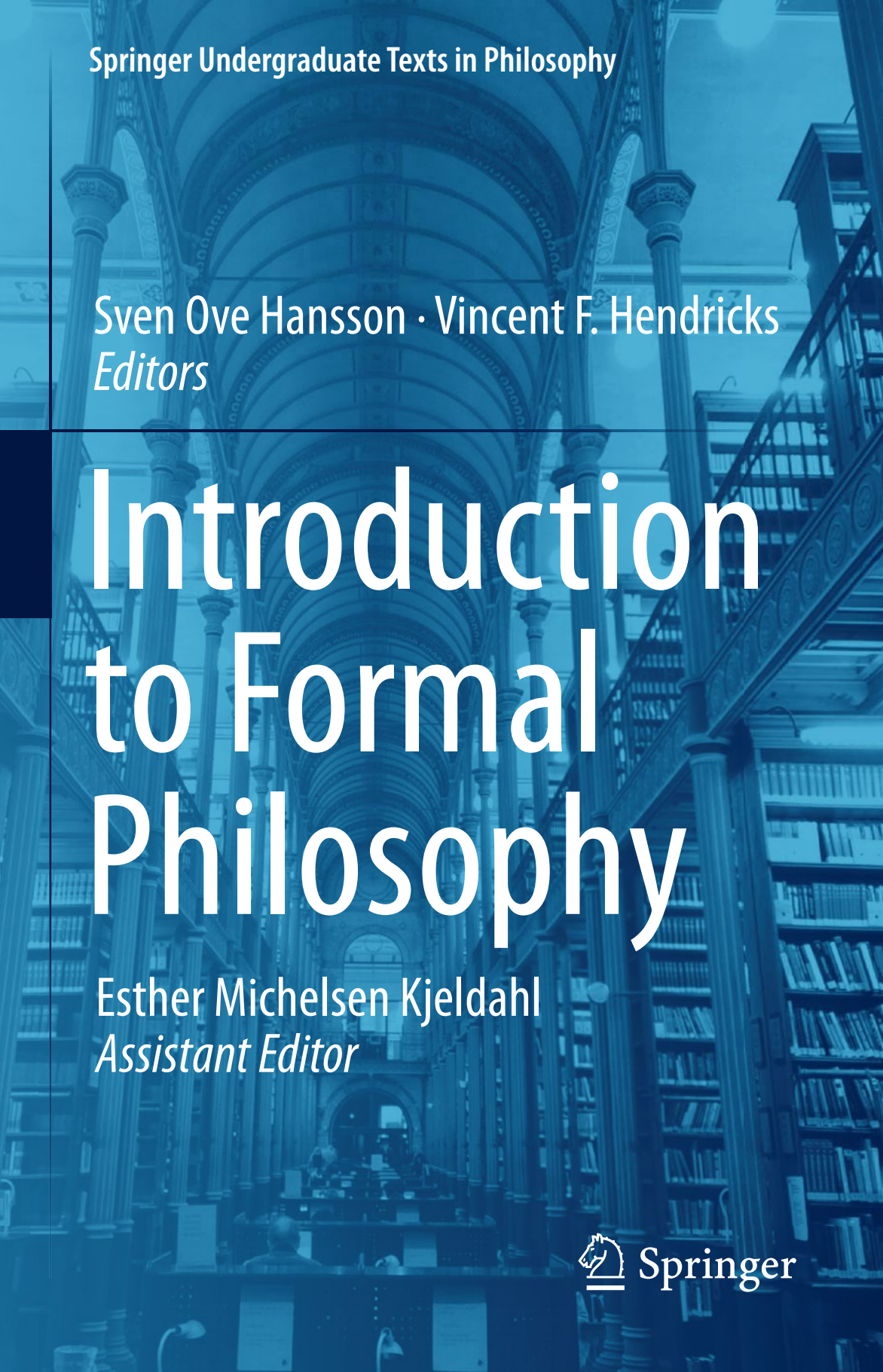
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Chapter 12
Can Natural Language Be Captured in a Formal System?

Martin Stokhof

Abstract The question whether natural language can be captured in a formal system has been argued at length, and both a positive and a negative answer has been defended. The paper investigates the main lines of argument for both, and argues that the stalemate that appears to have been reached is an indication that the question itself rests on a wrong conception of the relation between natural languages and formal languages, and hence of the methodological status of formal modelling of natural language.

12.1 Introduction

The question that this paper addresses has been answered with both an unqualified "Yes" and an unqualified "No", and both answers are not only straightforward but apparently, they can also both be justified. That suggests that perhaps something is wrong with the question, and that hence the best possible answer we can give is "It depends". In what follows we will proceed to explore these three options.

But before we start we must do some preliminary work. First of all, we should further specify the question by determining what we will take "natural language" to refer to. Is that the phonetic system of a natural language, its morphology, or its syntax? Although in these areas, too, the question of the possibilities and limitations of formalisation are interesting and important, we will concentrate on the "meaning" aspect of natural language, i.e., on its semantics and its pragmatics. The main reason for this restriction is that it is in this area that the question appears to have its main philosophical interest.

It should be noted at the outset that by distinguishing the question of the possible formalisation of meaning from that of, say, syntax, we allow for the possibility

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that the first question can be answered in the negative while at the same time the latter is answered positively. (As we shall see, the reverse possibility seems much harder to maintain.) Such a situation would be in accordance with the theoretical view that, indeed, there is a principled distinction between the syntax of natural languages on the one hand, and their semantics and pragmatics on the other, and that this distinction is reflected in the nature of linguistic competence. The former would correspond to Chomsky's conception of "the faculty of language in the narrow sense" (FLN), that is connected not with the communicative function of actual natural languages, but with an evolutionary and physiologically distinct computational system that is not unique for language. Semantics, and pragmatics in so far as it deals with meaning, would belong to a different system, "the faculty of language in the broad sense" (FLB), a conceptual system that draws on different cognitive capacities that are physiologically realised in different ways than those characteristic for the computational system.[1]

Most people working in semantics would tend not to agree with such a radical difference between systems, and one reason for this disagreement is that they conceive of semantics as a homogeneous domain, despite the customary distinction between lexical semantics and structural semantics. According to this view, the former deals with the meaning content of lexical expressions, whereas the latter is concerned with the semantic rules that govern the ways in which meaningful expressions are combined into larger, meaningful wholes. For an account of the meaning content of a complex expression we need both, hence semantics, at least in theory, should be homogeneous and unified, although in practice there may be a division of labour, of course. This assumed homogeneity does not sit well with the Chomskyan division between FLN and FLB, in particular because, according to the received wisdom of compositionality, the semantic rules that are the prime subject of structural semantics, in their turn should be aligned with the rules of syntax. But if Chomsky would be right, that would mean that there is a fundamental split between structural semantics and lexical semantics after all, the former being part of FLN and the latter belonging to FLB. This is certainly a possible point of view, one which is potentially agreeable to Chomsky, but nevertheless awkward for most semanticists, since it robs them of a homogeneous empirical domain. Whether the question of formalisation can shed further light on this issue is something we will return to later on.

So, we focus in what follows on the question of the formalisability of meaning, and hence the question addressed will be "Can natural language meaning be captured in a formal system?". Do note that the relevance of that question extends beyond semantics and pragmatics as parts of linguistic theory: if natural language meaning is non-formalisable, then this will arguably have implications for the potential of formalisation in epistemology, metaphysics, and other philosophical disciplines. Inasmuch as the concepts and the argumentative strategies employed in

[1] Cf., Hauser et al. [11]. The position that semantics is not part of grammar is one that Chomsky has defended throughout, cf., e.g., [4], Chapter 2.

those disciplines depend on, and are conducted in, natural language, the effects of natural language meaning being formalisable, or not as the case may be, will trickle down and affect what formalisation can reasonably be expected to achieve in these disciplines.

12.2 Yes

The wholeheartedly positive answer "Yes" started to be heard in philosophy, and a little later on in linguistics, only at the end of the sixties of the previous century. There had been people who had suggested that the tools of formal logic could be applied to the analysis of natural language meaning in a systematic and empirically explanatory way earlier on, but their voices were hardly heard at the time,[2] or their suggestions were brushed aside as irrelevant.[3] In analytic philosophy the two dominant schools of thought, logical positivism and ordinary language philosophy, both shied away from the idea of formalisation of natural language meaning, though for different reasons. For the positivists, natural language as such lacked sufficient systematicity and their semantic analyses were carried out by constructing interpreted formal languages and studying their logic. That same lack of systematicity for ordinary language philosophers also presented an obstacle to formalisation, but in their view, this was not so much a reason to switch to formal languages as to adhere to a more descriptive and informal methodology. As we shall see, both perspectives are still around.

It was only with the work of Davidson and Montague, and later on Lewis, Partee, Bartsch and a host of others, that the very idea of a formal treatment of natural language meaning came into its own. In view of Chomsky's rejection of Bar-Hillel's suggestion that logic and linguistics join forces (cf., footnote 3), it may come as a surprise that it is Chomsky who was often referred to as a major source of inspiration: his work in generative syntax inspired confidence that on that score doubts concerning a lack of systematicity could be considered as settled.[4] Syntax being amenable to a rigorously formal treatment meant that one condition

[2]The most prominent example perhaps being Hans Reichenbach, whose *Elements of symbolic logic*, which dates from 1947, contained a substantial part devoted to systematic treatment of, among other things, tenses and other temporal expressions in natural language, which became known and very influential only much later.

[3]Which is what happened to Yehoshua Bar-Hillel, who, inspired by Carnap's work in intensional logic, in the early fifties suggested that the formal methods of logic could be applied to the results of Chomsky's early work in generative syntax so as to provide a formal semantics for natural language (cf., [1]). The proposal met with a brusque and negative response from Chomsky (cf., [3]), and it took another decade for other people to take up on this idea.

[4]Cf., e.g., Davidson: 'Recent work by Chomsky and others is doing much to bring the complexities of natural languages within the scope of serious theory.' [7], and Montague: 'On this point [viz., that natural languages can be treated formally, MS] I differ from a number of philosophers, but agree, I believe, with Chomsky and his associates.' [21].

for a formal semantics was met. For, in some form or other, the compositionality principle, that says that the meaning of a complex expression is determined by the meanings of its component parts and the way these are combined, was leading, as it had been in philosophical logic since the days of Frege. It requires that the 'means of combination' of the expressions of a language, i.e., its syntactic rules, be determined in order to serve as the carrier of a compositional specification of their meaning. No guts no glory, no syntax no (formal) semantics.

Of course, the availability of a formal theory of syntactic structure fulfils a necessary condition, by itself it does not show that meaning can be formalised as well. This is where the enterprise of formal semantics starts. Looking back, we can discern a number of different trends. Some authors seem to aim at what can almost be called 'transcendental' arguments of the formalisability of natural language meaning, whereas others take a much more empirical stance, and proceed stepwise. The former approach starts from an assumption that can be epitomised in the following quote from Moerdijk and Landman: 'Things must be very strange if they cannot be captured in mathematical terms.'[5] It is that ultimately every phenomenon that is systematic and that can be understood by means of a rational inquiry, has sufficient structure and can be modelled formally. The subsequent task is then to find, or to develop, the appropriate formal tools and to apply them to real instances. That, to be sure, is indeed an empirical undertaking, and one that may run into problems or even fail. But formalisability as such seems less an empirical issue than a precondition for a phenomenon to be meaningful and subject to rational inquiry in the first place.

It comes as no surprise that this way of looking at things can be found primarily among the philosophers and logicians who were engaged in the development of formal semantics. An example to illustrate this. Richard Montague started his 'Universal grammar' with the following statement ([21], p. 373):

> There is in my opinion no important theoretical difference between natural languages and the artificial languages of logicians; indeed, I consider it possible to comprehend the syntax and semantics of both kinds of languages within a single natural and mathematically precise theory.

This claim functions more as a starting point than as a conclusion. In his 'Universal grammar' paper Montague proceeds to specify the form and content of such a 'single natural and mathematically precise theory', which consists of algebraic frameworks for the analysis of expressions, meanings and the meaning relation that associates (analysed) expressions with meaning in an explicitly formal way. What is outlined in 'Universal grammar' is a general framework, one that needs to applied to concrete phenomena, as Montague himself has done, for example, in his seminal paper 'The proper treatment of quantification in ordinary English' [22]. What is interesting about Montague's starting point is that it is conceptual, rather than empirical. The possibility of formalising natural language meaning is a starting

[5]Cf., Moerdijk and Landman [20]. Cf., also Cresswell's defence of his use of set theory as his metalanguage in his *Logics and languages* [5].

point, one that needs to be tested, but not as a specific claim but as something that defines an entire theoretical approach.

For Montague, this has consequences also for the empirical character of the subsequent application of the general framework. Thomason explains this in his introduction to *Formal philosophy*, the collection of Montague's papers on semantics, as follows (Thomason 1974, p. 2):

> According to Montague the syntax, semantics, and pragmatics of natural languages are branches of mathematics, not of psychology. The syntax of English, for example, is just as much a part of mathematics as number theory or geometry [...] This mathematical conception of semiotics does not imply that data are irrelevant to, for instance, the syntax of English. Just as mathematicians refer to intuitions about points and lines in establishing a geometrical theory, we may refer to intuitions about sentences, noun phrases, subordinate clauses, and the like in establishing a grammar of English. But this conception does presuppose agreement among theoreticians on the intuitions, and it renders statistical evidence about, say, the reactions of a sample of native speakers to "Mary is been by my mother" just as irrelevant to syntax as evidence about their reactions to "$7 + 5 = 22$" would be to number theory.

According to this characterisation, which seems to capture an influential early way of thinking about the nature of formal theories of natural language meaning, such theories are empirical in as much as they describe some form of idealised semantic competence, that plays out in the intuitions of skilled theoreticians.[6] The crucial question then becomes whether thus isolating meaning from use by relying on a distinction between competence and performance, is an independently motivated move and the formalisability of meaning an empirical hypothesis, or rather a precondition for conceiving of natural language meaning as formalisable to begin with.

Other pioneers as well deliver arguments for a formal treatment of natural language meaning that are primarily conceptual. Cf. the following passage from an early paper of Davidson (1965):

> I propose what seems to me clearly to be a necessary feature of a learnable language: it must be possible to give a constructive account of the meaning of the sentences in the language. Such an account I call a theory of meaning for the language, and I suggest that a theory of meaning that conflicts with this condition, whether put forward by philosopher, linguist, or psychologist, cannot be a theory of a natural language; and if it ignores this condition, it fails to deal with something central to the concept of a language.

The 'constructive account' that Davidson refers to in this passage, is, of course, a Tarski-style theory of truth: a formal theory that specifies in a rigorously formal manner the truth conditions of the well-formed sentences of a natural language.

[6] Thus, in that respect aligning formal semantics with the generative tradition. Cf., Stokhof [30] for a diagnosis of how that came about.

One final example, is provided by Lewis' early paper 'General semantics', which starts with the following claim (Lewis 1970, p. 18):

> On the hypothesis that all natural or artificial languages of interest to us can be given a transformational grammar of a certain not-very-special sort, it becomes possible to give very simple answers to the following questions:
>
> (1) What sort of thing is a meaning?
>
> (2) What is the form of the semantic rules whereby meanings of compounds are built up from the meanings of their constituent parts?
>
> It is not my plan to make any strong empirical claim about language. To the contrary: I want to propose a convenient format for semantics general enough to work for a great variety of logically possible languages. This paper therefore belongs not to empirical linguistic theory but to the philosophy thereof.

What we see expressed here resembles the views of Montague and Davidson in relevant respects: that both natural and formal languages can be analysed in a similar syntactic framework, and that the formalisability of syntax makes a compositional semantics possible. What is explicit in this passage is the status accorded to the theory that is based on these observations: the claims of general semantics are not empirical but philosophical.

Despite their abundance in the early works of formal semanticists, it would be inappropriate to mention only conceptual arguments such as these. Even the foundational and theoretical work of Montague, Davidson, Lewis, Cresswell and others contains applications of their ideas to concrete phenomena of natural language meaning. In fact, as was already mentioned above, it was not Montague's theoretical outline of his approach in 'Universal grammar' that served as a model for formal semantics in the early days, but the applied version in his 'The proper treatment of quantification in ordinary English' [22], that he used to analyse certain phenomena concerning quantification such as de dicto/de re ambiguities, and the like. This is characteristic of formal semantics as a branch of linguistics, of course. It deals with empirical phenomena, analysing and describing them by means of formal systems. That not just preaches formalisability of natural language meaning, it also practices it. Success and failure are measured by empirical adequacy and formal rigour. And whenever the enterprise succeeds, one might say, that constitutes ever so many arguments that meaning is indeed formalisable.

In that sense then, there is abundant evidence for a positive answer to the question under discussion: formal semantics has made great strides over the last four decades in capturing central aspects of natural language meaning. Quantification, anaphora, tense and aspect, modality and conditionals, mass nouns, plurals, questions, presupposition, focus and information structure, vagueness, and a host of other aspects of natural language meaning have been studied with formal means, by developing formal systems that describe the phenomena in question and provide systematic ways to make predictions about acceptability judgements of competent language users. Although initially most work was mono-lingual, increasingly cross-linguistic studies and typological investigations are being conducted in the framework of formal semantics as well. So, the scope of the formalisations has steadily increased,

both in terms of the phenomena captured as well as in terms of the languages covered, and this has contributed in important ways to our understanding of the phenomena in question.

A particularly successful example (though certainly not the only one) is provided by work on generalised quantifiers (by Barwise & Cooper, Van Benthem, Higginbotham & May, Keenan & Faltz, and many others). Building on Montague's original analysis (in [22]) and on logical work by Mostowski and others, semanticists have come up with a small number of general, formal properties of generalised quantifiers that characterise the quantifiers we actually find in natural language: among the totality of logically perfectly possible quantifiers these properties determine the restricted set we actually find in natural language. Although there is further discussion about empirical details, this is indeed an impressive result, one that seems to vindicate the positive answer to our question, perhaps even in a more convincing manner than the more conceptual considerations with which formal semantics started out. Other empirical results, too, provide insights into underlying constraints on how natural languages express meaning and reveal complicated relations between apparently unrelated phenomena, and taken together they seem to build a convincing case for the formal nature of fundamental aspects of natural language meaning.

Then all is well and the "Yes"-answer goes unchallenged? Not quite. There are a number of concerns that may provide reason to think things over. The first is the lack of a unified formal framework, the second concerns the distinction between structural and lexical semantic features.

Let us start with the first concern. In the early days of formal semantics research tended to be carried out in a uniform framework. Of course, there were various candidates for such a framework around, with Davidsonians preferring first order, extensional systems, Montagovians making use of higher-order intensional type theory, and Cresswellians favouring set-theory. But within each 'school' researchers tended to carefully fit their analyses in the overall framework of their choice, taking care to make sure that their results were actually consistent with those of others by showing that they could be unified in the overall framework. Fairly quickly this gave way to a much more liberal use of formal systems, with little or no attention being paid to their compatibility. Browsing through the literature one may find applications of domain theory, property theories, belief revision systems, event calculus, different many-valued logics, various non-monotonic logics, dynamic logic, various forms of game theory, second-order type theory, Martin-Löf's type theory, untyped lambda-calculus, Boolean algebras, lattices of various kinds, set theory with or without ur-elements: basically everything in the book has been thrown at natural language phenomena at some point. And then there are the custom built formal systems, such as various versions of discourse representation theory, of situation theory, and so on.

Pluriformity as such presumably is no objection *per se*, but the existing variety of methods and frameworks does shed a different light on the question of the formalisability of natural language meaning, and the positive answer that is indirectly provided by empirically successful descriptions and analyses. Where in the early days, formal languages appeared to be used as *models* for natural languages, as

is testified by the conceptual considerations which we illustrated above, the more piecemeal approach that has become characteristic of formal semantics suggests a more pragmatic stance, in which formal languages are regarded not as models but as *tools*. This is a crucially different way of looking at what we do when we apply formal methods in semantics, and hence a different type of positive answer. In the first case, the "Yes" is continued with "because natural languages are formal languages", whereas in the second case the reason given reads "because natural languages actually can be described in a formal manner". The practices may not be that different, but the underlying ideologies are really quite distinct.

Does that mean that the second, more pragmatic stance, which regards formal systems as tools rather than as models, is unobjectionable? Again, the answer seems qualified. In as far as it instantiates the general attitude that, indeed, "things must be very strange if they cannot be described in mathematical terms", it represents no stronger a claim than that, like any other natural phenomenon, natural languages are systematic and by that very fact should be amenable to systematic, formal investigation. By itself that seems a reasonable point of view, although as we shall see later on, it can be challenged. But does it also excuse the actual pluriformity of methods employed? In as much as these methods themselves carry different assumptions about the nature of what they are used to describe, the answer here must be negative, at least for the time being. Different formal systems may ascribe to the natural languages that they are used to analyse wildly different ontologies, they may be actually logically incompatible among themselves as they are based on incompatible logical principles, they may make different assumptions concerning the cognitive capacities of natural languages users, they may draw the line between semantics and pragmatics at different points, and so on. How to deal with such divergence is a concern that cannot be left unanswered, and it would seem that unless a satisfactory answer is given, the indirect positive answer to our question that empirically successful applications provide still needs additional justification.

Let us now to turn to the second consideration that may provide some reasons to suspend judgement on the positive answer, viz., the distinction between lexical and structural aspects of natural language meaning. Again, there is a distinct development to be discerned here. In the early days of formal semantics, the focus of research was on the meaning of expressions and constructions that play a structural role in the formation of the meanings of complex expressions. Quantifiers, tense and temporal expressions, modal expressions, and the like, appear to function very much like logical expressions, and it makes sense to focus on their analysis by taking suitable formal languages with appropriate counterparts, as models for their semantic behaviour. These are expressions that are systematic, invariant over different occasions of use, largely invariant over the linguistic context in which they occur, and their semantic content can be captured, it seems, in general principles of a more or less logical nature. On the other end of the spectrum we find the meaning of the majority of lexical items, which form the input of the semantic rules, but which do not play a structural role themselves. Their meanings often vary with linguistic and non-linguistic context, and it is often very difficult to distinguish between those aspects of their meaning that are properly linguistic and those that are intimately connected with various kinds of world knowledge. To be sure, there

are generalizable features, semantic properties that are characteristic for a class of lexical items, but these are difficult to establish and their specification always underdetermines the full meaning of a specific lexical item. Yet, in the further development of formal semantics there was an increasing interest to 're-instate content', i.e., to try and capture as much of the meaning of lexical expressions in formal models.[7]

As was mentioned above, for some authors this has been a reason to give up on the idea that natural language meaning is a homogeneous phenomenon, and to assign the specification of lexical and structural aspects to completely different kinds of theories.[8] Most formal semanticists do not draw such a drastic conclusion and prefer to view their field of study as essentially homogeneous. Yet the distinction is real, and it seems to signal a definite limit to the formalisability of natural language meaning that has to be acknowledged.

12.3 No

The considerations mentioned at the end of the last section suggest at least a qualification of the positive answer outlined earlier on. We will return to them later on in this section, but first consider some of the reasons that people have given for a more principled negative answer to our leading question.

For clear examples of such "No"-answers, we can go back in time again, in this case, almost all the way (as far as the Western philosophical tradition is concerned). Complaints about the unsystematic and misleading character of natural language, with its vagueness, lack of precision, ambiguities and referential failures, are of all times. Of course, not all such complaints are made in the context of the question whether natural language meaning can be formalised. One would expect that point of view to become prominent only when the development of suitable formal languages had made formalisation of natural languages an option to begin with. To a large extent that is true, specific arguments concerning formalisation were developed in close conjunction with the development of modern logic in the nineteenth and early twentieth century, in the work of Peirce, Bolzano, Frege, Russell, and the early Wittgenstein. But also in a non-formal setting philosophers of diverse orientation (empiricists, rationalists, hermeneuticists and romanticists alike) voiced concerns about the adequacy of natural language as a medium for rigorous philosophical thought. In the seventeenth century, a whole movement originated around the idea of creating artificial languages, and to the extent that such artificial languages (as developed for example by Wilkins, Dalgarno, Leibniz, and others) were of a formal nature, the various arguments in favour of their creation and

[7] Cf., Kamp and Stokhof [16] for extensive discussion of this development.

[8] Cf., above on Chomsky's distinction between the computational and the conceptual system. Cf., Higginbotham 1997 for extensive discussion of the implications of such a move for formal semantics.

deployment and their suitability as alternatives to natural languages can be looked at as arguments against the formalisability of the latter.[9]

But it was at the end of the nineteenth and in the early twentieth century that the issue became more pronounced. After all, one reason for the interest in the development and application of formal languages in the analysis of reasoning was the assumed deficiency of natural language. Explicating why he found himself forced to develop his 'conceptual notation' by the difficulties he encountered trying to analyse reasoning rigorously using natural language, Frege said it as follows in his *Begriffsschrift* ([8], p. 5–6[10]):

> I found the inadequacy of language to be an obstacle; no matter how unwieldy the expressions I was ready to accept, I was less and less able, as the relations became more complex, to attain the precision that my purpose required. This deficiency led me to the idea of the present ideography.

Vagueness and ambiguity, the lack of an explicit and formal structure, lack of precision and context-dependence are some of the deficiencies that Frege, Russell, the early Wittgenstein and, at a later stage, some of the logical positivists, identified. Such deficiencies, they claimed, could be overcome only by improving on natural language, or by a wholesale replacement of it, for those purposes, such as logic and philosophical analysis, for which explicitness, rigour and precision were crucial.

But to what extent are these considerations really arguments against the formalisability of natural language meaning, rather than a mere rejection of the idea as such? As was already mentioned, the observations as such were hardly new. Many philosophers had already deplored for instance the fact that in typical Indo-European languages existence, predication and identity tend to be expressed grammatically by one and the same verb. What was new is that with the development of explicit formal languages there was for the first time a real alternative: philosophers and logicians did not have to settle for what they regarded as a deficient tool, they could employ better ones, and even, develop such tools themselves as need arose. But perhaps more importantly, the conditions under which formalisation is possible also became much clearer. In particular the necessity of a formal specification of the syntax for a compositional semantics was identified as a condition that natural languages apparently did not satisfy.[11] And as we have seen above, it was exactly when opinion as to the formalisability of natural language syntax started to change, that the possibility of a formal semantics became a serious option.

The question whether a formal semantics of natural language can be, or should be, a compositional one, is much debated, and this is not the place to review the

[9] Cf., Maat [19].

[10] Page references are to the English translation in Van Heijenoort.

[11] The *locus classicus* is Tarski's 1944 paper on the semantic conception of truth, where he writes: "The problem of the definition of truth obtains a precise meaning and can be solved in a rigorous way only for those languages whose structure has been exactly specified. For other languages – thus, for all natural, 'spoken' languages – the meaning of the problem is more or less vague, and its solution can have only an approximate character."

various positions and arguments.[12] What is important is that even if full compositionality is replaced by something like 'systematicity' the demands on the formal specification of the syntax are not really diminished.[13] In fact, compositionality may be somewhat orthogonal to the question that is under discussion here,[14] but it would go too far to explore that in any detail.

The formal nature of syntax being more or less universally agreed upon, the real challenge for the formalisability of natural language meaning comes from a different quarter. It is a line of thought that in a sense generalises some of the old objections, regarding vagueness and context-dependence, and regards such features both as much more pervasive, and as a virtue rather than as a vice.

In analytic philosophy, this perspective on natural language had been endorsed in particular by the ordinary language philosophers, such as Austin, Ryle, Warnock and others. In their view, it is precisely because of its pervasive context-dependence that natural languages are able to serve the purposes that they do. Exact definitions, strictly delineated concepts, and a precise formal structure are not just constraints that natural languages do not meet, they would in fact diminish their usefulness.

Recently, similar observations and arguments have been subject of intense debate between minimalists and (radical) contextualists. Both parties agree that context-dependence is a defining characteristic of natural language. In fact, this realisation goes back to Frege, who in 'Der Gedanke' [9], argues that in order to preserve determinate meaning, we need to re-analyse natural language sentences of which the truth value depends on context, as implicitly containing a specification of the relevant contextual parameters. This form of 'eternalism' postulates a substantial difference between what intuitively is the meaning of such sentences and what this approach construes it to be. Also, there are good arguments to think that this form of 'de-contextualisation' will not always work, as it cannot account for the role of essential indexicals in action explanation.[15] In formal semantics indexicality is usually dealt with by associating context-dependence expressions with two distinct but related semantic objects: one that constitutes the context-independent content and another that determines such a content in each context.[16] But such an approach only works for a limited set of indexical expressions, such as pronouns, temporal expressions, locatives, etc.. Radical contextualists argue that in fact all expressions are context-dependent, that no descriptive context is immune for contextual variation. In fact, they claim, there is no such thing as semantic content, i.e., natural language meaning cannot be specified independent of the use that is made of language in concrete contexts. As Charles Travis formulates it ([36], p.41):

[12] Cf., Pagin and Westerståhl [23, 24] for a comprehensive overview.

[13] Cf., Pullum and Scholz [27].

[14] In view of the fact that for example model-theoretic approaches to syntax (cf., [26]), though definite alternatives to generative ones, are committed to the formal specifiability of syntax just as well.

[15] Cf. Perry [25].

[16] The most well-known instance of such an approach is that of Kaplan, cf., [17].

> The core thesis of [radical contextualism] is that any way for things to be which an English (or etc.) open sentence speaks of admits of understandings as to when something would be that way. Any of many different things may thus be said of a given item in saying it to be that way. The same variety of different things may thus be said of it in using that open sentence of it.

But how would one argue for such a position? The arguments that radical contextualists adduce to support their view usually consist of ingenious examples that indicate that even such apparently stable descriptive predicates as the adjective 'red' can be used in radically different ways depending on the context. Such observations and constructions are certainly appealing for a sympathetic reader who might be willing to generalise from them to the systematic position that radical contextualism defends. But it is also true that such observations as such do not constitute a principled argument: suggestive as they may be, they do not force one to accept that there are no context-independent aspects of meaning whatsoever that could be captured in a formal model.

12.4 It Depends

Confronted with two such well-argued, seemingly firmly justified, yet diametrically opposite answers to a simple question, we should perhaps stop and step back and ask ourselves whether the question we asked, which initially looked simple, straightforward and clear, might not be so on closer inspection. After all, taking sides would be decidedly odd for it would mean to reject sound argumentation and reasonable observation and to declare it as somehow due to a deep misunderstanding of the issue at stake. More plausible, it seems, is that each party answered a slightly different question: those who favour the "Yes"-answer are concerned with structural aspects of natural language meaning, whereas those who defend a "No"-answer focus primarily on lexical content.

So, does that mean that the best answer we can give to the unqualified question is "It depends"? Although it may look like it, the "It depends"-answer really is not a way of dodging the issue, but neither does it represent a definite, contentful stance on what natural language meaning is and on how semantics therefore should (or should not) be done. Rather, it represents a more meta-level perspective on what it is that we do when we do things formally. It assumes that the question that this paper is concerned with, should not be construed as a factual one: there is no fact of the matter as to whether natural language meaning is something (an object, a complex entity with a certain structure) that is formal in nature, the structure of which can hence be explicated in some formalised description. Formal theories are not descriptions of formal objects, they are specific ways of interacting with a complex phenomenon, some aspects of which lend themselves to formal representation, whereas others do not. Arguments that purport to show that one grand unified formal theory must be possible because the nature of what gets formalised allows for it, and

arguments that are supposed to prove that such is not the case because there are no formal properties of natural language meaning to begin with, both miss this simple, but profound point.

One may feel that the "It depends"-answer motivated along the lines just sketched is something that actually holds across the board for any type of scientific inquiry. Many phenomena that we encounter in reality are too complex to be fully captured in a formal model or theory, and abstracting away from real but to a certain extent irrelevant aspects is standard procedure and in many cases, saves the day. Why wouldn't the formal study of natural language meaning be yet another instance of this general feature of scientific inquiry? That is an objection that deserves a much longer answer that we can provide here.[17] Let us just mention one important reason to think that natural language, in particular natural language meaning, might be a different case. It is that there is a distinct dependency in the case of natural language meaning between what is captured in a formal theory and the ways and means by which we formulate such a theory and understand those constructed by others: the object understood and the medium of understanding are by and large the same. This goes beyond the straightforward observation that, ultimately, any formal theory can be understood only because of our natural linguistic abilities. And of course, this should not be taken to mean that such formal theories cannot extend our understanding and those abilities, because when successful they do, in fact, it is one of the criteria in terms of which success is measured. What makes the case of the formalisation of natural language meaning different is that what we seek to understand and what that understanding ultimately relies on are one and the same thing. And that can be taken as an indication that the relation between formal theories in this domain has a different status.

So, what are formal descriptions, formal theories of natural language? They are, to borrow an apt phrase from Wittgenstein,[18] 'übersichtliche Darstellungen ('perspicuous presentations'): insightful, lucid, surveyable presentations of particular aspects of natural language meaning; presentations that are explicit, that can be formally manipulated, and that lend themselves to implementation; presentations that by their very being formal allow us to see and do things that we could not see or do as easily using the expressions they formalise. But also, and this is the crux of the matter, presentations that themselves can be understood only in terms of what they present: not exclusively, because that would mean that they don't add to our knowledge and insight and they obviously do; but nevertheless essentially, since our understanding of such presentations, the very fact even that we have an interest in constructing them, can be understood only in the context of natural language itself. This is a kind of self-reference that facilitates all kinds of 'looping effects' between what is described by the formal theory and what makes our understanding and our use of that formal theory possible.

[17] Cf., Stokhof and Van Lambalgen [32, 33] for further discussion.

[18] Cf., Wittgenstein [37], section 122.

This is a point of view on the nature of formalisation of human language and kindred phenomena, on its usefulness and its limitations, that authors in quite different traditions have expressed as well. Wittgenstein having already been mentioned, perhaps it is apt to end with a quote from another prominent twentieth-century philosopher, Martin Heidegger, who in his essay 'The way to language' stated ([13], p. 422):

> There is no such thing as a natural language, a language that would be the language of a human nature at hand in itself and without its own destiny. Every language is historical, also in cases where human beings know nothing of the discipline of history in the modern European sense. Nor is language as information *the sole* language in itself. Rather, it is historical in the sense of, and written within the limits set by, the current age.

For Heidegger then, just as for Wittgenstein, the distinction between formal language and natural language is not a real opposition, but a reflection of a particular way of dealing with the world. What matters is a clear awareness of the perspective we take, and the pragmatic concerns that motivate it. In that sense, truly "it depends".

12.5 Conclusion

So where does this leave us with regard to the question we started out with? As is customary with such profound questions, final answers are hard to come by. That does not mean that we should not address them, of course. Such considerations as we have reviewed in the above do tell us something, albeit not something definite. First of all, it is clear that the conceptual motivation for a positive answer is in general insufficient. Not only is it constitutive of the enterprise rather than based on independent evidence or considerations, also it seems to steer a formal approach far too much in the direction of "modelling", something that runs into deep conceptual problems. If anything, more evidence based arguments, consisting of actual and successful attempts at formalisation in the end carry more weight. Second, this more pragmatic view comes with a focus on formal systems as tools, rather than models. That seems a much more realistic perspective, but it does come with its own set of questions, the most important of which is: what are the adequacy criteria for our choice of tools from the enormous toolbox that logic, computer science and mathematics have to offer? If we take a theory of natural language meaning to be a theory of semantic competence, then the multiplicity of the formal systems that are employed constitutes a serious challenge, one that still needs to be met.

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[19] Asterisks (*) indicate recommended readings.

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