

LOGICAL RATIONALISM : ON DEGREES OF ADEQUACY FOR SEMANTICS OF NATURAL LANGUAGES¹

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I. Introduction : Goals of Semantic Theories

It is a truism that semantic theories should specify and explain semantic properties of semantic objects and semantic relations between such objects. Since there is no broad agreement about what should be taken to be the nature of semantic objects, properties and relations, the question arises whether there is any non-trivial condition which linguists and philosophers would agree must be imposed on semantic theories. The present paper is devoted to a discussion of two, seemingly simple such conditions. Some ways of satisfying these conditions are pointed out, which are of linguistic and philosophical interest.²

Any suggestion of adequacy conditions for semantic theories seems out of place as long as no general delimitation of semantics has been put forward, at least in broad outline. Indeed, a list of accurately formulated adequacy conditions often serves as a delimitation of a theoretical topic, but what gives such a list its life is a pre-theoretical conception of the intended subject matter.

What, then, is the subject matter of semantics of natural language? What are the goals of semantic theories? Since it is impossible to extract from the current theoretical approaches to semantics any common answer to these questions, it is difficult to avoid taking sides with one party or another. We proceed to point out a major dispute on goals of semantic theories and to present our

own view of the latter.

To get some idea of the disputed goals recall two dicta — Chomsky's characterisation of linguistics as a branch of cognitive psychology versus Thomason's characterization of Montague's formal linguistics as a branch of mathematics.³ Obviously, a branch of mathematics is not incompatible, in any significant sense, with a branch of a science, be it physics or psychology; the rivalry between the schools is only apparent, because *thus characterized* the two approaches do not share their theoretical goals.

The nature of the implicit dispute becomes much clearer when we move from a contrast between dicta to a comparison of explicit pronouncements. Chomsky argued recently that

"Linguistics.. is concerned with the nature, function and origin of a particular "mental organ".. the language faculty, a common human attribute, genetically determined, one component of the human mind. Through interaction with the environment, this faculty of mind becomes articulated and refined.. We will therefore be particularly interested in properties of attained linguistic competence that are vastly underdetermined by available experience in general, but that nevertheless hold of the linguistic competence attained by any normal speaker of a given language, and in fact by all speakers of all natural languages... on the natural assumption of uniformity across the species. The commitment to formulate a restrictive theory of Universal Grammar is thus nothing other than the commitment to discover the biological and to determine its particular manifestations" (Chomsky, (1975)).

Three points should now be underlined. First, the major goal of linguistics is, according to this view, the characterization of the concept of a psychologically possible human language.⁴ However, since human beings are psychologically restricted in various ways which reflect not only on language but on other human faculties of mind as well, the psychological specification of our cognitive abilities, language included, will incorporate both an account of linguistic competence and a theory of independently specified factors of linguistic performance.

Secondly, we should not disregard the obvious point that human beings seem to be unique in their linguistic capacity. Thus, another way of describing the major task of linguistics, according to the present view, is requiring linguistic theories to provide a framework for describing and explaining the unique properties of the psychologically possible human languages, in terms of structure, meaning, use or what have you.

Thirdly, notice that Chomsky's program is in the rationalistic tradition, being engaged in the pursuit of the *innate ideas* which characterize human languages, i.e., the internal equipment which makes language acquisition possible in the manner shared by all normal infants. Such an endowment may take the form of a specification of the conditions, formal and substantive, which a system of rules must satisfy in order to count as an internal description of a natural language.

Montague's attitude stands in sharp contrast with Chomsky's view, on each of these points, as shown by the very first sentence of each of his papers (1970a) and (1970b) according to which there is no important theoretical difference between natural and formal languages⁵. Now, importance of differences is relative to purposes of comparison and what is of utmost significance when attempts are made to answer the question "what is a psychologically possible human language?" might be taken no notice of when efforts are required to answer another question, *viz.* "what is a language, a symbolic system of no restriction?". Whereas Chomsky is interested in drawing an interesting distinction between what is linguistic and human and what is linguistic but not human, so to speak, Montague disregards it on purpose.

There was no genuine argument concerning empirical issues between Chomsky and Montague. It is not the case that the latter claimed that there is no significant difference between English and Intensional logic, while the former has maintained that such differences exist and are extremely important. From the generative point of view the natural language is unlike the logical system in some respects which bear the marks of the distinction between what can serve as a human, natural language and what cannot. From a formal point of view the same respects are of no theoretical significance so long as both English and Intensional Logic can be described within the same framework.⁶

Notice also that Montague's approach carries some empiricistic traits, in contrast with the clear rationalistic nature of Chomsky's program. First of all, Montague was engaged in a project of reduction. Empiricists have always thought that reducing one theoretical system to a seemingly less problematic one is of major philosophical import. Thus attempts to reduce psychology to biology, chemistry to physics, mathematics to logic used to be abundantly recommended by empiricists. But whereas some arguments for relating psychology to neurophysiology might be advanced, the reduction of an empirical domain to a mathematical field is doomed to gain no ground, on a par with the futility of any

attempt to reduce physics to mathematics. Empirical constraints of correspondence with facts cannot be reduced to formal constraints of coherence.

Thomason has suggested that a less stringent relation holds between a Montague grammar and a natural language, *viz.* the relation mathematical geometry holds to physical geometry. However, there is a major point of difference between the two cases. Formulae of mathematical geometry are uninterpreted in themselves and it is physical geometry, which associates "line" with "light-beam", for example, which furnishes them with a standard interpretation. Under such an interpretation, physical reality is a *model* of the mathematical system; the interpretations of the axioms of the latter hold in the former. However, because of the intricate nature of various performance factors, natural languages cannot be regarded as models of Montague grammars, even under the assumption that such grammars are adequate theories of linguistic competence. Embodiment is not interpretation.

Another involved dogma of empiricism is that of the respectability of mathematical appeal. Natural language is accordingly a legitimate object of empiricistic study, because it is identical with or reducible to a mathematical object. But though mathematical studies provide exemplary standards of clarity, preciseness and expressive power, mathematics itself is not innocent of philosophical mines and pitfalls. Mathematics is not a philosophical resting point.

The divergence of Montague's approach from generative linguistics is reflected in different theoretical decisions that will be reached by the two induced research programs, under the same conditions.⁷ There is no reason to assume that the fundamental divergence will turn into a practical convergence or a genuine contest, without a major shift in the theoretical goals of the Montaguean enterprise.

Our problem now is that of the theoretical possibility of *Logical Rationalism in the realm of language*. Where "logical" is taken to mean formal to the extent shown in current trends of philosophical logic, Montague's intensional frameworks included, and where "rationalism in the realm of language" stands for the philosophical foundations, theoretical goals and articulated methodology of Chomsky's linguistics, is logical rationalism in the realm of language possible? The following discussion will be devoted to this question. Semantics will be in focus.

II. Elementary Adequacy

It is pointless to try to delimit semantics precisely from the outset

of any research program and it is equally useless to make any attempt to find a significant theoretical similarity between different studies that have been labelled "semantic" during the last decades. The same holds for any attempt at a premeditated, exact delimitation of pragmatics. We are content to remain on the intuitive level of discussing semantic and pragmatic theories, which suffices for a broad outline of intricate theoretical interests.

Both semantics and pragmatics are centred upon specification and explanation of certain human competences or parts thereof, possibly abstracted parts. The competence related to semantics is that of systematically understanding the literal connections between sentences and their well-formed parts, on the one hand, and situations, courses of events or what have you in a world, whether actual or possible, on the other hand. The pragmatic competence is that of systematically using the linguistic means for effecting literal purposes.

A few clarifications would not be now out of place. Notice, first, that we are not committed to the view that the subject matter of semantics is an independent competence.⁸ First of all, our characterisation of it is in terms of both sentences and worlds. Consequently, if semantics does not carry the burden of specifying what is a sentence and what is a world, then the system of semantic rules *either* depends on a grammar, which determines the class of sentences and their forms, and on a conceptual framework, which determines the class of possible worlds and their relations, *or* is part of a complex of interrelated rules which fixes sentences, worlds and connections between them, perhaps inseparably. Moreover, a plausible assumption about the human network of systematic sentence-world connections is that they are based, partly but intrinsically and significantly, on non-linguistic knowledge and belief.⁹ Still, literal sentence-world connections are definable, by means of appropriate abstractions. The existence of a defensible, *clear-cut* distinction between literal and non-literal sentence-world connections is an empirical, open problem, to be settled by semantic theories.¹⁰ The same attitude is held by the present position towards the question whether our subject matter is a competence, a separable part of a competence, or an abstraction from a competence.

Secondly, at the outset we are not committed to any extreme position with respect to the role played in semantics by truth conditions. The natural place of the latter in many if not all linguistic institutions, expressing a central sentence-world relation, is undeniable, but the claims that everything in semantics can be done in terms of truth conditions and that everything in semantics can be

done without resort to truth condition are both in want of defence of a conclusive nature.¹¹

Among the sentence-world relations that semantics will probably be required to explain are institutional relations which grant many imperative and interrogative sentences, for example, their meanings. Since these linguistic institutions define standard uses of such sentences, there seems no way of avoiding pragmatic considerations within basic semantic theories. In a sense, some parts of pragmatics are completely included within semantics.¹²

General as that outline of goals might seem, the reference to human competences suggests a seemingly obvious adequacy condition, imposed on every theory of a human, mental capacity, namely finite representability (in the general sense that applies to systems of rules.) Every theory which is not a finite representation of a system of rules and which purports to specify a human competence, we shall describe as 'elementarily inadequate'.

The elementary adequacy of most syntactic theories is indeed obvious. A transformational grammar includes a finite class of syntactic rules, each of which is a computable function from finite labelled trees to finite labelled trees.¹³ Some of the systems current in philosophical semantics are also elementarily adequate, when construed as partial specifications of a "semantic competence"¹⁴. Hintikka's model sets and model systems are cases in point.¹⁵ Our own theory of pragmemes, which represent implicatures of sentences characterizing the latter's literal mood (or use) in terms of standard preferences of some possible courses of events over others, is an example of an elementarily adequate theory in pragmatics.¹⁶

Taking steps to assess the proposed possibility of Logical Rationalism in semantics, the problem arises of the elementary adequacy of Montaguean frameworks. As far as one can tell from Montague's own papers, he was not interested in imposing such restrictions on systems definable in the framework of his "universal grammar" and intensional logic. Nothing of the kind of elementary adequacy is suggested by Montague, even when fragments of English are under consideration, and functions, sets and operators of all kinds are used without restraint.

Rather than issuing an explicit, global limitation of formal armament, thus gaining elementary adequacy without illuminating any semantic matter, we suggest two particular restrictions which may enrich formal semantics with elementary adequacy.

Consider an adverb, such as 'slowly'. If one understands this word, then one has mastered a finite system of rules which governs the literal properties of the adverb, in terms of structure, meaning and

use. Moreover, such a system of rules should furnish one with an understanding of 'walk slowly' as a function of his knowledge of the literal properties of 'walk' and with an understanding of 'talk slowly' as a function of his knowledge of the literal properties of 'talk'. Now, these functional expressions should differ from each other just with respect to their arguments, i.e. properties of 'walk' and of 'talk'. Hence it is natural to construe an adverb as an operator from predicates to predicates, provided it satisfies some requirements which are not of our business here. Mastering the literal properties of a certain adverb is, then, mastering a function of a certain kind.

Now, there are two ways of treating functions within formal frameworks. According to the extensional approach, a function is a set of ordered pairs and its identity and properties depend on nothing but the identities of the pairs. According to the intensional approach, a function is identified not by a set of ordered pairs solely, but by a given specification of this set. It comes as no surprise that different intensionally given functions share their extensionally given set of ordered pairs.

If understanding an adverb involves mastering a function, then the mere compilation of ordered pairs, such as $\langle \% \text{walk}, \% \text{walk slowly} \rangle$,¹⁷ is extremely implausible for a variety of reasons, not the least among which is that the list is most probably infinite. If such a function is represented within an elementarily adequate semantic theory, it is finitely representable, which means that there is a *uniform* method of deriving the properties of the modified predicate from properties of the predicate itself.¹⁸ Thus, the following conjecture seems plausible :

(C1) The semantic values of adverbs in an elementarily adequate formal framework are computable operators.¹⁹

It is important to notice here the difference between a computable operator and a computable predicate. If a predicate (of one argument) is semantically represented as a function from individuals to truth values, relative to possible worlds, then it is computable, in a sense, if there is given a uniform procedure of computing the appropriate truth value, given a standard representation of an individual and a standard indication of the possible world relative to which the computed truth value shows whether the predicate holds for the given individual or not. When an operator is under consideration, however, it does not involve computation of a truth value for given individual and possible world, but a computation of an appropriate representation of a function, given a representation of another one. Evidently, predicates which are not computable are available in natural languages, e.g., "is the last 7 in the decimal

representation of a fraction"; it is our conjecture that operators which are not computable are not available. If a predicate is represented as an operator from individual terms to sentences (or from individuals to propositions) a revised form of our conjecture (C1) will apply to it.

The present conjecture seems to be generalized to every case in which the semantic properties of an expression are uniformly determined by the corresponding properties of its parts and by its structure. It has been commonly assumed, since Frege, that this is always the case, but some examples have started cropping that assumption and even if it has not been worn away some significant modification seems to be required.²⁰ Hence, the general form of the computability hypothesis does not involve presupposing Frege's principle :

(C) In an elementarily adequate formal framework for semantics, all operators are computable.

A proof of such a conjecture or a counter-example to it require a certain extent of formalization of the concept of computability for common linguistic entities, such as predicates, prepositions, quantifiers, etc. Inputs and outputs of operators will be required to be finitely and uniformly represented, i.e. built from an appropriate, finite collection of atoms through applications of operations drawn from a finite list, all explicitly given.

Among arguments and parameters of semantic functions one finds expressions of different logical types, two of which deserve particular attention at this context, namely proper names, however construed, and theoretical terms which stand for possible worlds. At a first glance, both seem to resist the suggested atomistic approach, for different reasons, and any attempt to develop Logical Rationalism in linguistics is bound to take up the challenge.

Proper names. Many formal semanticists, including Montague, have adopted the view that the semantic value of a proper name is a set of properties or a cluster of sets of properties. According to one version of this approach the sets define uniquely identifying descriptions of the object referred to by using the given proper name under certain circumstances, and the definitions of these special descriptions are given in terms of finitely many given properties that object has under those circumstances and relationships in which he stands then to some other given objects. However, according to a different version of the same approach the set of properties which the semantic theory assigns to a proper name is the set of all the properties of the corresponding object, in a certain context.²¹ Bearing in mind the requirement of elementary adequacy it seems

that the first version should be preferred to the second one; however, the following apparent counter-argument should be considered: the set of *all* properties a certain object has under certain circumstances is independent of the state of belief and knowledge of anyone who uses the proper name which refers to that object, whereas sets of uniquely identifying descriptions vary with users and should, therefore, be excluded from *linguistic* theory, at least from semantics. The charge against Logical Rationalism at this point is that finite representability is required on pains of blurring the limits of semantics.

In response to this charge one does not have to indulge himself in a defence of any delimitation of semantics or of any distinction between linguistic knowledge and any other kind of knowledge. Granting that uniquely identifying sets of properties may vary with speaker and context and that the correspondence between proper names and such sets is laden with beliefs and cognitions which could not be assumed to be shared by all speakers of the same natural language, one still imports a non-vacuous restriction by requiring elementary adequacy. Clearly, even if semantics does not provide a conceptual analysis of, say, some relation, it is only natural for the theory to impose some formal or material restrictions on the possible semantic values of the given term. When proper names are under consideration, the specification of characterizing sets of objects is relegated to whatever part of the mental equipment which suits such a task, but since semantics processes proper names, so to speak, it is obvious that theoretical restrictions are imposed on semantic values^{2 2} of proper names *qua* inputs for linguistic operations. Such values may be produced elsewhere, but since they play a semantic role they are required to satisfy general semantic requirements, such as finite, uniform representability.^{2 3}

Possible worlds. It would be difficult to imagine Logical Rationalism completely deprived of possible worlds and everything else which is often defined by means of possible worlds, such as propositions.^{2 4} For the present purposes it is assumed that possible worlds will play an indispensable role in semantics and that it is our task to find out whether their employ is reconcilable with elementary adequacy. (If formal semantics could dispense with possible worlds, no reconciliation problem would, indeed, have arisen.)

To get an idea of what we take a natural approach for Logical Rationalism to adopt, consider the suggestion to identify possible worlds with distributions, of matter in space-time.^{2 5} Assuming that matter is homogeneous, in the sense that for any single space-time

point there is nothing to specify beyond mere existence or mere absence of matter at that point, a possible world is defined by the set of space-time points which include matter. When logical necessity or possibility are considered it seems natural to impose no restriction whatsoever on those sets, but otherwise such generality is not obviously tolerable, if at all. When propositional attitudes, for example, are analyzed, only possible distributions of matter which show a certain extent of continuity, required by the existence of persons or similar individuals, are admissible. In such a case, all classes of possible worlds over which variables range include only possible worlds for which that continuity condition obtains. Moreover, the universe of discourse for that purpose, which will consist of all possible worlds satisfying the continuity condition (and perhaps some other conditions, similarly required), and all its proper subsets over which variables will range, should be finitely representable. Otherwise, it would be implausible to assume that the theory can be incorporated into an elementarily adequate theory of natural language.

In general, if any class of possible worlds plays any theoretical role in an elementarily adequate theory, it should be finitely representable. To see that this is not an obvious requirement, consider two extreme cases, *viz.* a class of just one possible world and the class of all possible worlds.

To characterize any single "object", whether a person, a state or a possible world, is to provide theoretical means for its identification, by a uniquely identifying description or by an appropriate use of some special institutional devices which do not produce such descriptions.²⁶ Notice here the difference between a complete description of an object and an identification of it. Clearly, a president of a state can be uniquely identified by a description from which noting follows about most of his virtues and vices. Now, each case of such an identification involves a finite description or a finitely represented institution, but an infinity of independent cases of identification might involve infinite resources of description or institutional operation, which are not finitely representable.²⁷ Such a possibility is banned by the requirement of elementary adequacy; if infinitely many objects are individually characterized by an elementarily adequate theory, all the infinitely many characterizations are within the expressive confines of a finite supply of predicates, relations, operators, logical particles or what have you, the same finite supply being used for all characterizations. In a sense, elementary adequacy requires uniform representability.

Turning now to the class of all possible worlds, recall the

above-mentioned stipulation that a possible world is a distribution of matter in space-time. Thus, the requirement that the class of all possible worlds will be finitely representable is tantamount to the requirement that the concept of possible world will be (finitely) definable in terms of concepts of matter, space, time and distribution. Constructing a *logical space*²⁸ each of whose dimensions is the matter-scale for a certain space-time point, we can represent every distribution of matter in space-time as a "point" in the logical space, but there is no reason to assume that even if every conceivable situation or course of events, which is the case or might have been, is representable in the general terms of matter distribution, our own conceptual framework is thus general. It is only plausible to maintain that our innate logical space is much more structured: it has dimensions of various kinds, it includes interrelated dimensions, and it can probably be extended in useful ways.²⁹

Now, the subject matter of semantic theory is the relations between sentences and worlds. Obviously, all the concepts involved in these relations are drawn from the concurrent logical space, and are, therefore, restricted in their nature. Revealing the structure of our logical space — its dimensions, their interrelations, the possibilities of extending it — is a major task of Logical Rationalism in semantics.³⁰ If classes of possible worlds are employed in a semantic theory, they should not be considered as classes of "points", because possible worlds are not atomic and classes of possible worlds are not extensionally understood collections of such atoms. The classes of possible worlds used in a semantic theory should be appropriately representable within the logical space suggested by the theory; this fact about classes of possible worlds bears, indeed, characteristic consequences with respect to the elements of these classes — they have properties which are representable in the logical space under consideration.

Intensional logic is of theoretical significance, because it provides a framework for representations of interesting semantic properties and relations, but it should not serve as a linguistic resting point. For intensional logic to constitute an essential part of an elementarily adequate semantic theory, its framework should be finitely and uniformly representable. The pursuit of appropriate logical space seems the advisable way of trying to give intensional logic linguistic spirit, following the basic train of thought of Logical Rationalism.

III. Explanatory Adequacy

In the preceding part of the present paper the notion of elementary adequacy has been introduced. When the problem is considered whether a certain semantic theory is elementarily adequate, some global properties of the theory and of it alone are at stake. Different properties of such a theory, which involve not just this theory but additional ones as well, are at the bottom of another adequacy condition, to which we turn now.

Theories are meant to *explain* families of phenomena, in addition to describing them, giving details of some aspects of the field and taking no notice of some other aspects of it. However, we are quite in the dark about the precise nature of explanation, all the attempts philosophers of science have made to explain explanation notwithstanding, and for the moment there is no choice at all but to rely upon some basic, shared intuitions.

Notice that Chomsky has defined *explanatorily adequate* linguistic theories those that succeed "in selecting a descriptively adequate grammar on the basis of primary linguistic data"³¹. Explanation involves, in this case as well as in any other case, some enhancing of understanding by a systematic broadening of the theoretical scope. An explanation of a variety of phenomena requires not only a theory which includes interesting generalizations, pertaining to these phenomena, but also a move from one theory and its set of goals to another theory which has deeper and more intricate goals.

Different explanatory moves suggest themselves, with respect to any linguistic theory. The assumption of homogeneity of the linguistic community can be waived, giving rise to theories which might explain general facts about syntactic systems in terms of a system of syntactic resources that copes with the requirement to understand sentences produced by grammars of different idiolects.³² The ideas of moving from a competence theory to a performance theory or from a synchronic theory to a diachronic one also spring up into one's mind. However, some theoretical moves are more natural than others. To see that, consider the analogous pursuit of understanding social systems. Assuming that a social order is determined, in abstraction from some practical factors, by a system of social rules. Having thorough understanding of the general form of such a social system of rules is a prerequisite of understanding several other social aspects, such as interrelationships between sub-systems of the same society or between different societies. Moreover, supplementing to a theory of abstract social systems an analysis of justifications of preferring certain systems to others will probably

provide explanation of social facts related to general goals societies have and their institutionalized achievement. The contribution of an analysis of historical changes of social order to the understanding of the concept of social system should not be denied, but the introduction of historical changes into the theoretical framework of specifying and explaining social systems involves not just comparisons of social systems to each other but also interactions of such systems with completely different ones. One theoretical move is, therefore, more natural than another, in a certain theoretical context. Such considerations seem to justify Chomsky's conception of explanatory adequacy for syntactic theories.

A similar train of considerations advances a general notion of explanatory adequacy for pragmatic theories, the subject matter of which is the human competence to use linguistic means for achieving certain standard, literal purposes. Part and parcel of our ability to use linguistic means for obtaining some desired ends is our ability to use appropriate means for attaining given aims. Thus, principles of rationality such as that of effective means govern some aspects of our linguistic activity, and an *explanation* of several regularities concerning conversational implicatures is provided by applying general rationality principles to the case of linguistic means and ends.^{3 3}

Furthermore, linguistic activity is always institutional; different kinds of speech acts involve operations of different systems of constitutive rules which define these institutions, and the very appropriateness of an utterance of a sentence by some speaker in a certain context depends on the existence of a linguistic institution which grants that speaker in the same context an institutional role which enables him to operate within the institution, attaining particular aims he is entertaining, by uttering that sentence.^{3 4} Now, the existence of institutions, having characteristic goals, roles, means and products, is not confined to language, and it is again the application of the general notion of institution to a particular case which enables us to explain a variety of facts about linguistic activity.

The competence to use linguistic means cannot, then, be formed in one's mind without mastering the general concepts of using means and of institutions. Since there are non-linguistic uses of means, non-linguistic institutions, and even non-linguistic intentional activities within non-linguistic institutions, a connection is thus established between theories of language and other branches of that field of inquiry which is engaged in understanding our mental capacities. Such connections are apt to provide explanations of

regularities in the realm of linguistic pragmatics in terms of broader conceptual frameworks.

However, explanation of such facts can be sought elsewhere as well. If some linguistic means are sentences, which have syntactic structures, then the source of some interesting restrictions on the family of linguistic institutions might be discovered to be in the syntactic system. Explanations of established uses of artifacts are often provided by their structural properties, and the institutional uses of sentences in contexts are similar in that respect.

Our approach to the problem of specifying explanatory adequacy for semantic theories should now be clear. Semantic theories invoke conceptual frameworks, logical spaces, possible worlds and classes thereof, but all of them are used within semantic theories in such a general way that renders futile any attempt to treat them as semantic peculiarities. If one admits that a certain logical space underlies the abstract internal representation of what is linguistically understood and expressed, and also that conceptual activity is involved in our perception, then it seems plausible to assume that the logical spaces of language and of perception are not independent of each other. On the contrary, it is only natural to put forward as a starting point for discussion the hypothesis that the logical space underlying perception is mostly included within the logical space which underlies natural language.³⁵ Indeed, such connections between the conceptual frameworks of two different mental capacities should naturally be expected to provide some explanations of semantic generalizations.

Obviously, the possibility of explaining certain features of some devices used in semantic theories, such as classes of possible worlds or clusters of truth-conditions, in terms of syntactic properties of sentences or in terms of substantive or formal properties of syntactic systems, should not be overlooked.

IV. Conclusion : Logical Rationalism

The problem we have set out to ponder is that of the possibility of logical rationalism in semantics. In the preceding parts of the present paper we have pointed out two conditions that a serious attempt at launching out into logical rationalism in semantics should bear. Uniform finite representability, which is at the heart of elementary adequacy, is a formal property of theories, and relevancy to non-linguistic mental activity, which is at the center of explanatory adequacy, is a substantive property of theories, but both stem from the rationalistic factor of logical rationalism. The logical factor of it

has supplied central notions, formal frameworks and powerful tools, the accomodation of which into a rationalistic conceptual theory is presently at stake.

Tentative as any conclusion seems at the present stage, the problem of the possibility of logical rationalism in semantics is indeed open, but any thrust into a position which provides better understanding of the relations between full fledged formal logic and well worn philosophical relationalism is worthwhile, for the possible benefit of both foundational linguistics and rationalistic philosophy.

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NOTES

¹This is a completely revised version of a paper read to the third Groningen round table under the title "Original sins and possible redemptions: Possible world semantics and possible context pragmatics."

Noam Chomsky's remarks on my paper "The proper treatment of Montagué grammars in natural logic and linguistics" (Kasher (1975)) motivated the present paper; I admit turning more skeptical with respect to some versions of formal semantics.

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²Kempson maintains in her (1975 : ch. 1.1 and p. 60 fn 2) that "there are four conditions which linguists working within the framework of a formal model of language would agree must be satisfied by a semantic theory", but philosophers will not consider the conditions she mentions as either theoretically neutral or philosophically innocent.

³Chomsky (1972); Thomason (ed.) (1974).

⁴One's interest in what is *psychologically possible* does not commit him to any negative attitude towards biological explanations of psychological systems, indeed.

⁵D. Scott expressed similar views in his (1970).

⁶Notice the peculiar ambiguity of the term 'universal grammar' which is given completely different meanings in Chomsky's and in Montague's frameworks.

⁷See Kasher (1975) for the details.

⁸A similar question arises with respect to pragmatics. See Kasher (1976c) and (1976d).

⁹See Davidson (1973).

¹⁰See Chomsky (1976).

¹¹See Davidson (1976) for an articulated defence of the first view.

¹²The treatment of indices (time, place, speaker, etc.) and of the institutional characterization of the meanings of non-indicative sentences, for example, should not be excluded from semantics, whereas the study of implicatures or the role of rationality principles in linguistic activity should be.

¹³For a precise demonstration of computability some arithmetization of labelled trees is required, but this is carried out easily.

¹⁴See Cresswell (1973) and (1976).

¹⁵See his (1962), for example.

¹⁶See Kasher (1974).

¹⁷The mark ' / ' stands for 'a representation of — within the theory under consideration'. or some similar expression.

¹⁸Such a derivation may involve uses of, say, common knowledge which is clearly not of a linguistic nature, but the way such information is used is uniform, in a sense.

¹⁹By 'the semantic value' of any expression we mean the formal entity which is ascribed to that expression by the theory.

Again, computability presupposes arithmetization, but this is of no particular importance here.

Notice that functions may generally be partial.

²⁰See Hintikka (1976) and also Kasher (1976a).

²¹This is Montague's approach, in a sense. The former position has been defended by Strawson and Searle and criticized by Kripke.

²²Perhaps the term 'cognitive value' would fit better, since parts of ascribed values are not purely linguistic in any way.

²³It seems that a similar approach may provide useful theoretical devices for explaining inherent vagueness. The semantic value of a single common noun is related to several procedures for deciding

whether an individual, given under a description or through an observation, belongs to a certain class. Usually, those different procedures will yield the same results when applied to the same individual, when appropriately given. Vagueness involves border-line case where the procedures are not always in accord with each other.

²⁴ See Stalnaker (1976) and Hintikka (1975) for some arguments.

²⁵ Quine (1968) and Cresswell (1973). At the moment, no commitment to any form of materialism should be taken to be involved.

²⁶ See Kripke (1972) and Putnam (1975).

²⁷ This possibility should not look far-fetched, because usually space-time points are represented in terms of real numbers.

²⁸ See Thomason (1972) for an application which presents all the essentials of the concept of logical space. See also van Fraassen's (1967).

²⁹ This does not mean that distributions of matter in space-time do not play any role in the innate logical space, but just that space, time and matter are not the only fundamental concepts of our mental non-formal equipment.

³⁰ Some parts of Katz's semantic theories can, it seems, be interpreted along these lines, thus vindicating at least their general goals.

³¹ Chomsky (1965 : p. 25). Notice that this characterization does not bear any direct relation to Hempel's models of explanation, in his (1965).

³² See Bierwisch's paper (1976) for an attempt at this direction.

³³ See my (1976b).

³⁴ See my (1976c) or (1976d).

³⁵ See Hintikka (1975) for an intentional (and intensional) theory of perception.

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