitivity of certain word orders requires the formulation of surface patterns or filters specifying under what conditions sentence-final adverbs must be (part of) the topic. Such a procedure would not only be cumbersome, it would in all probability result in a taxonomy of the facts that would be captured much more

elegantly and with much greater explanatory power in terms of a transformational movement rule system.

It should be noted, in this connection, that Koster's description itself is susceptible of serious criticism. Without going into the numerous and intricate details of Dutch word order, it may be observed that any system which takes the final position of the verb as basic will have to account for the possible alternative positions (in subordinate clauses) by the invoking of movement rules of one sort or another. This, however, creates the anomalous situation that sentence forms resulting from minimal rule applications would also rank highest on the scale of stylistic preferability, whereas application of the available rules would result in a deterioration of the sentence's quality. No matter how the rules of grammar are to be interpreted or considered to be implemented in brain systems, a grammatical description with this property must be considered counterproductive. This is easily seen when we go back to the sentences (15a-d). As has been said, there is a descending degree of preferability ranging from (a) to (d). The most preferable form is the one where (1) the verb is final in its immediate VP, and (2) that VP stands to the right in the higher VP. Violation of condition (2) results in a small decrease in preferability; violation of condition (1) is more serious. In (d), both conditions are violated. A system with verb-first in underlying structure would avoid this anomaly: there application of optional rules will improve the quality of the sentence.

Furthermore, there is the behaviour of Dutch clitical pronouns. In main clauses they are seen to gravitate towards the verb form, whereby the neuter object pronoun *het* (it) stands closest to the verb, the neuter prepositional object pronoun *er* and the other pronouns take later positions:

(24) a. Ik gaf Karel het boek. (I gave Karel the book)
b. Ik gaf *het hem*. (I gave it him)

(25) a. Ik liet het boek altijd graag op de tafel liggen.
(I always preferred to let the book lie on the table)
b. Ik liet *het er* altijd graag op liggen.
(I always preferred to let it lie on it)

The phenomenon of the verb attracting weak (clitic) pronouns is, of course, very widespread in European and other languages. The verb seems to act, in these languages, as some sort of structural pivot or rallying point for weaker elements to attach to. If we now accept the theory that underlying form in Dutch has verb-final word-order, as in the subordinate clauses:

(26) a. .... dat ik het boek altijd graag op de tafel liet liggen.
b. ... dat ik *het er* altijd graag op liet liggen.

we face the undesirable consequence that Dutch clitics cannot now be said to gravitate towards the verb, since the verb stands at the far right in (26), and, according to this theory, has never been moved. Yet the clitics (*het, er*) stand between the subject (*ik*) and the time ad-

verbial (*altijd*). A theory which has the verb moved from its end-cyclic position after the subject, leaving behind the orphaned clitics, would avoid this awkward consequence.

Finally, there is the point that Dutch and German do not behave at all like verb-last languages. In particular, both languages are essentially prepositional, and not postpositional languages. They also have normal question word fronting, unlike SOV-languages.

It seems to me, therefore, that the best theory is one that gives Dutch a deep structure VSO-order, which is transformed during the cycle to end-cyclic SVO (NP - VP), whereupon postcyclic rules move the verb (in main clauses only the non-finite parts of the verb) to the right under a variety of conditions.[2] It would be presuming too far upon the reader's patience to try and specify all the manifold and in part unexplored complications of the conditions under which the rule or rules in question are optional or obligaroty.[3] But it is clear that the underlying word-order for the verb-movement rules is too important to be dispensed with. It is clear, furthermore, that constituent structure can be 'broken into', as we see in (20e),[4] so that the, in itself very elegant, proposal made by McC must, unfortunately, be considered inadequate.

In the final paper of the book under review, McC argues not so much for the nonexistence of syntactic categories (this is just one of McC's titular quirks) as for the thesis that deep structures are constrained by being built up from a very limited number of categories (probably just S, N, V), and that the multiplicity of surface categories and semicategories is the result of the rules of grammar transforming the deep structures into surface structures. That is, it is McC's view that transformations not only change tree structures from the point of view of constituent structure, but also from the point of view of node labellings. He considers (p. 199-200) the possibility that syntactic categories are not 'basic' in any sense but manifestations of bundles of more basic factors. He admits, however, that this view remains speculative.

The article latches on to the discussions that have taken place in the past about the identity, at some level of analysis, of the categories NP and PP, AP and NP, auxiliary verb and main verb, etc. He then passes on to a consideration of what makes a syntactic category. Here he mentions the function of a constituent in logical structure as one criterion (p. 185), and lexical category as another (p. 186). This latter categorization is probably constrained by structural factors. Thus, McC observes that "while a V in English can have up to two NPs as sisters, only a highly restricted set of As (for example *like* and *worth*) allow even a single NP sister, and combinations of an N with even one NP sister are excluded altogether" (p. 186). Morphological features, as well as grammatical relations count in determining categoryhood, and also the rules of grammar that are lexically associated with particular lexical items.

My impression of this paper is that it falls somewhat short of the usual standards of vigorous and systematic presentation McC's readers have come to expect. This is particularly regrettable since the question

of syntactic categories changing systematically through a transformational derivation is of great interest and badly in need of further competent research. It would have been to the point and also very enlightening if McC had pointed to cross-linguistic category differences, as he did in McCawley (1973: 282), where he mentions the interesting fact that in Finnish negation is a suface verb. Such facts can be multiplied at will. English adverbs, for example, find greatly divergent expressions in other languages. Sometimes a verb:

(27) a. Harry has just left.
b. Harry vient de partir. (French)
(lit: Harry comes from leaving)

sometimes a separate clause, or some other 'creative' rephrasing:

(28) a. I have been reliably told that the earth is flat.
b. Ik heb uit betrouwbare bron dat de aarde plat is. (Dutch)
(lit: I have (it) from (a) reliable source ...)

We also find the opposite, where English uses a verb but another language an adverb:

(29) a. Gerald likes to get up early.
b. Gerald staat graag vroeg op. (Dutch)
(lit: Gerald willingly gets up early)

Adjectives and verbs, as is well-known, often serve as recipient categories for semantically identical material in different languages, and sometimes even within the same language (cp. English *squint* and *be cross-eyed*, or Italian *zoppicare* and *zoppo*, both meaning 'limp', or, for that matter, the English word *limp*).

Historically, there is a great deal of evidence that words change category. Usually they move from verbal to adverbial or prepositional status. This evidence is strongest in the case of Creole languages (see, e.g., Seuren 1983) and languages with serial verb constructions.

This whole fascinating area of category shift and reanalysis is rather badly underexplored at the moment. Universalist linguistics will be of great help here, and we may expect some useful results given the recent tide of universalist linguistic studies. But we would also like to have some insight into the universal constraints that can be formulated within the terms of a theory of grammar whereby deep structures containing only the categories 'noun', 'verb' and 'sentence' correspond with surface structures containing a multiplicity of categories and semicategories ('squishes'). A great deal of research is still needed here, at least if it is agreed that such a theory of grammar is worth developing on independent grounds. For if it were not, the research proposed would be a shot in the dark, and the chances of hitting a good one among the thirty million theories of grammar floating around in dark grammatical space would be very slight indeed.

Notes

1 I must say that I prefer to leave out the final *to* in this case, although I have no explicit account of this preference. However, the presence or absence of *to* in VP-deletions is not an issue in the discussion between McC and Jackendoff.

2 For an exposé of the cyclic rules mapping underlying VSO on end-cyclic SVO (NP - VP), see Seuren (1983), in particular p. 240-248.

3 For one thing, the rules are clearly topic-sensitive, as has been noted. This also appears from the fact that (20e) is possible only if the book in question is (part of) the topic under discussion. In (20e) the topic is rather what happened during the intermission (or what Piet said that happened during the intermission). If the book in question is (part of) the topic in (20b), then the word *las* (read) must be heavily (almost contrastively) accented, carrying the burden of being the comment expressed in the sentence.

4 It is possible, and as far as I can see by no means absurd, to propose that there is a difference in underlying structure for the verb-movement rules according to whether *het boek* is a topic constituent or belongs to the comment expressed in the sentence. We might think of a structure where *het boek* is a fixed VP-constituent when it expresses the topic, and that it takes part in the game of verbal musical chairs when it is part of the comment.

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Book reviews

Christopher J. Pountain, *Structures and Transformations. The Romance Verb.* Croom Helm, London/Canberra, 1983. xvii + 254 pp. Price: £ 15.95 (hardback).

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This study is a revised version of Pountain's Cambridge Ph.D. dissertation, *Aspects of verb-form usage in French and Spanish* (1978), which, in the author's own words, was not originally aimed at "setting one approach to language description against another, but rather less ambitiously at describing a set of data". Apart from an interesting, though partial, description of Romance verb-form usage, the present book also contains a comparison of two linguistic approaches: the structuralist and transformationalist models. Structural linguists have generally focused on systematising the rich inflectional morphology of Romance verb-forms and on describing the meanings of morphemes. Transformationalists, however, have largely ignored the study of verb paradigms, and have mainly concerned themselves with syntagmatic relationships. In this work, Pountain attempts to bring about a compromise between the two approaches, arguing that transformational grammar might be enriched by insights drawn from pre-Chomskyan investigations of paradigmatic structure.

The book consists of eight chapters: (1) A programme for historical Romance syntax, (2) The verb itself: morphological, syntactic and semantic properties, (3) The verb itself: implications for the descriptive model, (4) The verb as constituent: conditional sentences, (5) The verb as constituent: *when*-sentences,(6) Conditional sentences from Classical Latin to Modern Romance, (7) *When*-sentences from Classical Latin to Modern Romance, and (8) Conclusions. *Structures and Transformations* - the title is meant to reflect the compromise which is sought between the taxonomic and transformational models - contains a long list of References, a survey of the historical Texts studied and and Index. As the chapter titles suggest, the author pays particular attention to the syntactic properties of verb-forms in two particular constructions: conditional sentences and so-called temporal *when* sentences.

Pountain's programme involves recognition of the achievements of structuralists, and incorporating their insights about the workings of language into the more syntactically-oriented transformational model. The latter is characterised in the usual way: syntax, not phono-

logy or morphology, is central to linguistic description; the object of description is competence, not performance; a high degree of abstraction is needed; syntax cannot be merely taxonomic; the linguistic theory must be explanatory; particular languages are exponents of a universal 'model' of language; there is a distinction between a surface and an underlying level of structure, etc. The author rather uncritically accepts each of these assumptions as if they have not all been seriously challenged in the linguistic literature (e.g. Gross (1979)), and uses this as the framework for his analysis of conditional and temporal *when*-sentences. He claims that the descriptions he offers are neutral between a generative and an interpretive semantic approach. I shall argue below that it is, in fact, one of the weaknesses of this work that it is difficult to see how the analyses offered here can be fitted into *any* of the existing varieties of transformational grammar. Pountain also states that both structuralists and transformationalists have given very little thought to the syntactic patterning of verb-forms. Although I am not convinced that this is a fair judgement of the work done by structural linguists in the past 50 years or so (take, for example, Pike, Bloomfield, Fries), I think Pountain is right in observing that the two constructions which he is concerned with have so far been grossly neglected. Since neither of the linguistic approaches seems capable of adequately dealing with the syntax of tenses and other verbal phenomena, the question he poses is this: assuming that a full description of verb-usage should include syntagmatic as well as paradigmatic information, and also that a transformational generative model is particularly suitable for describing syntagmatic properties, what is the contribution that structuralism can make? Unfortunately, Pountain does not make it clear what the structuralist contribution could be. His two main suggestions in this respect are: (1) a careful description of the morphology of verbs is advantageous in the description of their syntactic behaviour, and (2) it is convenient to describe inflectional forms in terms of their 'residual value', i.e. the value of a verb inflection without surface context, but with obligatory co-occurring verb-stem. As for point (1), he proposes sets of distinctive feature matrices with features such as Past, Future, Subjunctive and Punctual, each of which may be +, - or zero, but he runs into the traditional problems of formally determining what forms constitute a 'verb-system' in any given language, and of associating verb-forms with meanings or functions. As regards point (2) above, he realizes that 'residual value', however defined, is only one element in the expression of time-reference, aspect and modality in a sentence. Other, perhaps even more crucial, factors are the lexical aspect ((*Aktionsart*) of the verb, the interaction between verb and temporal/aspectual adverbials, the syntactic context of the verb, as well as the pragmatic context (including the speaker's presuppositions and modalities). This suggests that, apart from looking for a compromise between the structuralist and transformationalist approaches, we should also (perhaps more urgently) try to find ways of incorporating insights from semantics, pragmatics and discourse into a unified description

of verb usage. Pountain appears to take a different view as far as pragmatics is concerned: "The incorporation of pragmatic factors into a grammar is a very general theoretical problem with which we need not become embroiled here" (p. 86). However, he agrees that one of the serious deficiencies of the generativist position is its failure to account for the non-syntactic dimensions of verb-usage.

There is no doubt that for an adequate description of the use of verb-forms, verb-systems must be examined from a paradigmatic as well as from a syntagmatic viewpoint, and that factors which are not purely syntactic, also play an important role. Pountain provides some interesting examples of how verb-forms participate in syntactic rules (e.g. in the complements of reporting verbs, and in elliptical surface structures), and introduces the device of an abstract adverbial, which may be FUTURE, PAST, ANTERIOR, PUNCTUAL, etc., in an attempt to account for the semantic interpretation of combinations of verb-stem, verb-inflection and surface adverbial. This interaction is shown particularly clearly in the two cases examined in the book; conditional and temporal *when*-sentences exhibit a wide variety of semantic relations between matrix and embedded clauses, which cannot be fully captured by a purely syntactic model. Pountain's proposal for the analysis of conditional sentences is to regard the verb-forms of protasis and apodosis as constituting a discontinuous sequence, which is to be inserted into the sentence in 'modular' form, the 'module' being in accordance with the pattern of time-reference and truth-value presuppositions of the sentence. For example, in Modern French the underlying adverbial specification PAST and an associated presupposition COUNTERFACTUALity will require insertion of the 'module' Pluperfect (in the protasis) + Conditional Perfect (in the apodosis). The case is well-argued and illustrated with numerous examples, and the main advantage of this kind of approach, as I see it, is that it makes it possible to deal with the whole sequence of verb-forms, etc. as one unit, instead of separating protasis and apodosis. It is clear, that such a solution involves going beyond the boundary of the single sentence, which is a problem for current transformational models. Moreover, interesting though Pountain's proposal is, it requires further elaboration. No attempt has been made, for example, to specify the syntactic difference between pseudo-conditionals and genuine conditionals and to account for the difference in tense usage in these clauses (see e.g. Haegeman and Wekker, forthcoming). The analysis proposed for temporal *when*-sentences is different; it is based on a modified version of the 'relative adverb hypothesis'. Pountain proposes that *when* may be derived not only from the underlying adverbial *at the time*, but also from *before the time* or *after the time*. An important difference between conditional sentences and *when*-sentences is that the constituent clauses of *when*-sentences often have the same verb-forms as the corresponding simple sentences in isolation (although there are interesting cases which he fails to account for). Because of this difference, Pountain suggests no 'modular' analysis for temporal *when*-sentences, and generally deals with these constituent clauses

separately, although there is clearly a dependency between the clauses.

The suggestions made in this book are extremely interesting. One great virtue is the careful examination of a wide range of French, Spanish and Italian synchronic and diachronic data, and also occasionally of some English verbal phenomena. Another is the excellent critical review of previous Romance scholarship in this area. However, the book still shows clear signs of being based on a Ph.D. dissertation, with all its usual padding and rhetoric. The long quotations and detailed discussions of most questions could have been omitted or reduced in this commercial edition. It is to be regretted, on the other hand, that Reichenbach's and Bull's well-known tense systems have been so uncritically accepted, and that no attention has been paid to the important work by McCoard (1978), Dowty (1979), Vet (1980), and many others.

Pountain's proposals are highly original and challenging, but he is probably more aware than anyone else that his own contribution towards providing a full description of the semantics and pragmatics of the verb-forms he has dealt with, is rather modest. It may be necessary to attempt a compromise between the structuralist and transformationalist approaches, as Pountain has fairly successfully done in this book, but it is of far greater importance to search for the semantic and pragmatic factors which determine the use of verb-forms in conditional and temporal *when*-sentences.

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Brian Loar, *Mind and Meaning*. Cambridge Studies in Philosophy. Cambridge University Press, Cambridge, 1981. xii + 268 pp. Price £ 22.00 (hardback).

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Loar argues in this book that the so-called propositional attitudes can be analysed without using propositions or other semantic concepts. His position is that the content of a particular attitude, such as Tarski's belief that snow is white, is given by the functional role of this belief in the system of other attitudes taken by Tarski. This system would explain Tarski's behaviour given his observations. Loar sees his view as closely related to Grice's attempt to base meanings on intentions and to what Harman has called conceptual role semantics.

Loar's approach can be usefully compared with Searle's proposal to explain linguistic meaning in terms of mental states in his recent book, *Intentionality*. Searle rejects functionalism and thinks of mental states themselves, and not merely their descriptions, as having semantic properties and even logical relations. Searle thus tries to make his job easier by claiming that mental states themselves are much more like meaningful expressions than Loar, and most other analytical philosophers, could allow. For Loar mental states like beliefs are essentially parts of physiological mechanisms, and he faces the problem of saying how specific beliefs are associated with such things.

Loar begins by assuming that propositions do exist, while pointing out that he later tries to remove these from his analysis. He even assumes the existence of what he calls 'fine-grained propositions', which supposedly do not have logical equivalence as their criterion of identity. The point of the latter is to pick out 'fine-grained functional roles', which supposedly give separate places in the physiological mechanism to logically equivalent beliefs. The next step is to describe how perceptual 'input' to the functional system gives rise to certain beliefs. This Loar tries to do by saying that if a person believes an observational proposition p, if p is true, he is 'observationally related to p', 'p-attentive', and 'open to p'. The phrases I have just quoted did not seem to me to be fully or clearly explained by Loar. But he holds that observational beliefs can be associated with basic aspects of the functional system which respond to perceptual 'input'.

'Output' from the system, the behaviour of the person involved, depends also on his non-observational beliefs. How can these be tied to unique roles in the system when people notoriously do not always believe the logical consequences of what they believe? Loar's answer to this question is to lay down restrictions he considers quite weak on what people can be said to believe. For example, he states that

no one can be said to believe the negation of the law of excluded middle, and that no one who believes a conjunction can be said to believe the negation of one of the conjunctions. He goes on to propose something like meaning rules for certain general terms, e.g., one which ensures that people's beliefs about which objects are north of others will be consistent with the transitivity of this relation. The result is supposed to be that, if a person satisfies these conditions, then we know what 'output' to expect from his beliefs, or at least what 'output' not to expect.

Loar does eventually try to free his analysis of reference to propositions. He assumes that awkward complications like synonymy and ambiguity can be removed from his presupposed language, and that there is a one-one correspondence between propositions and the sentences of this language, with the 'fine-grained' propositions linked to sentences of some kind of complex syntactic structure. Then he argues that the above restrictions determine which sentences a person may be said to believe, and that non-semantic, syntactic relations between sentences 'index' functional states. Understanding these states in a person, and the ones 'indexed' by ascriptions of desire, we should be able to explain his verbal and non-verbal behaviour under given conditions. Loar holds that this behaviour would be covered by complex counterfactuals, describing how the person's functional system would work.

Loar realizes that he must bring the concept of truth into his analysis at some point, and account for the importance we attach to it. Loar's plan is to use a Tarskian truth theory to define a truth predicate for the presupposed language without using any unexplained semantic concepts. He then claims that this procedure specifies truth conditions for beliefs, which are 'indexed' by sentences from the language, in a way which also does not rely on any unexplained semantic concepts. If what Loar says is correct, it will not be circular to attempt to base the semantics of natural language on his functional theory of the propositional attitudes.

Loar's views seem to me to be especially obscure when he is talking about truth. He sees a problem in fitting the two basic aspects of his analysis together, saying that '... nothing in the specification of the functional roles of (non-observational) beliefs requires truth conditions' (p. 156). If the contents of beliefs can be given by their functional roles, and these contents are the basis of semantics, then why should the truth predicate (above the observational level) have any significance? Loar apparently wants to answer this question by pointing to the association between the truth predicate, defined in the way he describes, and the general reliability of our beliefs. But surely the states of a functional system would not count as beliefs in the first place if they could not give reliable statements as 'output' from good perceptual 'input'. How could the functional role of *beliefs* be 'indexed' by purely syntactic relations between meaningless marks? The methods of manipulation would have to be semantically justified:

they would have to be capable of preserving some reliable concept of truth before they could be considered part of a system of beliefs. It is interesting to note, however, that nothing Loar says rules out a constructive or intuitionistic, rather than a classical, interpretation of truth. As is well known, a constructive concept of truth can be defined in Tarski's way by using intuitionistic logic in the metalanguage. The constructive concept would seem to go better with Loar's restrictions on belief than the classical one, and it is arguably even more reliable.

This book contains much abstract methodological reflection without any real attempt to solve relevant ground floor level semantic problems. Consider the problem of understanding what 'fine-grained' propositions are. One would naturally have expected a theory like Loar's to say something interesting about how the functional system represents and works on these things. How are they connected with the limited number of logical implications of a proposition which the system is capable of discovering? As the system works out more logical implications of a proposition does it have a deeper, or more 'fine-grained', representation of it? Loar does not answer these questions, and most of what he has to say about these propositions is contained in an inadequate footnote (on p. 58), which makes it appear that he would be happy with the very limited concept of intensional isomorphism.

Consider also the problem of explaining the semantics of counterfactuals. These constructions are important in Loar's theory, but he does not give us a Tarskian truth theory for them, nor does he tell us how a belief in one of them would operate in a functional system. He confines himself to an extensional first-order language when he talks about truth theories, or about restrictions on beliefs, and is at best quite sketchy about how the meaning of any construction would be elucidated by referring to a functional system. Yet an attractive analysis of counterfactuals would do more for his approach than any amount of methodological theorizing about theorizing.

Loar's book cannot be called a good introduction to his basic semantic position, such as might be found, say, in the recent articles by Harman, Schiffer and Loar himself in the *Notre Dame Journal of Formal Logic* (1982). His arguments in the book sometimes depend on unstated or unjustified assumptions, and his style is often unclear and occasionally even unreadable.

Benoît de Cornulier, *Meaning Detachment.* (Pragmatics & Beyond, 7). John Benjamins, Amsterdam, 1980. Pp. 124. Price: Hfl. 30,-.

Reviewed by: Roland R. Hausser and Claudia Gerstner
University of Munich

In *Meaning Detachment* the logical deduction rule of Modus Ponens, familiar from propositional calculus, is presented as the basic strategy employed by the speaker/hearer in the interpretation of meaning. Cornulier formulates Modus Ponens as a rule of communication of the following form, whereby a weak and a strong version are distinguished.

(1a) weak version: (P&(P means Q) implies Q
(1b) strong version: (P&(P means Q) means Q

As examples, the author presents pieces of discourse such as the following.

(2) If I am not crazy, it's raining. (p. 2, (2))
(3) (Athens was a republic)$_i$. This^i means that Athens had a president re-elected every four years. (p. 4, (7))
(4) Do you mean that I may go out? - Of course! (p. 16, (28))
(5) I LOVE that spaghetti! - But it's a very ordinary meal, it took me twenty minutes to cook them ... - I was speaking in metaphors, I mean the opposite. (p. 29, (46))

It is claimed that 'meaning detachment' (1a) or (1b) provides a uniform method for coding and decoding the intended meaning of these diverse types of discourse. The relations between examples like (2-5) and the deduction schema (1), however, is not explicitly shown in the book. Rather, each case is discussed separately in an informal manner. The author presents his idea and the data in form of a sometimes witty essay, appealing to the reader with his unpretentious, colloquial style, his modest confessions regarding his background in logic, and frequent off-colour examples reminiscent of the popular 'Studies out in Left Field' (J.D. McCawley, 1971). Nevertheless, the formal schemata (1a, b) of 'meaning detachment' should have been complemented by a definition of *meaning*, which in our opinion would have to involve a clear distinction between the literal meaning of expressions (meaning^1) and the speaker meaning of utterances (meaning^2). A specification of the respective domains of semantics and pragmatics is likewise missing. Thus the reader best settles into reading the book leisurely, waiting to find out eventually what the linguistic content of 'meaning detachment' is supposed to be. In this way, we arrived at the following informal description of the intended content of 'meaning detachment':

(6) *Meaning Detachment* (intuitive):

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(6) *Meaning Detachment* (intuitive):

Singling out a certain phrase as representative of the meaning of the whole utterance or singling out the intended reading.

This is still rather vague. Therefore we could not resist to state explicitly the exact correlation between the examples (2-5) and the schematic detachment rule (1). Consider (2*-5*).

(2*) P = I am not crazy.
P *means* Q = I am not crazy. *means* It's raining.
Q = It's raining.

(3*) P = Athens was a republic.
P *means* Q = Athens was a republic. *means* Athens had a president re-elected every four years.
Q = Athens had a president re-elected every four years.

(4*) P = Do you mean that I may go out?
P *means* Q = Do you mean that I may go out? *means* I want to go out.
Q = I want to go out.

(5*) P = I LOVE that spaghetti.
P *means* Q = I LOVE that spaghetti. *means* I hate that spaghetti.
Q = I hate that spaghetti.

Comparison of (2-5) with (2*-5*) in their respective relations to schema (1) shows two things. On the one hand, the examples (2-5) may indeed be described under the common denominator of 'meaning detachment', either in terms of Cornulier's formal version of this 'rule' stated in (1) or in terms of our intuitive reformulation stated in (6). On the other hand, we see that the relation between the examples (2-5) and their explicit analysis in terms of schema (1) in (2*-5*), respectively, is quite indirect. For instance, the *P means Q*-clause in (2*)seems to be little more than an *ad hoc* assumption; if there is a general pragmatic rule behind the interpretation of examples like (2), it is surely something more than simply Modus Ponens. But no such additional rule is spelled out. Similar considerations apply to the other examples, particularly (4) and (5).

The problem is that an informal analysis employing such freedom in the intuitive reconstruction of concrete examples can fit anything into the schema of Modus Ponens (or some other deduction schema), thus raising the question whether Cornulier's hypothesis is really empirically meaningful in the sense that it could be refuted by counter-examples. However, *Meaning Detachment* shares this kind of problem with many other books in the area of pragmatics, a field of inquiry which at present is still weak in theory, but rich with intriguing problems. Cornulier's book, which also contains a lengthy discussion of 'meaning detachment' in relation to the phenomenon of self-reference (liar paradox) and a discussion of performatives, is a valuable contribution to the description of pragmatic reasoning in natural language

interpretation, presenting many interesting examples and ideas.

Thomas W. Simon & Robert J. Scholes (eds.), *Language, Mind, and Brain.* Lawrence Erlbaum Associates, Hillsdale (NJ)/London, 1982. Pp. xvi+263. Price: £ 19.95.

Reviewed by: Han Reichgelt
University of Edinburgh
School of Epistemics

In the introduction to *Language, Mind and Brain* the editors, T. Simon and R. Scholes, write that the aim of the symposium out of which this book grew was to enable philosophers, computer scientists, linguists and psychologists to:

> '... focus attention on language in order to generate a truly interdisciplinary (as opposed to multi-disciplinary) approach to problem solving within the cognitive sciences.'

They rightly say that this interdisciplinary approach is only possible if the various papers are comprehensible to practitioners of all the disciplines involved.

It seems to me that, with the exception of two papers, the aim of mutual understandability has been achieved. One of the exceptions is a paper by P. Suppes in which he gives a brief outline of his variable-free formal semantics and makes some remarks on the possibility of extending it in a procedural way. It seems to me that this paper is very hard to understand if one does not have a thorough knowledge of formal logic and mathematics. The other exception is C. Pearson's paper on a semiotic paradigm for cognitive science. His paper uses a lot of obscure terminology and is hardly readable for anyone who does not have much knowledge of semiotic theories such as have been developed on the basis of Pierce's and Morris' philosophical writings.

The other papers are relatively accessible. Yet each of them betrays the background of its author rather clearly, which makes it doubtful whether the editors achieved their aim of generating a truly interdisciplinary approach to problem solving in cognitive science.

One of the most remarkable features of the book is that is includes, unlike most introductory courses and collections of papers in cognitive science, various contributions by neurologists. Given the assumption that our cognitive behaviour takes place in the brain, the editors have to be credited with this.

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Scholes looks at different types of aphasia in order to throw light on the question whether one has to postulate in psycho-linguistic models an autonomous sequencing mechanism that orders the terms

in a given sentence, but is independent of their identity or the relationships between them. He suggests that there is no evidence that shows unequivocally that there is such a mechanism. K. Pribram looks at the brain-mind problem from a neurological point of view and suggests that we at least have a vague idea as to which neurological mechanisms underlie some of our cognitive processes.

The book also includes a paper written by a biologist. D. Griffin argues that there is no *a priori* reason to suppose that there is a qualitative difference between human and animal communicative behaviour. That is, there is no reason to describe animal communicative behaviour as not involving a language. He suggests that an open-minded approach to animal communication may therefore throw some light on human language and thus on the human mind.

Computer science is represented by R. Schank, M. Ringle and F. Oppacher. The former retraces in an autobiographical way his research on the conceptual dependency theory in knowledge representation and language understanding systems. Ringle and Oppacher both argue for a procedural semantics as opposed to a truth-conditional one. Unlike a number of other authors who have argued the same point, they take truth-conditional semantics seriously and criticize it, to my mind, successfully.

The need to take processing considerations into account is also central to G. Lakoff's paper. He argues that the autonomous view of language, which states that language does not make use of any other human cognitive capacity such as memory and perception and which underlies most work done in syntax and semantics, has to be given up in favour or the opposite view which he calls experimental. He gives a number of examples which show the importance of processing considerations.

McCawley's paper is also critical of current syntactic theories. He argues that there are a number of relevant propositions generative grammarians tend to assent to but which do not play any role in actual linguistic practice. He gives as an example the claim by generative grammarians that they seek theories which are psychologically real whereas they often fail to ask any psychological questions, such as questions about the learnability of the systems they propose.

V. Vallian on the other hand is a bit more positive about current linguistic practice and defends the distinction between competence and performance and the use of intuitions in linguistics.

The philosophers' contributions are rather varied. M. Boden argues that the nature of human language is essentially dependent on our terrestrial environment and material embodiment. Z. Vendler analyses the concept of imaginations by looking at the way the verb *imagine* is used in English. G. Harman discusses the questions whether logic plays any role in actual reasoning by people and whether sentences of natural language have logical forms. S. Harnad attempts to show that there are certain philosophical reasons to expect a difference between two modes of processing information. It seems to me that the distinction he is after is more or less the distinction between

semantic and episodic memory which Tulving drew in 1972 on more or less theoretical grounds.

Finally, the formal semanticists are represented not only by P. Suppes. The book also includes an article by B. Partee in which she suggests two ways in which one could arrive at a psychologically acceptable semantic theory without giving up too much of the framework of Montague grammar. The first one is to allow partial models; the second to replace the concept of function in the analysis of intension by the concept of procedure. Although Partee admits that she does not provide a working solution, she is essentially optimistic about the possibility of a semantic theory which satisfies both the logicians' criteria, i.e. gets the truth conditions right, and is psychologically plausible. I am more sceptical about it since it is not clear to me how such a change in the truth-conditional approach to the semantics of natural language would allow one to include processing considerations in one's theory. Given Ringle's, Oppacher's and Lakoff's insistence on the need to do so, one may wonder if the changes in the overall approach Partee proposes, will indeed lead to an entirely acceptable semantic theory.

Summarizing then, the volume contains a number of interesting papers, most of which are reasonably accessible to a wider, non-specialist, audience. Moreover, the different authors seem to have an understanding of the problems which have been raised in other disciplines. Another remarkable feature of the book is that it actually includes papers by neurologists. It seems to me that the editors have to be given credit for this.

The question arises whether the book is new in that the various papers are readily accessible and in that the various authors seem to understand the problems of the other disciplines. It seems to me that the answer has to be negative. The various disciplines which together make up cognitive science have been able to communicate for at least ten years now. What is needed, is a "truly interdisciplinary approach to cognitive science" and although this book may help to achieve it, the aim has certainly not been achieved in the book itself yet.

Gillian Brown and George Yule, *Discourse Analysis*. Cambridge Textbooks in Linguistics. Cambridge University Press, Cambridge, 1983. Pp. xii+288. Price: £ 20.00 ($ 39,50) - cloth; £ 6.95 ($12,95) - paperback.

Reviewed by: Ton Weyters
University of Nijmegen
Department of Philosophy of Language

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Gillian Brown and George Yule, *Discourse Analysis*. Cambridge Textbooks in Linguistics. Cambridge University Press, Cambridge, 1983. Pp. xii+288. Price: £ 20.00 ($ 39,50) - cloth; £ 6.95 ($12,95) - paperback.

Reviewed by: Ton Weyters
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The growing insight that a great many problems in linguistic theory

cannot be solved without an adequate account of discourse factors has given rise to vastly increased activities in various disciplines in the field now known by the cover term "discourse analysis". This fact by itself is sufficient reason for adding a book on discourse analysis to the well-known series of Cambridge textbooks in linguistics. An inevitable problem with a book like this is presented by the fact that so many different disciplines are involved. It is not only theoretical linguists who are interested in discourse analysis. There are also sociolinguists, psycholinguists, computational linguists, and even philosophers of language. In each of these respective fields there are different traditions, different ways of thinking, different norms, different approaches. The authors of this book have solved this dilemma by taking a primarily linguistic stance, trying to bring out the greatest common factor of all disciplines involved. One result of this approach is a refreshing openmindedness.

In a way, this book embodies a paradox: it is a step backwards, but it is a step in the right direction. It is a step backwards in that no attempt is made, contrary to current trends in theoretically oriented literature, to present formalized theories. The authors operate more on a descriptive than on an analytical level. They look for *regularities* rather than for *rules*. It is also, however, a step in the right direction, and therefore forward, since, as the authors say (p. 270), "at the present time, workers in discourse analysis have only a partial understanding of even the most-studied ingredients." Given this state of affairs, full formalization of theories is likely to be premature. In fact, we have spent too much time on technical discussions about formal details of approaches which are fundamentally misguided and untenable in the light of real data. The strength of the book lies in the authors' concern to keep an open eye for *language in use* ("the linguistic output of someone other than a discourse analist", as they say on p. 20), for real data. Their view is predominantly functional and dynamic: the communicative function of language is the primary area of investigation, not texts as static objects. "The view taken in this book is best characterised as a **discourse-as-process** view." (p. 24). The price to pay for this data-oriented functional dynamic approach is a certain informality and lack of strictness. Some may find the book a little too anecdotal. Yet it is nobody's fault that data or observations in discourse analysis are almost by their very nature 'anecdotal'. Neglect of such 'anecdotes' would, in this case, be a neglect of the essential requirements of empirical support. It is true, however, that, especially early on in the book, the level is not too elevated, perhaps at times even a trifle trivial.

Later on, however, there are a number of highly competent and interesting discussions of a variety of problem areas and theories that are 'on the market' these days. In fact, these discussions take up the bulk of the book. Chapter 3 deals with the vexed question of 'topic' and discourse representation. In chapter 4, the discussion shifts to questions of 'staging', theme and thematisation. In chapter

5 we find a discussion of the 'given/new' distinction, and of Halliday's theory of information structure. Reference is central in chapter 6, including questions of anaphora. Finally, in chapter 7 there is a discussion of questions of textual coherence. This chapter teaches the student about 'frames', 'scripts', 'scenarios' and 'mental models'. These discussions are always clear and of a fundamental nature.

The book makes for absorbing reading. It is very well-written, inspiring and clear. It is indispensable literature for anyone working in the field of discourse analysis. The presentation of the book is up to the usual standards of Cambridge University Press.

John Dinsmore, *The Inheritance of Presupposition*. Pragmatics & Beyond, II:1. John Benjamins, Amsterdam, 1981. Pp. vi+97. Price: *f* 38,- ($ 14,00), paperback.

Reviewed by: Pieter A.M. Seuren
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The title of this booklet is to be understood as saying that it is about the well-known *projection problem of presupposition*. This is the problem posed by the fact that presuppositions associated with embedded clauses are sometimes preserved as entailed presuppositions of the whole complex sentence, sometimes weakened to the status of 'suggestion', and are sometimes 'filtered out' entirely. Thus, the clause:

(1) : Harold's rabbit has won a prize.

is generally taken to presuppose (and entail):

(2) Harold has a rabbit.

When (1) is embedded in (3), this entailed presupposition is preserved. In (4), however, it is weakened to a suggestion, and in (5) it is entirely lost:

(3) Ben realizes that Harold's rabbit has won a prize.
(4) Ben thinks that Harold's rabbit has won a prize.
(5) If Harold has a rabbit, it has won a prize.

Dinsmore intends to solve this problem by proposing a system of 'worlds' whose relations depend on the linguistic material by which they are referred to (or introduced, - Dinsmore remains unclear on this point). Presuppositions are then said to hold in the worlds their carrier clauses refer to (or introduce), and may sometimes be inherited by other, related worlds. Dinsmore is convinced that his theory is "highly plausible" (p. 40; 90), indeed "the best account available" (p. 91).

Although one can sympathize with many of the intuitions that

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Although one can sympathize with many of the intuitions that

are behind this work, it must be said that the theory proposed does little to solve the projection problem. Dinsmore classifies his work mainly under what he calls "procedural accounts" of presupposition, and in writing this little book be demonstrates the truth of what he says (p. 6) about such accounts: "The weakness of existing procedural accounts lies not in their conception, but in their resistance to explicit formalization, and in their reliance on undefined concepts."

First, the central concept of 'world' is left fatally obscure, and perhaps fatally incorrect. On p. 12-3 we read: "The concept of world in this sense should not be confused with that of *possible world* as used in model-theoretic semantics." Also: "A particular world of belief is one in which exactly those propositions are true which a particular person believes to be true." Furthermore, "worlds are objects which have a specifically cognitive function, and ... play a crucially important role in discourse." Intuitively, this notion in no doubt useful, perhaps even powerful. But then Dinsmore proceeds (p. 17 ff.) to speak of "truth in a world", as though his worlds are possible worlds after all. It is, generally, left unclear whether Dinsmore's 'worlds' are constructively built up as a result of proceeding discourse, or whether they are objects with respect to which truth-values can be established and references can be made, whereby the assignment of such truth-values and the making of such references are essential elements in the semantic calculus. Furthermore, Dinsmore stipulates (p. 18) that "the set of propositions true in a given world is closed under entailment", thereby ruling out the possibility of contradictory belief worlds. This is rather sad, given the massive literature on precisely this issue. Surprisingly, Dinsmore feels (p. 18) that he

> "should warn that this is already an oversimplification. The most typical worlds are individual belief worlds. Since people don't always know the consequences of their beliefs, (W1) [i.e., the preservation of logical entailments in 'worlds'] is not strictly true of a belief world. However, the positing of belief in cognition is functionally motivated by the fact that (W1) generally applies to belief worlds. In the following, I will assume that (W1) is valid for belief worlds, because this assumption allows for a simpler model."

It then turns out that the preservation of entailments in 'worlds' is meant to play a central and indispensable role in the (otherwise badly defective) formalism proposed further down. By Dinsmore's own admission, therefore, his whole theory is thus based on a fiction. Note that this fiction is highly damaging, since, apart from the ever-present belief worlds, there are also worlds of hope, worlds of memory, worlds of fancy. And these are most certainly not "functionally motivated by the fact the (W1) generally applies" to them. There is nothing strange, for example, in having irreconcilable hopes.

It would be pointless to dwell on every weakness in this book. It must be said, however, that Dinsmore has nothing of interest to say on the phenomenon of presupposition itself: he simply accepts

whatever has been written on presupposition as correct. Then, as Dinsmore acknowledges (p. 70) that his formal apparatus lacks the means for handling weakened presuppositions ('suggestions'), as well as other well-known problematic cases (such as cases of presuppositions embedded under modalities), he turns to a Gricean theory of conversational implicatures for a way out. On p. 90 it is quietly admitted that "not all of the predictions of this last section are rigorously demonstrable". If we add the numerous formal and logical mistakes or unclarities, the total lack of original good observations, and the boastful tone with which the product is presented, the reader will see why it is difficult not to be uncharitable about this book.

The book is produced in offset with a printed paper cover. It is disfigured by many typing errors (some of which are serious), and is generally poorly produced.

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