

KLAUS VON HEUSINGER & URS EGLI

INTRODUCTION:
REFERENCE AND THE SEMANTICS OF ANAPHORA

1 THE SEMANTIC BACKGROUND

An investigation of reference and anaphoric relations is of central interest to the understanding of the structure of linguistic meaning in its truth-conditional aspects. The truth-conditional tradition in semantics has its roots in the works of logicians and philosophers of language who investigated the relation between language on the one hand, and the objects that are associated with the linguistic expressions on the other hand. In this tradition, reference, truth-conditions, and inferences are the basic data which a semantic theory must correctly describe to meet even the most minimal standards of adequacy.

Montague (1974) was the first to give a complete formal framework for the description of a fragment of natural language. His formalism is still the ground on which all other formal semantic theories are built. However, there have been several extensions of the classical framework that have emerged from the discussion of anaphoric relations and related problems such as the representation of indefinites or the relation between context and meaning. In the following, we present a brief sketch of the most important problems that caused the development of the new semantic formalisms, and then give an overview over the articles in this volume, each of which contributes new insights to one or more aspects of the initial questions.

1.1 Anaphora and binding

Geach (1962) was among the first to note that cross-sentential anaphora cannot be described by means of classical variable binding since the scope of the existential quantifier cannot extend across a sentence boundary. In the classical representation (1b) of sentence (1a), the last occurrence of the variable x is not bound, i.e. the anaphoric relation is not expressed. Geach proposes a different kind of existential quantifier, a text quantifier that takes the whole text into its scope, as illustrated in (1c).

- (1) a. A man walks. He whistles.
b. $\exists x [\text{man}(x) \ \& \ \text{walk}(x)] \ \& \ \text{whistle}(x)$
c. $\exists x [\text{man}(x) \ \& \ \text{walk}(x) \ \& \ \text{whistle}(x)]$

However, Evans (1977) argues that the representation (1c) is highly problematic because (i) the existential quantifier receives a scope that extends the sentence, and (ii)

the analysis cannot be compositionally derived. He therefore proposes an alternative theory to cope with this problem. He represents the pronoun *he* not as a bound variable, but as the definite description *the man who walks*. This is shown in the paraphrase (1d) and the formalization (1e). This approach – generally referred to as the E-type approach – has different versions depending on the construction procedure for the definite description *the man who walks*. Evans (1977) suggests a semantic characterization of the definite description by the objects that verify the sentence containing the antecedent. Cooper (1979) infers the descriptive material of the definite description from a contextually salient property; and Neale (1990) as well as Heim (1990) give syntactic construction rules for how to form the definite description out of the material of the antecedent sentence. The first generation of E-type approaches were heavily criticized because of problems with the uniqueness condition (cf. Heim 1982). However, E-type approaches had a renaissance in the beginnings of the nineties (Neale 1990, Heim 1990, van der Does 1993, Chierchia 1995) because the alternative dynamic approaches exhibited other drawbacks. A different way of vindicating the original E-type approach was taken by Egli & von Heusinger (1995), who represented E-type pronouns by Hilbertian epsilon terms, as in (1f), rather than by the Russellian iota term. Unlike the iota operator, the epsilon operator is not interpreted by a complex quantifier phrase expressing uniqueness, but by a choice function, as discussed in section 1.5 below.

- (1) d. A man walks. The man who walks whistles.
 e. $\exists x [\text{man}(x) \ \& \ \text{walk}(x)] \ \& \ \text{whistle}(\iota x [\text{man}(x) \ \& \ \text{walk}(x)])$
 f. $\exists x [\text{man}(x) \ \& \ \text{walk}(x)] \ \& \ \text{whistle}(\epsilon x [\text{man}(x) \ \& \ \text{walk}(x)])$

1.2 Quantificational force of indefinites

Another puzzle posed by the semantics of indefinites is their quantificational force, which depends on the construction in which they occur. The indefinite *a man* in (1a) has existential force, while the indefinite *a donkey* in (2a) or (3a) receives universal force. Donkey sentences like (2a) and (3a) were introduced in the modern discussion by Geach (1962). Both sentences are interpreted by the formula (2b) expressing the universal force of the indefinite NP *a donkey*.

- (2) a. Every farmer who owns a donkey beats it.
 b. $\forall x \forall y [(\text{farmer}(x) \ \& \ \text{donkey}(y) \ \& \ \text{own}(x, y)) \rightarrow \text{beat}(x, y)]$
 (3) a. If a farmer owns a donkey, he beats it.
 b. $\text{Always}_{x, y}(\text{farmer}(x) \ \& \ \text{donkey}(y) \ \& \ \text{own}(x, y)) (\text{beat}(x, y))$

Kamp (1981) and Heim (1982) represent indefinite and definite noun phrases as variables (in the relevant argument position) and as open sentences, rather than as quantifier phrases. The indefinite noun phrase receives its quantificational force from an operator in the construction rather than expressing any quantificational force by itself. For example, sentence (1a) is governed by an (invisible) existential text operator as in (1c), while the variable introduced by the indefinite *a donkey* in (2a) is bound by the

universal quantifier *every*, as in (2b). The conditional (3a) is analyzed in (3b) with an (invisible) universal quantifier *Always*, which unselectively binds all occurrences of free variables.

1.3 Discourse referents

A related problem was noted by Karttunen (1976), who observed that referents introduced by indefinites may have different “life spans”, indicated by their potential to act as antecedents. The pronoun *it* in (4) can be anaphorically linked with the indefinite NP *a donkey*, while this is not possible in (5). The life span of the referent introduced by *a donkey* cannot exceed the domain that is governed by the negation. Since a referent in the external world exists independently of any linguistic construction, Karttunen concludes that the notion of “life span” holds not of referents in the external world but of semantic objects that he named “discourse referents”. Discourse referents are entities that are defined by expressing anaphoric relations and the interactions with domain-creating operators like negation, modals or verbs of attitude.

(4) Pedro owns a donkey. He beats it.

(5) John does not own a donkey. *He beats it.

Heim’s File Change Semantics introduces the concept of *file cards* as the objects between which anaphoric relations are constructed. Kamp’s Discourse Representation Theory defines anaphoric relations between *discourse referents* at a representational level. Both theories assume that anaphora and definiteness belong to the same general principle of familiarity, which is analyzed as an accessibility relation between the discourse entities and the domains in which they “live”.

1.4 Dynamic logic

One alternative family of approaches that has been developed is Dynamic Logic. It was developed partly in connection with a claim that Kamp’s Discourse Representation Theory is insufficiently compositional. The classical formalism was presented in Dynamic Predicate Logic (Groenendijk & Stokhof 1991) and extended by other formalisms (cf. Dekker 1993, Chierchia 1995). The basic idea of Dynamic Logic is that the meaning of a sentence is not a truth value, but rather a contribution to the change of context. The meaning is expressed as a relation between two information states, an input and an output state. An information state can be constructed as a set of assignment functions. The basic assumption is the same as in the Heim-Kamp theories, namely that an indefinite NP determines an assignment function for the variable introduced by the indefinite. The formalism passes this assignment function to the following text, and all subsequent occurrences of the variable receive the same value by the determined assignment function. Dynamic Logic dismisses the additional representational level of Kamp’s Discourse Representation Theory, and encodes the dynamicity directly in the interpretation rules. For instance, Dynamic Predicate Logic employs the traditional syntax of predicate logic, but interprets the symbols in a different way.

In particular, the conjunction and the existential quantifier receive a dynamic interpretation that makes it possible to “bind” variables across the syntactic scope of the existential quantifier. Sentence (1a), repeated as (6a), is represented by the formula (6b), which is equivalent to (6c) due to the dynamic interpretation of the logical signs.

- (6) a. A man walks. He whistles.
 b. $\exists_{dyn}x [\text{man}(x) \&_{dyn} \text{walk}(x)] \&_{dyn} \text{whistle}(x)$
 c. $\exists_{dyn}x [\text{man}(x) \&_{dyn} \text{walk}(x) \&_{dyn} \text{whistle}(x)]$

Like Heim’s File Change Semantics and Kamp’s Discourse Representation Theory, Dynamic Logic can be understood as an implementation of Geach’s proposal of representing anaphoric pronouns as bound variables. An alternative view to this representation of anaphoric pronouns and indefinites is provided by semantics with choice functions.

1.5 Semantics with choice functions

Recently, choice functions have received much attention in formal semantics. The syntactic counterpart of choice functions, the epsilon operator, was first introduced into meta-mathematics by Hilbert & Bernays (1939, 12). They use the epsilon operator as a generalized iota operator in order to replace the existential and universal quantifier, and characterize it syntactically by the epsilon formula (7a), which entails the two epsilon rules (7b) and (7e). If there is any term t which fulfills a predicate F then the epsilon term $\epsilon x Fx$ fulfills the predicate as well. From this it follows that if the predicate F holds of the epsilon term $\epsilon x Fx$ then there is an F and vice versa. The equivalence (7e) is derived from (7b) by substitution of $\neg F$ for F yielding (7c), contraposition (7d) and replacement of the existential quantifier by the universal in (7e).

- (7) a. $F(t) \rightarrow F(\epsilon x Fx)$
 b. $\exists x Fx \equiv F(\epsilon x Fx)$
 c. $\exists x \neg Fx \equiv \neg F(\epsilon x \neg Fx)$
 d. $\neg \exists x \neg Fx \equiv \neg \neg F(\epsilon x \neg Fx)$
 e. $\forall x Fx \equiv F(\epsilon x \neg Fx)$

The epsilon operator is interpreted by a choice function Φ , which is a function that assigns to a non-empty set s one of its elements, as defined in (8) or alternatively in (9). Intuitively, a choice function selects one element out of a set, and an epsilon term $\epsilon x Fx$ refers to an F that is selected by a choice function Φ out of the set of F s.

- (8) $\Phi(s) \in s$ if $s \neq \emptyset$
 (9) f is a choice function (i.e. $CH(f)$ holds) iff $P(f(P))$, where P is non empty.

This very general characterization makes choice functions an attractive and flexible semantic tool. For instance, choice functions, like Skolem functions, allow us to interpret the linguistic expressions associated with them *in situ*. The specific reading of the indefinite NP in (10a) can be interpreted *in situ* if the indefinite article is associated with a choice function which takes wide scope, as illustrated in (10b).

- (10) a. Every student read a book.
 b. $CH(f) \ \& \ \forall x \ [student(x) \rightarrow read(x, f(book))]$

The range of application of choice functions in formal semantics has not yet been fully determined. They have been used for representing questions (Engdahl 1986; Reinhart 1992), specific indefinites (cf. Reinhart 1992; 1997; Kratzer 1998, Winter 1997), E-type pronouns (Ballmer 1978; Hintikka & Kulas 1985; Slater 1988; Chierchia 1992, van der Does 1993, Egli & von Heusinger 1995) and definite NPs (von Heusinger 1997b). However, there has been no uniform account of these different applications so far, except for Egli (1991), who has sketched a semantics for definite and indefinite NPs and pronouns with choice functions, which was subsequently worked out in von Heusinger (1997a).

1.6 *Semantic partitions, merging views, and open questions*

During the last three decades, Montague Grammar has not only established itself as the classical semantic view, but it has also split into diverse branches on questions like anaphoric reference, the representation of indefinite and definite NPs, and the role of context in meaning. First, the question of how to represent cross-sentential anaphoric pronouns divided the semantic world into two groups: (i) E-type approaches, which kept to a basically static interpretation; (ii) dynamic approaches, which modify and extend the classical concept of binding and include the context into the process of interpretation. The discussion of this problem has led to very controversial disputes. Second, indefinite and definite NPs are represented either as complex quantifier phrases, as variables and associated open sentences, or as epsilon (or choice function) terms. The evaluation of these different proposals is not resolved and is still in progress. Third, the dispute over an additional representational level for discourse information like anaphoric relations has led to an ongoing controversy between Dynamic Logic and Discourse Representation Theory.

After years of controversial discussions, the different approaches are merging together, enriching each other's formal apparatus and giving a more detailed picture of the underlying semantics. Kamp-Heim theories and Dynamic Logic now agree on some kind of representational level for modeling anaphoric information. For instance, Groenendijk & Stokhof & Veltman (1996) extend the formalism of Dynamic Predicate Logic by a so-called referent system that introduces "pegs" as intermediate discourse entities expressing discourse information such as anaphoric relations. Pegs are connected with the variables in the object language, on the one hand, and with the objects in the model (of the real world), on the other hand. Dynamic theories also use elements of E-type approaches (cf. van der Does 1993, 1996, Chierchia 1995). Furthermore, choice functions find their way into different semantic theories, improving their formal apparatus. In the spirit of these collaborations, the investigations can again be focused on central – and still unsolved – questions of reference and anaphoric relations, as well as related issues such as historical aspects of anaphoric relations, quantifier and scope, anaphoric reference, choice functions and the semantics of indefinites, and the relation between representation and interpretation.

2 THE CONTRIBUTIONS TO THIS VOLUME

2.1 *Historical aspects of anaphoric relations*

The controversy about the nature of reference in general and the nature of anaphoric reference in particular goes back as far as Greek philosophy. URS EGLI guides us in his article *Anaphora from Athens to Amsterdam* through the ancient treatment on anaphora, which reveals important insights for the modern discussion. Egli presents sample texts that indicate that anaphora was a very prominent issue in the Stoic tradition dating back to the 3rd century B.C. The Stoics described quantifier raising and they recognized that a pronoun – despite its name – cannot always be replaced by the noun with which it is anaphorically linked, as is the case with proper names. They illustrated this with the so-called “nobody paradox”, which arises if the pronoun *he* in (11a) is replaced by its antecedent *someone* in (11b):

- (11) a. If somebody is in Athens, it is not the case that he is in Rhodes.
 b. If somebody is in Athens, it is not the case that somebody is in Rhodes.

Egli implements the Stoic view on anaphora and quantified sentences into a dynamic semantics, thus merging different traditions into a new and fruitful view.

The modern discussion of the representation of cross sentential anaphoric pronouns can be traced back to the work of Geach (1962), who discussed medieval approaches to the study of anaphoric pronouns. Geach claimed that the scholastic tradition was not able to analyze more complex anaphoric constructions, like the celebrated donkey-sentences, which were a prominent example from the scholastic discussion. REINHARD HÜLSEN argues in his contribution *Understanding the Semantics of “relativa grammaticalia”: Medieval Logicians on Anaphoric Pronouns* that Geach did not pay enough attention to the medieval discussion. For instance, the E-type theory of Evans had been anticipated by medieval logicians, such as Buridan. Hülsen first provides a sketch of the scholastic theory of *suppositio* or “kinds of reference” which was used during that time. He then explains different forms of *suppositio*, and finally discusses the problem of fitting anaphoric pronouns into this system. Like the Stoics, the medieval logicians dismissed the naive idea that a pronoun always refers to the same object as its antecedent expression. They discussed the possibility that pronouns refer in the same way, i.e. that they express the same *suppositio* as their antecedents. However, even this more sophisticated view was rejected by Buridan, who noted that *a man* in (12) may have more ways of reference (*suppositio*) than the pronoun *he*. For the pronoun only refers to men who are debating and not to men in general, i.e. it refers to the “verifiers of the first clause”.

- (12) A man is debating, and he is running.

Hülsen shows in his interpretation that Buridan has anticipated one of Evans’ most important arguments against the theory of Geach.

In their paper *Meaning in Motion*, JEROEN GROENENDIJK & MARTIN STOKHOF sketch the place of dynamic semantics within a broader picture of developments in

philosophical and linguistic theories of meaning since the end of last century. They illustrate some basic concepts of dynamic semantics by means of a detailed analysis of anaphoric definite and indefinite descriptions, which are treated as contextually dependent quantificational expressions. They show how a dynamic view sheds new light on the contextual nature of interpretation, on the difference between monologue and dialogue, and on the interplay between direct and indirect information.

2.2 Quantification and scope

Scope and particularly noun phrase scope has become a central topic again due to renewed interest in the syntax-semantic interface from both syntaciticians and semanticists. DONKA FARKAS treats the semantic reflexes of scope in her paper *Scope Matters*. She first reviews the main tasks that a theory of scope has to solve, and the ways in which they have been approached in the literature. In her view, the structural position of a variable underdetermines the possible readings. She presents a non-movement based theory of scope, and examines how it fares with respect to the desiderata established so far. In her own indexical theory of scope, she assumes that scope is not syntactically constrained at LF, but freely assigned semantically. Thus Farkas can account for data that are highly problematic for a movement account of scope. In her proposal, the wide-scope reading of the indefinite in (13a) is due to the independence of the variable introduced by an *Indo-European language* from the variable introduced by *every student* as in (13c). The narrow scope reading is explained by covariance of the former variable with the latter as in (13b):

- (13) a. Every student speaks an Indo-European language.
 b. $\forall x[x: \text{student}(x)] [y_x: \text{I-E lang.}(y)] \text{ speak}(x, y)$ (narrow scope)
 c. $\forall x[x: \text{student}(x)] [y: \text{I-E lang.}(y)] \text{ speak}(x, y)$ (wide scope)

The relations between scope, lexical composition and properties of generalized quantifiers are discussed by HENRIËTTE DE SWART, who explores alternatives to a lexical decomposition account of the German determiner *kein* “no” and its Dutch counterpart *geen* “no” in her paper *Scope Ambiguities with Negative Quantifiers*. The lexical decomposition was proposed to account for readings in which a scope-bearing operator such as an intensional verb or a universal quantifier intervenes between the negation and the existential quantifier as the two parts of the determiner. De Swart argues that the lexical decomposition is not only undesirable, but also empirically incorrect. As an alternative, she develops a higher-order interpretation of negative quantifiers in terms of quantification over properties. Her analysis is built on the observation that split readings are restricted to monotone descreasing NPs in predicative positions.

In *Definiteness Effect: The Case of Russian*, ELENA PADUCHEVA deals with the phenomena known as “definiteness effects” – specifically, with the combinability restrictions that are at work in English *there*-sentences and their Russian equivalents. The distinction of strong vs. weak determiners was introduced in Milsark (1974), and formalized in Barwise & Cooper (1981) in order to give an account of these restrictions. Paducheva discusses a similar set of facts from a different perspective. It is

claimed that a *there is*-construction, in its most common use, expresses existential quantification of its subject, and thus demands that the subject be a property denoting expression (i.e. a common noun) – rather than referential or quantificational one. Explicit markers of definiteness or quantification in the subject NP – either universal (as in **There is every tiger in the garden*, **There are all solutions to this problem*) or, sometimes, even existential – contradict this requirement – hence the explanation of ungrammaticality. Such determiners as *most* express double quantification (more precisely, quantification over one set and referentiality of the other), and are at place only in the context of a sentence with a very special topic-comment-structure; for example in such sentences as **There were most men in the garden*, the topic-comment requirements of *most* contradict those of *there is*-construction.

STEPHEN NEALE shows in his puzzle *Persistence, Polarity, and Plurality* that the following three commonly accepted hypotheses are inconsistent: (i) A sentence of the form *the As are Bs* is true if and only if every *A* is *B* and there is more than one *A*. (ii) So-called “negative polarity” expressions like *ever* and *any* can occur only in “downward entailing” environments. (iii) Plural descriptions may contain negative polarity items. Since (i) defines the definite article as not downward entailing, it is predicted that the negative polarity item *ever* cannot appear in plural descriptions, contrary to assumption (iii). Neale elaborates this argument in detail by decomposing the meaning of the definite article into a complex quantifier phrase. He finally suggests different solutions to the puzzle.

2.3 Anaphoric reference

Anaphoric expressions can refer to antecedents in attitude contexts. This observation goes back to Geach’s (1967) notorious Hob-Nob sentence (14), who dubbed it “intentional identity”. (The following two papers concentrate on the belief-belief variant of (14).)

- (14) Hob believes that a witch blighted Bob’s mare, and Nob wonders whether she (the same witch) killed Cob’s sow.

According to the received view in semantics, so-called unbound pronouns – that is, pronouns not bound by a quantifier *Q* inside the smallest clause containing *Q* – should either be treated as abbreviations for the antecedent clause or as variables bound by a dynamic existential quantifier. Following the discussions of Geach and Edelberg (1986, 1992), ROBERT VAN ROOY argues in his paper *Anaphoric Relations across Attitude Contexts* that the anaphoric dependencies in Hob-Nob sentences cannot be accounted for by treating pronouns simply as abbreviations for their antecedent clauses. This not only indicates that Hob-Nob sentences pose a serious problem for the proposal to analyse all pronouns as *definite* descriptions recoverable from the antecedent clause, but it also suggests that it won’t be easy to account for Hob-Nob sentences for any approach that treats pronouns as abbreviations for *indefinite* descriptions, like standard dynamic semantics does. Van Rooy discusses various ways we might try to account for Hob-Nob sentences on the assumption that pronouns should be treated as

variables bound by a dynamic existential quantifier, but finds none of them fully satisfactory. He concludes by suggesting that the problem might be solved when we take the notion of ‘speaker’s reference’ seriously.

HARTLEY SLATER takes another direction in order to solve the problem of intentional identity. In his article *The Grammar of the Attitudes*, Slater suggests that a purely grammatical explanation is possible by using epsilon terms as representation for anaphoric pronouns. He gives a representation of (15) as $Ta(\exists x)Sx \ \& \ Tb \ C\exists x \ Sx \ \& \ (\neg(\exists x)Sx)$, in which the cross-referencing pronoun ‘he’ is captured by the epsilon term $\exists xSx$. He defends this kind of account in detail with respect to the twelve similar examples in Edelberg’s (1995) paper.

- (15) Arsky thinks someone murdered Smith, and Barsky thinks he is still in Chicago (but there is no such murderer).

2.4 *Choice functions and the semantics of indefinites*

Three papers focus on the representation of indefinites by means of choice functions: ARNIM VON STECHOW compares the *in situ* approach of choice functions with the classical movement approach of quantifier raising at LF in his contribution *Some Remarks on Choice Functions and LF-Movement*. He discusses the use of choice functions for indefinites and for *wh*-phrases with a variety of data. For a long time, the standard assumption in Generative Grammar was that *wh*-phrases had to move at LF for semantic reasons, more precisely, for reasons of scope. Problems of wide scope indefinites and *wh*-phrases that cannot move for syntactic reasons have demanded a different semantic representation of these expressions. Reinhart (1992) and Kratzer (1998) applied the formal mechanism of choice functions to such cases. These *in situ* approaches to indefinites and *wh*-phrases receive support from current development in Generative Grammar. In recent work, Chomsky seems to hold the view that *wh*-movement serves the purpose of clause typing, i.e. a fronted *wh*-clause marks a construction as an interrogative construction. In other words, *wh*-movement is not motivated semantically but syntactically. The *in situ* interpretation by means of choice functions seems to provide a method to implement this idea semantically. Von Stechow then argues on the basis of more complex cases involving reconstruction and scrambling that the definition of the choice function must be modified to account for these cases. However, he also points to some data that cannot be described without movement. Although skeptical about the choice function approach, he tentatively concludes that it is an interesting alternative to the movement approach and that it might shed new light on quantification.

YOAD WINTER, in his article *What Makes Choice Natural?*, treats two aspects of the application of choice functions to wide scope indefinites. First, given that the semantics of indefinites involves functions, it still does not follow that these have to be choice functions. The common practice is to stipulate this restriction in order to get existential semantics right. However, he proposes a different way to derive this fact by referring to the conservativity, logicality and non-triviality universals of generalized quantifier theory. Winter then discusses the commonly assumed “specific”

vs. “non-specific” contrast of indefinites. He classifies the choice function interpretation of indefinites as “definite” and “strong” in a precise sense, and treats it on a par with proper names, definites and other “referential” noun phrases. Finally, he explores the potential of such properties for describing the scope of indefinites in partitive constructions and *there* sentences.

KLAUS VON HEUSINGER argues in his paper *The Reference of Indefinites* that indefinite NPs have a more complex referential nature than is usually supposed, and that this structure must be reflected in their semantic representation. He first presents three requirements toward a semantic representation of indefinites: (i) The descriptive material of indefinites, which serves to identify the referent, must be distinguished from the matrix predicate, which expresses the assertion of the sentence. (ii) The meaning of indefinites consists of the reference of the indefinite and its context change potential, which is necessary to link the indefinite to anaphoric expressions. (iii) Indefinites exhibit a fine-grained dependency structure. They are not only dependent on quantifiers but they are also dependent on other indefinites, which is shown by asymmetric readings of donkey sentences. Von Heusinger argues that these requirements are met if indefinites are represented by epsilon terms or choice functions. This allows one to keep the descriptive material separate from the assertive material of the sentence. He then presents a dynamic semantics in which indefinites introduce updates of choice functions in order to license anaphoric relations. Finally, he models the dependency structure of indefinites by Skolem functions that determine the particular choice function of the dependent term. This dynamic semantics with choice functions provides a feasible analysis of the so-called ‘asymmetric readings’ of donkey sentences.

2.5 *Representation and interpretation*

The relation between the concept of reference and that of inference is investigated by JAROSLAV PEREGRIN in his article *Reference and Inference: The Case of Anaphora*. He argues that reference is parasitic on inference, and not vice versa, as is commonly assumed. Peregrin divides his argument into two parts. In the first part he provides an overview of the development of logical tools which have been employed in the course of the analysis of referring expressions, such as definite and (specific) indefinite singular terms. He contrasts the Russellian Theory of Definite Descriptions with Hilbert’s epsilon-calculus, and introduces the dynamic semantics with choice functions of Peregrin & von Heusinger (1995). He argues that the Russellian and Hilbertian ideas of singular terms only yield a satisfactory result if reconstructed in a dynamic framework. In the second part he turns to the discussion of the nature of such explications, and especially considers the question of whether a representational view of language is necessary. Peregrin shows that anaphoric pronouns are merely indicators (markers, slots) for singular terms already used. These indicators are necessary for inferences between sentences that are linked by anaphoric relations. In this way, he derives anaphoric relations from inferential relations. As a byproduct of his argument, Peregrin denies that the semantic representation can be taken as directly related to a mental reality: It must not be understood as depicting some cognitive machinery of the participants in the linguistic community.

PAUL DEKKER reflects on the relation between interpretation and representation in his paper *Coreference and Representationalism*. Research on the semantics of intersentential anaphoric relationships has led to a debate about the necessity of an additional level of representation of meaning. These relations are not established directly between the linguistic terms or the objects of the worlds, but between mediating entities, like discourse referents, file cards, or pegs, at a representational level. The additional level is necessary for the interpretation of discourses, in particular for the resolution of anaphoric pronouns. Dekker raises the question of whether the interpretation, i.e. the meaning, also needs such an additional level. He designs a dynamic epistemic predicate logic that offers a unified treatment of anaphoric and demonstrative pronouns. The different ways of representing discourse referents known from the literature cause different interpretational strategies, which Dekker characterizes as strong, midweakly and weakly representational. He argues that his own system is as weakly representational as possible. Thus, this investigation into anaphoric relations and the notion of subjects shows how the interpretation of anaphoric terms promotes new levels of representation of linguistic meaning.

In his contribution *Underspecified Semantics*, REINHARD MUSKENS investigates the interaction between representation and interpretation with respect to underspecified structures. Ambiguities in natural language can multiply so fast that no person or machine can be expected to process a text of even moderate length by enumerating all possible disambiguations. A sentence containing n scope bearing elements which are freely permutable will have $n!$ readings, if there are no other, say lexical or syntactic, sources of ambiguity, and a series of m such sentences would lead to $(n!)^m$ possibilities. Muskens proposes not to generate and test many possible interpretations, but to first generate one 'underspecified' representation which in a sense represents all its specifications, and then use whatever information is available to further specify the result. Muskens shows that it is possible to use a standard logic for underspecified representations, provided that we use this logic not only to reason about the content of any given statement, but also about its form. One central hypothesis in the paper is that the relation between an underspecified representation and its full representations is not so much the relation between one structure and a set of other structures but is in fact the relation between a description (a set of logical sentences) and its models.

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