

example we saw is that grammatical predication can be interpreted as set-inclusion). The result of the meaning composition functions consists in delivering a truth value: the sentence is either true or false. So, in the determination of the meaning of a lexical item the notion of extension (or denotation) is crucial, and so is the notion of truth in the determination of the meaning of a sentence.¹⁶

Chomsky's main line of work is focused on the syntax of natural languages and does not directly address the problem of meaning composition as such. However, he explicitly discusses the program of model-theoretic semantics in his more recent philosophical papers (see Chomsky, 1992; Chomsky, 1993; and Chomsky 1995a) and, as we are going to see, expresses a pessimistic attitude towards it.¹⁷ Model-theoretic semantics, according to Chomsky, is problematic because it is an expression of "externalism", a philosophical theory which he considers wrong because it postulates a relationship between the mind and a world composed of a totality of language-independent things.¹⁸

Chomsky argues against a conception of semantics as the bridge between language and the world, and challenges the legitimacy, in a genuinely scientific linguistics, of the idea that words *refer* to mind-independently "given" things.

As for the language-world relation, Chomsky of course admits that it obtains, but that it is established only in indirect and complex ways. For sure, we use language (also) to describe the world we live in but the relation is not simple, nor direct: for example, it is not the case that one referential term corresponds to one object. Rather, it is only through variegated social practices and the mediation of their many different uses that linguistic expressions are linked to the external reality. This is why a theory of use is called for: Pragmatics becomes important and its role might be comparable to the one conjectured in Wittgenstein's later work.

This is, in a nutshell, Chomsky's argument against reference-based semantics: Let us take some *prima facie* innocent relation of reference, for perfectly basic terms. (Chomsky's favorite examples are the terms *house*, *London*

and *book*). His opening move is to show that to posit, even for them, a referent (some concrete thing outside, in the real world) is highly problematic, if not downright contradictory. Then he concludes that, if even in these very simple cases the idea of external referents leads to undesirable results, we are entitled to fear the worst for more complex, but nonetheless still quite ordinary, terms.

More concretely, let us take the term *book* in the sentence *The abstruse book John wrote weighs 5 pounds*. What is its reference? In particular, if something like that exists at all out there in the world, then it should be an entity which is at the same time concrete (it has a certain weight) and abstract (only its abstract content can be said to be *abstruse*). It could hardly be the case that John materially scribbled ink-marks (or typed strings of characters) on one single exemplar that weighs 5 pounds, and it could hardly be the case that this heavy object is, as such, *abstruse*. Thus, we patently have a contradiction. No such entity *could* possibly exist in the external mind-independently characterized world. Analogous considerations can be made for the term *house* in the sentences *He painted his house red*, and *The house is for sale*. In the first sentence *house* has as its referent an external surface (the sentence would be *false* if he only painted the interior of the house red, leaving the outside surface intact). On the other hand, the second sentence would be false if the proposed transfer of property against money were limited to the outer walls only, excluding everything that the walls enclose. Thus, once more, *house* refers to a bidimensional surface, but also to a well delimited three dimensional space. Another contradiction. Finally, take the term *London*: What is its referent in the real world? One might think it is "the portion of space-time delimited by the present London", but this is problematic: if a new skyscraper that happens to be the highest in town is built, does the reference of *London* change? Moreover, in some cases at least, we might want to speak of London in the future or in the past as the same entity it is today, even if the material composition of the town is (or will be) completely changed. For example, if an earthquake is going to destroy the city and it is rebuilt in a different place, there

is a sense in which we want to say that the new city is still London. Moreover, we can say things like *London is polluted*, *London is culturally sophisticated*, *London is awfully expensive*, and so on. The referents, accordingly, range from a certain bubble of air, to institutions of higher learning and literary events, to average prices paid for rents and in restaurants for meals over a certain territory.

This is only a sample of the problems one has to deal with when an extra-mental entity is posited as the referent of simple, ordinary terms. The source of these problems is the fact that the speaker's conception of objects, events and situations seems to play a crucial role in determining the reference of the term. The variability of use determines the variability of the actual physical reference (supposing that something of the sort exists at all) in ways that are perfectly obvious to the speaker and the hearer, yet conducive to all sorts of paradoxes, if one insists on trying to connect terms with external, mind-independent, material objects. Chomsky's main point is not that these external referents are elusive, or complex, or ill-defined, but rather that no such external object could *possibly* exist at all, or at any rate become a minimally consistent object of study for a serious science. Therefore, a reference-based theory (and model-theoretic semantics is such a theory) is built on a weak basement, to say the least. This, according to Chomsky, calls for a theory of use and indeed for a rather sophisticated one.

Chomsky, however, is not always completely negative and seems to believe that an alternative is available that can salvage much of the work carried out in the model-theoretic semantics framework (see for example Chomsky, 1992, pp. 218-224). This alternative involves reinterpreting large parts of the theory in an internalist framework. Maybe, the best way to characterize such a reinterpretation is to pay attention to what Chomsky considers a paradigm of the internalist approach: the theory of vision elaborated by David Marr (see Marr, 1982). This theory is paradigmatic because it "applies to a brain in a vat exactly as it does to a person seeing an object in motion". Chomsky (1995a) goes on to say that Marr's

"studies of determination of structure from motion used tachistoscopic presentations that caused the subject to see a rotating cube, though there was no such thing in the environment; "see", here, is used in its normal sense, not as an achievement verb... the account is completely internalist. There is no meaningful question about the "content" of the internal representations of a person seeing a cube under the condition of the experiments...".

The counterpart of Marr's approach in semantics would consist in treating meanings not as relationships between language and chunks of the external world but, instead, as mental objects created at the interface between two different levels of mental representations: The one of proper syntactic objects, and the one of our conceptual world, somehow including the ability to use concepts in everyday existence. The rough idea being that when one talks about "discourse representations", "models", "situations" and other familiar semantic notions one is still inside the mind, not outside in the world. Chomsky has sometimes stressed that we know vastly more about the former level than we do about the latter, maybe for contingent reasons, due to vagaries in the progress of our scientific knowledge, or maybe because the latter is not structured, like the former, around deep universal traits that can be the object of a serious scientific inquiry (maybe our conceptual-pragmatic component is a haphazard repository of species-specific idiosyncratic filters, rules of thumb, and tentative conjectures subject to incessant updating and revision). To this day, he remains noncommittal about these two possibilities.

Mental Models and Internalist Semantics

The discussion on externalism (and on the proposal of replacing it with internalism) may seem a quintessentially philosophical matter, of no great interest to linguists and psychologists, but, although it is indeed a philosophical matter, it is not uniquely that. In this paragraph, we will see that an internalist position may be related to a specific semantic theory and to a specific psychologi-

cal research program. Establishing such a link, however, carries us until a certain point only, and is far from being unproblematic.

Chomsky is not explicit about the features that internalist semantics should have. Apart from some general considerations, he says little, not to say nothing, about specific implementations.

The general considerations are the following: we should not stick to the common-sense idea that things have referents in the world, but we should rather say that our mind is such that it can contain, somewhere, somehow, mental entities like generic objects (*the average man*), things that are both concrete and abstract at the same time (*books*), maybe partly immaterial and partly extended entities (*London*), and so on. These mental objects, and not something else, are the entities we associate to the words.

In order to better understand what an internalist semantics might be, we will try to go beyond the general sketch traced by Chomsky. The fact is that in the last 15 years¹⁹ a research tradition in semantics (and in the theory of mind) that can qualify as internalist has received increasing interest. Let us start with a presentation of the general idea underlying this kind of research; later on, we will give an example of its empirical motivation.

Johnson-Laird (1983) lists a set of desiderata a theory of meaning should satisfy. One of them is that it should be a two-stage theory. To clarify what this means, let us modify an example he gives (Johnson-Laird, 1983, pp. 244-245):

The elderly gentleman often visited the town (18)

Suppose someone reads (or hears) sentence 18 out of the blue. Johnson-Laird's point is that what the listener does *in the first place* is not to get the denotation of the words and the truth value of the sentence. The first step, instead, is building a mental model of the situation. A *discourse referent* (or a file card)²⁰ is introduced, to which the property "being an elderly gentleman" is attributed. Another

discourse referent is introduced by the expression "the town" and the two are linked because the former is in the relation of "often visiting" the latter. With this piece of information we begin to have a sketchy model of the narrative, but, as you can see, at the very beginning the mental model is descriptively very poor. If a new sentence is read, new discourse referents can be introduced or new properties can be attributed to those already present and new relations between them are established. The mental model of the discourse is then enriched, and this happens every time a new sentence is heard (or read).²¹ Now, observe a point that is crucial for us: this first step in the comprehension of a discourse (the construction of a mental model) is not affected at all by the fictitious or veridical status of the discourse. Understanding Joyce's *Ulysses* or a faithful crime report requires the same process of mental model-building. In this sense, the first step in the comprehension task is entirely internalist; no question of its relation with the outside world is raised.

Of course, one can ask if the discourse our mental model represents is true or false. But that is only a further step and one that is not even required in order for us to *understand* the discourse. We do not ask whether Bloom's wife "really" had a lover. Yet, we understand the contents of *Ulysses*. Similarly, we understand sentence 18 even if we do not know that the elderly gentleman is Niels Bohr and the relevant town Princeton. As for the cases in which knowing the truth of the discourse is relevant (the crime report), one can say that a discourse is true if it has at least a mental model that can be embedded in the model corresponding to the world.²²

Needless to say, all this is pretty vague. What we are summarizing here cannot be considered a theory, unless the function that constructs, extends, evaluates and revises a mental model is introduced and explained. Nonetheless, the general project should be clear enough and it should be equally transparent why it satisfies to a large extent the requisites of an internalist semantics. In the next paragraph, we will see the empirical motivation that supports this kind of theory.

Indefinites and the Necessity of a Two-Stage Semantic Theory

If *entia non sunt multiplicanda praeter necessitatem*, (entities are not to be engendered beyond necessity) we need evidence supporting the theory that postulates two semantic levels, the first being the construction of a mental model and the second being its updating (in particular, its embedding in the model corresponding to the world, when the computation of a truth value is required). The strongest empirical evidence probably does not come from Johnson-Laird's work directly, but from a domain much studied by formal semanticists: indefinite expressions.

Starting from the seminal work of Russell (1905), an indefinite description like *a man* is translated by the existential quantifier of symbolic logic. One might think that this is not really right since there are cases in which an indefinite has a specific content that allows it to be a sort of naming expression. This is the case of the indefinite *a man with dark hair and a yellow coat* in sentence 19:

Yesterday around noon, a man with dark hair and a yellow coat entered the room twice looking for John (19)

However, it is not difficult to show that indefinites are not naming expressions.²³ Consider sentence 20:

It is not true that a dog entered the room (20)

This sentence can clearly mean that no event of dog-entering-the-room occurred. But, if the indefinite is a naming expression, this reading cannot be represented. So, a standard treatment (stemming from Russell) is to represent the indefinite article by the existential quantifier \exists (sentence 21 is a simplified formal representation for sentence 20: ²⁴

It is not true that $\exists x$ (x is a dog and x entered in the room) (21)

So far, so good. Let us simply comment that this treatment, in a sense, violates internalist principles since the variable bound by the existential quantifier ranges directly over the domain of interpretation representing the entities of the world.²⁵

More recently,²⁶ a new theory of indefinites has been proposed that capitalizes on the idea of mental models. The starting point of the new theory is the anomalous pattern of the so-called donkey sentences:

If John owns a donkey, he beats it (22)

The problem with sentence 22 is that the indefinite description *a donkey* cannot be interpreted *a la* Russell. To see why, consider that, adopting the standard analysis of the indefinite article as an existential quantifier, there are only two possible formal representations for sentence 22, depending on the scope of the existential quantifier with respect to the conditional:²⁷

$\exists x$ (x is a donkey and John owns $x \rightarrow$ John beat x) (22a)

$\exists x$ (x is a donkey and (John owns $x \rightarrow$ John beat x)) (22b)

Both these representations are problematic, as we are going to show (however, the reader not willing to consider the details of symbolic logic can simply take for granted that no adequate formal representation exists for sentence 22 as long as the indefinite article is treated *a la* Russell, for in the remainder of this paper we will not make further use of the logical tools necessary to analyze this sentence). The problem with sentence 22a is the fact that the

variable following *beat* is outside the scope of the existential quantifier (as indicated by the parenthesis, its scope is in fact limited to the antecedent of the implication). As a consequence, the variable is not bound and can receive an arbitrary interpretation. This representation, then, does not capture the reading we are interested in (the one in which John beats the donkey he owns, and not some other arbitrary entity in the domain of interpretation). For example, sentence 22a would be true in a situation in which John does not beat the donkey he owns, but rather beats his dog.

The problem with sentence 22b is different. Now the quantifier has scope over the consequent of the implication but, by the standard definition of \rightarrow , we derive that the entire sentence 22b is true for any value of x that makes the antecedent false. So, just to give an example, if there is at least a donkey in the domain of interpretation that John does not own, sentence 22b is true (independently of John's attitude towards the donkeys he owns).²⁸ Patently, this does not capture the truth conditions of sentence 22 either.

This is one aspect in which indefinites behave differently from what is expected when one assumes a standard existential interpretation (for a more extensive discussion, we refer to the works cited in note 26. To handle this pattern, a theory often referred to as *Discourse Representation Theory* [DRT], has been proposed whose formal apparatus takes advantage of the idea of mental models. We will limit ourselves here to the fundamental insight underlying the theory, namely that indefinites introduce new discourse referents [or file-cards] that can be used in subsequent text [definites, on the other hand, do not introduce discourse referents but simply update them]. This applies, in particular, to the case of the donkey-sentences. So, the pronoun *it* in sentence 22 picks up the discourse referent introduced by *a donkey*. Now, the point that should be emphasized is the following: the indefinite *a donkey* in sentence 22 cannot be interpreted existentially for the reasons we have seen, but it cannot be interpreted as a

naming expression either, for reasons similar to those we discussed with reference to sentence 20 (even intuitively, it is clear that the function of the expression is not that of picking up a particular individual from the domain). So, we are almost forced to introduce an intermediate level between language and the world, that of the discourse referents (the basic building blocks of mental models).

What the treatment capitalizes on is the fact that a discourse referent does not (at any rate, not necessarily) correspond to an actual referent in the domain of interpretation. Of course, many unsolved questions remain about the relationship between the two semantic levels (for instance, when does an actual referent correspond to a discourse referent?). These questions are legitimate but we cannot really address them. The interested reader is again referred to the cited works.²⁹

We believe that we have attained our limited goal. We wanted to understand better what an internalist semantics *might* be. We now have an idea of some of its formal features, and of the empirical motivation that can support it.

General Considerations

We have seen which kind of semantics is compatible with the philosophical doctrine of internalism. It remains unclear whether Chomsky thinks that some portion of semantics, different from the one inspired by the idea of mental models, is amenable to an internalist reinterpretation (to tell the truth, he never explicitly endorsed DRT as a positive example of an internalist semantics). We will leave this interpretative question open.

In closing, we wish to add some general considerations. The first is that, even if part of this semantic enterprise, being internalist, is safe from the Chomskyan critiques seen earlier, much of it may still be affected. In fact, even in DRT, the internalist stage is only the first one. Once a mental model is built, in order to compute the truth value of a sentence, one has to embed it in a model of the (portion of) reality the discourse is about, and here, following Chomsky, the externalist problem arises again.

One might ask, at this point, whether an internalist reinterpretation of the notion of truth would solve it. The answer to this question lies in part in the answer to another, more general, question: Which notion of truth is adequate for the theory of meaning? Note that, if we concede that semantics is a branch of an individualistic cognitive psychology, then the traditional pragmatist definition (according to which truth is "correspondence in the ideal limit of complete rational inquiry"), becomes unavailable. This definition, independent of its dubious value in other fields, being intrinsically sociological (or, to be more cautious, intersubjective), cannot be adopted in the investigation of *individual* psychology. This is an important point, because the pragmatist definition could, in the abstract, be amenable to an internalist interpretation: What counts is not the state of a mind-independently given totality of things, but instead the asymptotic goal to which a collective mental effort tends. It is mentalistic, for sure, but not individualistic. On the other hand, the Aristotelian "correspondence theory" of truth (*adequatio intellectus et rei*) bears no collectivist commitment, but is, by definition, founded on an externalist concept. This concept of truth, through the mediation of Tarski (1936/1956) became crucial for semantics (proof is, the label "truth-functional semantics"), and it can have, as such, a legitimate role in psychology, at least if what we want is to explain data like judgements of the native speakers about the truth values of sentences. This concept of truth can be made individualistic, but it remains ineliminably externalist, admitting no hypothetical internalist reinterpretation. All in all, the concept of truth that is relevant for linguistics and psychology cannot be easily integrated into the internalist framework.

So, the next question is: Are the Chomskyan objections to externalism really sound? And, if they are, must we then abandon much of the good work done in semantics?

We will conclude this paper trying to make explicit a counter to Chomsky's objections that, though not often voiced explicitly, we believe many semanticists

would be ready to subscribe to.

It consists in ruling *out* of the jurisdiction of semantics proper the determination of what belongs to the domain of interpretation, and what does not. Semantics has to determine the way in which words and sentences receive meanings. To do so, it has to determine how the meanings associated with words combine and result in complex meanings associated with sentences. This can be accomplished by just presupposing that certain words, somehow, have a referent outside, in the real world. Being about the modes of combination, and these being, in turn, (at least largely) independent of the actual references of the words, semantics does not have to explain reference. Of course, some other science (not semantics), under an externalist perspective, must be charged with the identification of the actual referents of the words whose meanings semantics is about. This other science (again, not semantics), will have to say a final word on ontology. Semantics does not have to worry about the actual referents of words, any more than it has to worry about the actual truth values of sentences whose structure it deals with. Its worries are limited to the (recursive) procedure of composition of meanings. Once it has identified these procedures, its task is over. If semantic analysis successfully tells us how the meanings of the constituents of sentence 23 below contribute to its truth value, we must be satisfied, even if the actual truth value of the sentence remains unknown. It is for astrophysics, not for semantics, to say what the truth value of 23) is.

Mars will collide with the Earth on the last day of the year
9998754327465529977540685271476 AD. (23)

The natural question now is: which sciences must be charged with the identification of the actual references of words? The easiest answer might be: That depends on what the discourse is about. If the discourse is about electrons, then it is for physics to say what the actual referent of electrons is. And so on. What, then,

about the problematic cases, those discussed by Chomsky involving fuzzy and paradoxical referents (*house, book, London* etc.)? The proponent of this approach, probably, would say that these should be the pertinence of pragmatics. Therefore, acceptance of this approach as an effective counter to Chomsky's objections, relies heavily on what, in the end, pragmatics will be able to accomplish. Let us not lose sight of a typical problem this discipline inherits: Why do we use a unique referential term like *London* to refer to such different things as a geographic area ("London is very large"), the air surrounding it ("London is polluted"), or the people therein ("London is more lively than Paris")? The burden on pragmatics, as proposed by Chomsky, is heavy indeed. Yet, this does not absorb the role of the semantic component. Far from it. After all, if it did, we should also say, by analogy, that the fact that biology fixes the truth conditions of sentences describing the structure of DNA makes the theory of meaning useless. Pragmatics, in these cases, plays exactly the role that biology, physics, geology etc. play in the non-fuzzy ones (like, for instance, sentence 23 above).

It remains to be seen whether pragmatics can really accomplish the task it would, thus, inherit.

Summarizing, although the issues discussed by Chomsky constitute a real challenge for much of traditional theorizing in semantics, at least one strategy is available that is worth pursuing and that can be effectively used to defend a reference-based semantics, notably including those parts that do not easily admit an internalist reinterpretation.³⁰

CONCLUSION

As we have seen, although it is true that the Chomskyan tradition is not primarily concerned with semantics, there has been among the generative scholars a lively debate on the problem of meaning. A point that can be considered sound enough is that lexical semantics is on a par with syntax in regard to the following problem: children show such extraordinary skills in acquiring lexical

meanings that this process must be to a great extent internally caused. There have been different proposals to the effect that lexical competence drives the acquisition and, more generally, the knowledge of the lexicon. Some of them have been described in this paper stressing both their merits and problematic aspects. Although, as usual in scientific research, no statement expresses the definitive truth, lively research is going on and it is leading to significant results.

More problematic is the relationship between generative scholars (especially Chomsky himself) and the tradition we labelled compositional semantics. Historically, an influential approach within this tradition denied the possibility of an autonomous and interesting theory of syntax. Today, however, this problem has been to a large extent overcome, since it is admitted more and more that an adequate theory of meaning cannot but operate on the basis of a sophisticated theory of syntax. Another problem in the relationship with compositional semantics is philosophical, and as such, bound not to have a definitive assessment. Chomsky's skepticism on the notion of reference risks undermining much work in semantics, and, as we have seen, no obvious reinterpretation seems to be available which is compatible with the internalist approach he advocates.

What we hope the reader has realized is that research in both syntax and semantics -even the hottest and most polemical debates- have contributed to an indubitable growth of our knowledge of meaning.

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ENDNOTES

1. At any rate the distinction is not rigid and cases of overlap exist. The meaning of a lexical item such as a preposition cannot be anything other than its role in the composition of the meanings of other constituents. In this case, lexical semantics just is compositional semantics.
2. For example, Thomason in his introduction to Montague's collected papers (Montague, 1974) writes that "we should not expect a semantic theory to furnish an account of how two expressions belonging to the same category differ in meaning".
3. See the second part of this paper and, especially, the quotation in note 18.
4. The typical data elicited in these experiments consist of the presentation of a certain stimulus to the child (a drawing, a strip of cartoons, a certain series of sounds etc.) accompanied by different, quite specific, syntactic constructions containing plausible new words (such as: "Donald Duck is *gorping* Cookie Monster", versus "Cookie Monster and Donald Duck are *gorping*"). The different meanings that the child instantly conjectures for the new term (in spite of the sameness of the perceptual non linguistic stimulus), upon hearing different syntactic expressions, are systematically predictable and are in excellent agreement with syntactic and lexical-semantic hypotheses possessing strong independent plausibility (Gleitman, 1990; Bloom, 1994). The innate character of these constraints on lexical meanings has also been corroborated by studying the process of lexical acquisition in blind children (Landau & Gleitman, 1985), and in congenitally deaf children acquiring the lexicon of sign-languages (Petitto, 1987).
5. To speak of "current version" might seem vague and inadequate, especially given the well-known fact that generative syntax is a research program in fast and continuous evolution. In recent years a major shift is taking place from the so-called Government and Binding Theory (born in the late seventies and initially formulated in a systematic way in Chomsky (1981) to the Minimalist Program

(whose more complete, but still largely programmatic, enunciation is given in Chomsky, 1995b). However, the role of Theta Theory (on which we are going to focus in the next paragraph) has remained pretty much stable through the changes in the research program.

6. The idea of using some kind of network to represent semantic relationships can only be justified (if it can be justified at all) by the unique perspicuousness that such networks are expected to possess in displaying all and only the correct inferential relations between the terms of the language. As both theory and practice (notably computer simulations) have shown, the very idea is crushed by unsurmountable difficulties. To begin with, it is far from clear what should be represented by the nodes and what by the links connecting these nodes. Standard candidates are concepts for the nodes, and relations for the links. Thus "building" and "person" should be typical nodes, while the relationship "taller than" should be a typical link. The architecture of the network should allow one to see at a glance that a building is (usually at least) taller than a person, and that persons go into and out of buildings and not the other way around. Yet "height" is also a concept, and so is "visitor". So, should "height" be a node, connected by a link of weaker intensity to "person" than it is to "building"? Then the link "taller than" becomes unnecessary. Should "visitor" be linked to "person" by a link that is qualitatively (not just quantitatively) different from the one that relates it to "building"? How many such qualitatively different links should there be in a semantic network? Must there be separate links expressing relations of size, causality, composition, precedence, worth, prominence, ownership, whatever? No principled specifications have ever been offered for such crucial choices (for a cautious review by an early proponent of semantic networks see Woods, 1975). Yet, it is plain to see that inferential relations (i. e. the very stuff semantic networks are allegedly made of) are crucially sensitive to the nature of such links. The inferences one draws from the fact that buildings are taller than people are different from those that can be drawn from the fact that people own buildings. In

the limit, it is arguable that we may need as many kinds of links as there are verbs in the lexicon, and as many nodes as there are nominals made out of verbs (including concepts such as donation, foreclosure, incineration, perusal and command). Possibly some nodes will be preferentially linked only to some other nodes and maybe only by a subset of these links, but the sheer number of components needed in a network that remotely captures most of our straightforward linguistic inferential powers is astronomical. The problem of combinatorial explosions always plagues such models, even granting one could solve in a non arbitrary way the fundamental uncertainty as to what these semantic networks are supposed to connect, and by what kinds of links. Finally, nowhere has there been the beginning of an idea of how to express by means of semantic networks the obvious *inferential* roles created by adjectivals ("A toy pistol", "A fake Stradivari"), adverbials ("Mary is allegedly taller than John"), tense ("A child was born that would be king"), aspect ("I consider it too dangerous"), progressives ("Buildings grow taller as you drive north") and much besides. On the basis of these fundamental shortcomings (and others we cannot go into here), it is our opinion that the perspective of ever modelling the semantics of natural languages by means of such networks is doomed.

7. One can ask if (and how) meaning postulates theories could account for the metaphoric use of linguistic expressions. The idea underlying this approach is that the metaphoric meaning is derivative from the strict meaning and that mastering the latter is a prerequisite to get the former. So, metaphoric meaning would not be a counter example to the theory but rather an indication that it stands in need of integration, if it has to account for the many different uses of linguistic expressions.

8. For example, "conceptual role semantics" is close in spirit to structuralist linguistics. According to De Saussure and to his followers, language is a "system of differences" and the semantic value of an expression is given by its collocation in this system of differences. For a discussion of this theory and its relations with

the holistic view, see Fodor and Lepore (1992). Also note that, although, as we are saying, in their formal and most perspicuous definition meaning postulates are devices operating at the denotational (language-external) level, it is also possible to define them more generically (and maybe vacuously) as "the set of links that hold between the expression and the rest of the lexicon". This vague definition allows an internalist reinterpretation of meaning postulates (in the sense of "internalist" that will be introduced in the second part of this paper).

9. We are not strictly faithful to Frege when formulating the problem this way. As it is well known, Frege was not interested in the psychological problem of comprehension. Analogously, presenting the "Principle of Compositionality" we will simplify the discussion avoiding the presentation of some crucial distinctions: the consequences of its application to the different levels of *Sinn* and of *Bedeutung*, the "Principle of Substitutability" etc. We feel free to do so because our aim here is not an exegesis of the Fregean text as such. The first to emphasize the infinite use of finite means in language was von Humboldt (see von Humboldt, 1889/1988).

10. A recursive rule is one that can be applied one more time to the result of its former application, and then again on the result, and so on. Take the arithmetical operation "successor of": be it $S(x)$, where x is a variable ranging over the set of natural numbers. It can initially apply, for instance, to the natural number 0, giving as a result $S(0)=1$. Then, as a second step, that operation can also apply to the result of its former application, that is to $S(0)$, now giving as a result $S(S(0))=2$. Of course, one can again apply the operation "successor of" to $S(S(0))$, obtaining $S(S(S(0)))=3$, and so on, and so on. An infinitely recursive rule has, among others, the property that it can create an infinite set of new entities starting from a single one. Needless to say, not all the operations are recursive: For instance, the operations "greatest number" and "arithmetical average" defined over sets of numbers are not recursive. We will see in a moment examples of recursive operations defined over linguistic entities.

11. Of course noun phrases can also refer to pluralities; a sentence like *John, Bill and Mary smile* can be given a coherent semantic analysis along the lines suggested in the text. Roughly speaking, the sentence is true if the set whose individuals are John, Bill and Mary is a subset of the set whose individuals are the entities of the domain that smile.

12. This fact is explicitly noted by Chomsky (1977). For the hypothesis that quantificational expressions move at the level of Logical Form to the left peripheral position, see May, 1985; Haegeman, 1994, (chapter 9) and Huang, 1995 are two recent introductions to the topic. See Hornstein, 1995 for a treatment internal to the generative tradition that does not need this hypothesis (this book also contains a detailed bibliography).

13. The condition we are talking about is known as *weak crossover* (WCO) constraint. The presentation we are going to give is simplified in many aspects (for example, it does not consider the crucial difference between A and A' movement).

14. Furthermore, a very interesting trend in current research consists in an attempt to take elements from both traditions, even though historically they have been presented as competing research programs. (Often polemically so: In fact, Montague believed linguistics to be part of mathematics, an assumption that is worlds apart from the Chomskyan idea of linguistics as a natural science very close to biology). In this new trend, there is a growing belief that many empirical analysis and technical devices can be mutually exchanged. For a systematic attempt to supply generative syntax with a formal semantic theory see Higginbotham (1985). Chierchia (1995) and Reinhart (1995) are two interesting recent works that, although internal to the generative tradition, nonetheless take many elements from model-theoretic semantics (for example, the hypothesis of quantifier raising is accepted but is not obligatory, since the interpretation of quantifiers directly *in situ* is admitted as an option).

15. The affirmation in the text is a simplification, as some reader could observe. We are ignoring in our presentation the important part of model-theoretic

semantics which uses possible worlds for the analysis of intensional contexts. If possible worlds semantics were considered, we should say that the meaning of a lexical entry is a function from possible worlds to the appropriate extensions in the domain of interpretation.

16. The idea of representing the meaning of the sentence by its truth conditions goes back to Wittgenstein's *Tractatus logico-philosophicus* (Wittgenstein, 1922). Wittgenstein said that to understand a sentence is to be able to say what happens if it is true (cf. proposition 4.024). The idea is simple: a proposition is a partial description of reality. So, we can say we understand the proposition if, and only if, we can identify (at least some) possible situation in which it is true, and (at least some) possible situation in which it is false. If the relevant proposition is "it snows", we can confidently say that someone understands it if he can say that it is false when it rains but true when it is actually snowing. Before Wittgenstein, Frege had identified the denotation (*Bedeutung*) of each sentence directly with its truth value (the True, or the False).

17. In conversation, he has once symptomatically characterized to one of us (M.P.P.) Montague's semantic theory as, at bottom, the semantics of the verbs "can" and "must".

18. Chomsky has changed his mind on semantics several times during 40 years of lively intellectual life and even today he seems to show some oscillations on this topic. Actually, it can be argued that he moved from the initial skepticism of *Syntactic Structures* (that is, Chomsky, 1955) to a more optimistic attitude in the '70s. In his latest philosophical papers, however, he goes back to the initial critical position. For an example of the middle-period, see the introduction to Chomsky (1975) and Chomsky (1977). The following are some recent papers in which the role of semantics is seen (again) quite critically: Chomsky (1992), Chomsky (1993) and Chomsky (1995a). Particularly interesting is the following passage of Chomsky (1995a):

As for semantics, insofar as we understand language use, the argument for

a reference-based semantics (apart from an internalist syntactic version) seems to me weak. It is possible that natural language has only syntax and pragmatics; it has a "semantics" only in the sense of «the study of how this instrument, whose formal structure and potentialities of expression are the subject of syntactic investigation, is actually put in use in a speech community» to quote the earliest formulation in generative grammar 40 years ago, influenced by Wittgenstein, Austin and others.

Here Chomsky is quoting a passage from *Syntactic Structures* with the purpose of saying that his initial skepticism on semantics might well be sound. Chomsky's statement seems to be hardly compatible with some other recent affirmations according to which semantics, if internalist, is a workable and interesting project.

19. However, Karttunen (1976) had already discussed the linguistic problem and introduced the basic idea to deal with it. Another important work in this approach (in addition to those we are going to mention) is Fauconnier (1985).

20. The expression "discourse referent" is not Johnson-Laird's but comes from the cited Karttunen work. The expression "file card" is used by Heim (1982).

21. For simplicity we omit discussion of the fact that a mental model can also be enriched nonlinguistically (for instance pictorially, or ostensionally).

22. Note that a discourse can have many mental models associated with it. Take sentence 18: there are many mental models compatible with it: One is that in which the elderly gentleman is a famous physicist, another one is that in which he is a famous film director, and so on. If (18) is followed by the sentence "he did that in order to teach in the local physics department", the mental model in which the main character is a film director is ruled out (or discouraged), but others remain. Generally speaking, the more elaborate a discourse is, the more constrained the mental models representing it are. But, given the fragmentary and finite character of the written (and oral) discourses, there will always be more than one mental model representing them.

23. For a different view see Fodor and Sag (1982) (who, however, do not deny that

indefinites can be interpreted existentially).

24. Representation (21) must be read in the following way: "It is not true that an individual x exists that is a dog and that entered the room". Sentence 21 is true if no dog that entered the room exists in the domain of interpretation representing the entities of the world referred to by the language.

25. A caveat for the reader familiar with symbolic logic: one can observe that what we said in the text is not (necessarily) true, since the matter entirely depends on the choice between substitutional and referential methods for interpreting the quantifiers. However, in order to get the adequate truth conditions for a sentence of a natural language, if one chooses the substitutional method (the more internalist one), then one must postulate that every individual of the domain has a name, an assumption that, according to us, violates the internalist maxims as well.

26. See Geach (1962) for the initial evidencing of the donkey-sentences pattern. As for the formal treatment usually labelled DRT (Discourse Representation Theory), see Heim (1982) and Kamp (1981) for its early development (borrowing elements from Karttunen, 1976 and Lewis, 1975) and Kamp and Reyle (1993) for a systematic presentation. For a new (dynamic) version of the theory, see Chierchia (1995) (that also contains a detailed bibliography on the issue).

27. The reader not familiar with symbolic logic is advised that, in the propositional calculus, the formula $A \rightarrow B$ stays for "if A , then B " and is equivalent to the formula $\neg A \vee B$ (to be read "not A or B ").

To get what this equivalence expresses, one must remember that the formula $A \vee B$ is true in the propositional calculus even if both A and B are true (that is, disjunction is not exclusive).

Keeping that in mind, consider when $\neg A \vee B$ is true. As the reader can easily verify, $\neg A \vee B$ is made true by three combinations of truth-values out of four: When A is false and B is true; when both A and B are false; and, finally, when

both A and B are true. In fact, the only combination that makes $\neg A \vee B$ false is the truth of A and the falsity of B. Whence, the equivalence that holds between $A \rightarrow B$ and $\neg A \vee B$ expresses the idea that a conditional is false just in case the antecedent is true and the consequent false. In the discussion of the formal rendering of sentence 22, this equivalence plays a crucial role.

28. We are interpreting the conditional in terms of the material implication but the same point holds for other interpretations as well.

29. Nevertheless, let us try to give a simplified answer to the question in a few lines. The reason why not every discourse referent does find a corresponding real referent in the domain of interpretation is the following: some discourse referents have a limited life-span (to use an expression due to Heim 1982). They survive (that is, they are accessible to anaphoric pronouns) only in a certain syntactic environment. Consider the following contrast:

- i) He got a car. It was cheap and reliable
- ii) * He did not get a car. It was cheap and reliable

As shown by i), the indefinite *a car* can establish a discourse referent that can be accessed by an anaphoric pronoun. However, when the indefinite occurs within the scope of negation, the discourse referent is not available any more. Data like these have suggested that an operator fixes the maximum range within which the discourse referent is available (metaphorically, its life-span).

30. This is not the only possible counter to Chomsky's objections. One of the authors of this paper pointed out that another strategy is available (cf. Cecchetto, forthcoming who attributes the initial suggestion to Gennaro Chierchia): it can be argued that semantics is not about the way in which the truth value of a single sentence is determined compositionally in a given context; rather it is *only* about inferences that relate two (or more) sentences to one another. In this perspective,

semantics has to deal uniquely with concepts like consequence, presupposition, tautology, and so on. If one is willing to narrow its range of application in this way, semantics becomes more easily amenable to an internalist reinterpretation. The point is that the inferential schemata on the basis of which the meaning links are calculated are just a question of syntax. It is true that syntax needs to be interpreted (a theory of logical consequence must come alongside with it), but we know from symbolic logic that in many cases, although some model must be there, an abstract one (that is, one that is *not* intended to give a description of a certain portion of reality) can be enough.

By analogy, in natural languages a theory of inferential links that hold among sentences might be given in which the model for interpretation is not intended as a description of the world. The difficulties discussed by Chomsky would then disappear because semantics would no longer be the bridge towards a language-independent reality.

However this way out has a cost: one has to give up the idea that semantics deals with the compositional fixation of the truth value of a sentence *in isolation*. That is, we must abandon the idea that we can give an account of why we judge a certain sentence A true or false in a given context B. Needless to say, this is one of the traditional semantic jobs.

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