

Carnap and Natural Language Semantics

Max Kölbel

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The idea that logical truth and factual truth have different epistemological status, with only the latter requiring empirical evidence, was one of the central threads of Carnap's thought, one that survived from the Vienna days until the end of his career. Driven by this epistemological agenda, Carnap's view of logical truth underwent several revisions, as he sharpened his conception of linguistic meaning and of how languages can be described. Along with Tarski, Carnap pioneered what Tarski called (and is still called) "semantics", i.e. describing a (formal) language by assigning meaning properties to its expressions, as specified by the language's syntax. In 1943, Carnap developed "the method of extension and intension" as a method for describing a language, culminating in his 1947 book *Meaning and Necessity*. The method itself is neutral as to whether it is applied in describing a natural language or in defining a constructed language. While Carnap himself was often more interested in language engineering, i.e. in constructing languages for scientific purposes, the method of extension and intension had a lasting influence on natural language semantics. Carnap's method of extension and intension soon became the standard framework not only for formal intensional logics (e.g. temporal, modal, doxastic logics) but also for formally modelling natural languages. This part of Carnap's legacy in natural language semantics is obvious and undisputed. In response to criticism, especially by Quine, Carnap also articulated views about the empirical legitimacy of the notion of intension (in natural languages) and thereby anticipated some contemporary ideas about how claims about natural language meaning can be empirically confirmed.

This article outlines Carnap's intensional approach (§1), how it was criticised by philosophers and how it was adopted by the founders of natural language semantics (§2). The article then turns to Carnap's ideas about empirical evidence for intensions and its significance to the contemporary debate (§3).

1. The Method of Extension and Intension

Carnap viewed the notion of *intension* as an explication of the pre-theoretical notion of meaning, an explication that was supposed to address the misgivings that Quine and others had about meaning. Quine thought that only meaning in the sense of extension (i.e. the entities to which a given expression applies) was legitimate and regarded modal languages with quantification as problematic. Carnap addressed Quine's worries, but also addressed Frege's related worries in "Über Sinn und Bedeutung".

According to Carnap, an expression has both an intension and an extension. Carnap defines sameness of intension first ("L-equivalence") and then looks for entities that can play this role: an intension needs to be something that determines an extension for every "state-description", i.e. for every complete description of the universe as it might have been. One of these state-descriptions correctly describes the actual state of the universe, i.e. is true. Thus the actual extension of an expression is what its intension determines for the one true state-description. Extensions of sentences are truth-values, extensions of singular terms are individuals, extensions of predicates are classes of individuals. Knowledge of the intension of an expression corresponds to competence with the expression (i.e. to knowledge of its meaning), and one can have such knowledge without any empirical knowledge about the actual state of the world. Thus given knowledge of an expression's intension together with relevant knowledge of the actual state of the world, can provide knowledge of the expression's actual extension.

For example, the intension of the expression "the first woman to win the Rolf-Schock-Prize in Logics and Philosophy" determines for each state-description an individual as its extension, and for the actual state this is Ruth Millikan. For some non-actual state-descriptions the extension is different: say, Ruth Barcan Marcus or Judith Jarvis Thomson, or it may be empty (Carnap allows "intensional vagueness": cases where linguistic behaviour does not determine an extension for every state description, i.e. does not determine a unique intension). Similarly, the sentence "Ruth Millikan is the winner of the 2017 Schock Prize." receives different truth values in different state-descriptions. In order to understand the expression "the winner of the 2017 Schock prize", I do not need to know its actual extension. All I need to know is

what it takes to be the extension, i.e. which individual is the extension in each possible state of the universe. When an intension has constant extension, i.e. the same extension in all state-descriptions, then I may not need not know anything about the actual state of the universe in order to know the actual extension.

This allows Carnap to address Frege's identity puzzle in much the way Frege himself did: the sentence "Ruth Millikan is Ruth Millikan." is L-true, i.e. true in all state-descriptions. That's why it is a priori and not interesting. But "Ruth Millikan is the winner of the 2017 Schock prize." has a different intension. It gets the extension truth only in those state-descriptions in which Ruth Millikan wins the 2017 prize, and not in others. It is thus a posteriori. (NB: when proper names are on *both* sides of the identity sign, informativeness can be explained in this way only if names have non-constant intensions. Interestingly, so-called two-dimensional explanations in the style of Stalnaker (1978), which can fill this gap for those who treat names as rigid, also rely heavily on Carnap's method of extension and intension.)

It also allows Carnap to address some of Quine's worries about meaning and modality. The sentence "The number of planets is odd." has an intension that varies in truth-value from one state-description to another. But "The square of three is odd." has constant intension (it is L-true). Carnap models necessity as L-truth, i.e. truth in all state-descriptions. That's why "Necessarily, the square of three is odd." is true, while "Necessarily, the number of planets is odd." is not. According to Carnap, "Necessarily" is an intensional operator, which explains why co-extensional expressions are not substitutable in their scope. Carnap also addressed Quine's worries about quantification into intensional contexts.

Despite the obvious similarities between Carnap's notions of extension and intension with Frege's notions of *Bedeutung* and *Sinn*, there is also an important difference, and on this point posterity has so far sided with Carnap and not with his teacher Frege. Early on in "Über Sinn und Bedeutung", Frege commits himself to the view that the *Bedeutung* of any complex expression should be a function of the *Bedeutungen* of its component expressions and their mode of composition (and the same for *Sinn*). This is one of the assumptions he makes when arguing that the *Bedeutung* of a sentence is its truth-value. But this conflicts with the failure of substitutivity of expressions with the same *Bedeutung* in certain contexts, such as indirect speech. Frege's response is his doctrine of indirect (*ungerade*) *Bedeutung*:

within certain contexts, including indirect speech, an expression's *Bedeutung* is what is normally its *Sinn*. Thus Frege allows the *Bedeutung* of expressions to vary, depending on their linguistic context, and he does so in order to be able to maintain the principle that expressions with the same *Bedeutung* can be substituted for one another without affecting *Bedeutung*.

In *Meaning and Necessity*, Carnap rejects this move and instead gives up on the idea that co-extensional expressions should always be substitutable for one another without changing the extension. Since Frege insists on the universal substitutivity of expressions with the same *Bedeutung* (= extensionality), Carnap classifies Frege as pursuing “the method of the name-relation”, like Russell and Quine. Frege's own doctrine of indirect *Bedeutung*, of course, is especially costly, because it seems to require an infinite hierarchy of *Sinne* and *Bedeutungen*. However Carnap also regards the method of extension and intension to be superior to the extensional approaches of his contemporaries.

2. Intentions in Natural Language Semantics

Within philosophy, Carnap's intensional approach was met with Quinean scepticism. (see Quine 1951, 1953 and 1960). Even though *Meaning and Necessity* was in part the result of Carnap's intensive discussions with his friend Quine, and even though Carnap had included in the book a statement by Quine, in which he conceded the coherence of Carnap's notion of intension, Quine continued to oppose intensionality. On the one hand, Quine questioned the empirical credentials of intensions (more about this in §3 below), on the other hand he advocated a kind of restricted nominalism, trying to avoid abstract objects figuring as objects of reference. With respect to natural language meaning, Donald Davidson later tried to do justice to Quine's requirements by proposing purely extensional Tarskian “truth-theories as theories of meaning” (e.g. Davidson 1967). Quine's and Davidson's extensionalist approach was dominant in philosophy in the 70s and 80s—the opposition within philosophy of language came mostly from those advocating a Fregean approach, not Carnapian intensions.

Within linguistics, the development was different. Advances in syntax (see Chomsky 1965) allowed semantic descriptions of significant fragments of natural languages with the means of intensional logic, which marked the birth of formal

semantics of natural language. Montague, a pupil of Tarski's and colleague of Carnap's, not only advanced intensional logics but he also started treating "English as a formal language" (Montague 1974), and he did so using intensions. When the young David Lewis (1970) articulated something like a founding manifesto of formal semantics of natural language, he explicitly built upon Carnapian intensions, thus going against his own teacher Quine. At the same time, Montague students Hans Kamp and David Kaplan developed double-index semantics in order to do justice to context sensitivity in natural language: expressions are no longer treated as having intensions, instead they are treated as having Kaplanian "characters", i.e. functions from Kaplanian contexts to intensions. Not much later, Stalnaker (1973) and Lewis (1979) developed models of conversational updating (of conversational score and common ground), again built upon Carnapian intensions. This is now the standard approach (see Heim & von Stechow).

Within philosophy of language, too, the nominalist and extensionalist approach of Quine and Davidson seems to have few proponents today. Carnap's basic method of extension and intension thus remains the standard method of formal semantics of natural languages. Advances in syntax have radically increased its reach and it has been complemented with additional tools, but the basic approach remains Carnap's.

3. Empirical Evidence for Intensions in Natural Language

As already mentioned, one of Carnap's background motivations was epistemological. He was pursuing the idea that some claims in science are not subject to empirical confirmation because they are true simply by virtue of the meanings of the sentences used to state them. This was the point on which Carnap and Quine had a disagreement spanning decades. On the one hand, Quine opposed the idea that something might not be subject to empirical confirmation, defending instead a radical holism about confirmation. On the other hand, Quine attacked the very notion of meaning on which Carnap's idea relied as empirically illegitimate: all we can empirically examine, according to Quine, is the extension of expressions, but meaning in any sense richer than mere extension is empirically underdetermined (Quine 1951, 1953, 1960).

One of the strategies Carnap developed in confronting Quine's criticisms of the notion of meaning was to ask Quine whether he had in mind the "empirical investigation of historically given *natural* languages" (he called this "descriptive

semantics” or “pragmatics”) or the investigation of “constructed *language systems* given by their rules”. Carnap then offered different answers for the two different projects. (Quine tended to respond that he thought this was a false dilemma.)

Carnap’s answer for meaning in explicitly defined constructed languages is well known: he famously claims (e.g. in “Empiricism, Semantics and Ontology”, 1950) that we make practical decisions about which language we are going to adopt, and that such decisions are not in the business of being true or false, or of being empirically confirmed. Our choice of language may turn out to be more or less efficient, fruitful or practically useful compared to other frameworks. Thus all the claims that are true by virtue of the rules of the linguistic framework we have chosen are not empirical.

Carnap’s answer for the other horn of the dilemma, i.e. for meaning in historically given natural languages, is less well known but well worth considering in the light of recent debates. Carnap defends the claim “that the assignment of an intension is an empirical hypothesis which, like any other hypothesis in linguistics, can be tested by observations of language behaviour” (Carnap 1955, p. 237).

What are these observations? For example, when examining the language of Karl, how can we tell whether the meaning of Karl’s expression “Pferd” is like that of “horse” in English (hypothesis 1) rather than being like that of “horse or unicorn” in English (hypothesis 2), given that these two English expressions have the same extension? How could Karl’s linguistic behaviour provide any evidence that might favour hypothesis 1 over 2 or vice versa?

Carnap’s answer is straightforward. Even though “horse” and “horse or unicorn” do not differ in their actual extension, they differ in their extension in other possible states of the world (i.e. they differ in their intension). Even though they apply to the same actual cases, they do not apply to the same possible cases. But how could one test whether Karl, the subject whose language we are investigating, would apply “Pferd” to a merely possible case? Carnap says:

The linguist could simply describe for Karl cases He may, for example, describe a unicorn (in German) by something corresponding to the English formulation: “a thing similar to a horse, but having only one horn in the middle of the forehead”. Or he may point toward a thing and then describe the intended modification in words, e.g.: “a thing like this one but having one horn in the middle of the forehead”. Or, finally, he might just point to a picture

representing a unicorn. Then he asks Karl whether he is willing to apply the word ‘Pferd’ to a thing of this kind. An affirmative or negative answer will constitute a confirming instance for (2) or (1) respectively. This shows that (1) and (2) are different empirical hypotheses. (1955, p. 238)

Formal semanticists, of course, have usually not collected observations of this sort—until the recent wave of experimental semantics. This has at least two reasons. One reason is that semanticists are usually interested in questions that are more general than the intension of one particular expression: they examine the *kind* of intension expressions of a certain type could have in the light of certain assumptions of how expressions of this type behave; or they may examine even more general questions: why do sentences of this form entail sentences of that form. Consider, for example, a semantic hypothesis about gradable adjectives that is supposed to explain the “observed” contextual variation of those adjectives, or perhaps the “observed” patterns of entailment that gradable adjectives give rise to.

Another reason is that semanticists have usually regarded their own truth-value judgements about hypothetical cases as adequate empirical evidence for their semantic theories. Sometimes their colleagues disagree, so they will try to find cases where everyone agrees. But in general, formal semanticists have not considered it necessary to collect data about speaker behaviour in a more representative fashion. (In my own view, this procedure is often justified in so far as there are plenty of interesting data which do not exhibit significant variation between different users, and perhaps not even cross-linguistic variation in comparable constructions.)

But recently, especially since Machery et al. 2004, there has been criticism of the empirical legitimacy of this habitual procedure. The criticism is not like Quine’s fundamental criticism against notions of meaning richer than extension. Rather, the criticism is that the data and “observations” used are not reliable: they are the truth-value judgements or entailment judgements of the semanticists themselves. These are not only not representative of the relevant language’s users in general, but worse: the language users whose judgements are being used as evidence are clearly biased, for the success of their own proposals depends on those judgements.

Interestingly, the solutions proposed and adopted by those worried about the reliability of the habitual procedure often resemble the procedure Carnap proposed in order to prove the empirical legitimacy of his notion of intension: carefully

documented language users are given descriptions of hypothetical scenarios or cases (“vignettes”), and they are asked to comment on the correctness of using certain sentences in the described situations.

But the exact experimental set-up to be used is not obvious. The aim (in contemporary experimental semantics as much as in Carnap) is presumably to elicit responses that manifest the linguistic competence of language users. It is a good question what kind of experimental task provides the best insight into competence. Should they be asked to assess hypothetical uses of language in a hypothetical situation (“Would it be correct for the protagonist to use the sentence ‘ ... ’ in the described situation?”). Or should they be provoked into using language themselves? This could be difficult if the task is too open. But the task could be “Please tick any option you agree with.” followed by some sentences subjects can tick. Some experimental semanticists use a Likert scale on which subjects have to indicate levels of agreement: does this produce better data? Given the current state of development of experimental methods in semantics, it seems to me that Carnap’s 1955 proposals are at least not far behind the current state of the art (for a critical discussion of experimental semantics, see e.g. Jacobson 2018).

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