1.3

LOGICAL FORM

Kirk Ludwig

Interest in logical form has been driven historically by interest in valid argument forms, that is, semantic entailment relations between the premises and conclusion of an argument underwritten by their semantic forms. The pressure to provide an ever deeper and more general account of valid argument forms has led to a generalization of the notion of logical form to semantic structure relevant to the evaluation generally of the truth or falsity of a sentence.

It is a staple of the tradition since Frege that logical form differs, sometimes dramatically, from the surface or superficial grammatical form of a sentence. (We return below to whether logical form may be associated with some further level of syntactical analysis.) For example, some sentences, like 2 and 3, have multiple readings ("someone is loved by everyone" and "everyone is such that there is someone he loves"; "relatives who are visiting can be boring" and "it can be boring visiting relatives") which should be assigned different logical forms because the same words contribute differently to truth conditions on each. Some sentences with the same superficial form, such as 1 and 2, 4–6, 9 and 10, 11 and 12, and 13 and 14, are assigned different logical forms because they enter into different systematic entailment relations. And some sentences with superficially different forms, such as 6–8, are assigned the same logical form because they appear to enter into the same systematic entailments.

1. Mary loves John
2. Everyone loves someone
3. Visiting relatives can be boring
4. The hearth is warm
5. The weather is fine
6. The whale is a mammal
7. Whales are mammals
8. Every whale is a mammal
9. Felix does not bark
10. Pegasus does not exist
11. The president is 6' 1" inches tall
12. The average man is 5' 9" inches tall
13. Jack is a wolf
14. Jack ate a wolf

In the early analytic tradition, the divergence of surface and logical form was associated with a divergence between the form of thoughts and the sentences expressing them. Wittgenstein puts this vividly in his *Tractatus Logico-Philosophicus* ([1921] 1961: 4.002).

> Language disguises thought. So much so, that from the outward form of the clothing it is impossible to infer the form of the thought beneath it, because the outward form of the clothing is not designed to reveal the form of the body, but for entirely different purposes.

Bertrand Russell, in the second of his 1914 Lowell lectures, *Our Knowledge of the External World*, defined "philosophical logic" as that portion of logic that concerned the study of forms of propositions—or, as he called them, "logical forms." He claimed that

> some kind of knowledge of logical forms, though with most people it is not explicit, is involved in all understanding of discourse. It is the business of philosophical logic to extract this knowledge from its concrete integuments, and to render it explicit and pure.
>
> ([1914] 1993: 53)

The most famous exemplar of this activity is Russell's Theory of Descriptions (1905), according to which the logical form of "The King of France is bald" is not that of a subject–predicate sentence (or even a noun phrase + verb phrase construction—we return to this divergence later) but a quantificational sentence with internal truth-functional structure, "There is a king of France and whatever is a king of France is identical with it and it is bald," in which the grammatical subject of the original is not treated as contributing any entity to the meaning of the sentence, in contrast to, say, "Louis XIV was bald" (5, 6, and 12 introduce additional complexities).

In the early twentieth century, especially in the short-lived but influential theory of Logical Atomism, logical form was directly connected with metaphysics and the philosophy of mind (Russell [1918–19] 1985; Wittgenstein [1921] 1961). The logical form of sentences was taken to reveal both the forms of possible facts or reality and the thoughts expressed with them. This interest in logical form is clearly broader than an interest in inference patterns among sentences induced by the meanings of logical terms. For Russell, for example, a crucial question about logical form was whether belief sentences express relations to propositions, a view he held at one point but later rejected (Russell [1918–19] 1985: 87–8). (Importantly, Russell's and Wittgenstein's interest in the structure of thought blurs the distinction Davidson drew later between investigation of logical form and conceptual analysis (Davidson [1980] 2001b: 105–6, [1984] 2001c: 31).)

Even apart from Logical Atomism, investigation of logical form is an important component of what Strawson (1959) called "descriptive metaphysics," the project of uncovering the ontology embedded in natural languages, what must exist if the sentences we endorse are true. Given Quine's (1948: 33) criterion of ontological commitment, according to which "a theory is committed to those and only those entities to which the bound variables of the theory must be capable of referring in order that the affirmations made in the theory be true," it follows that one goal of the recovery of logical form is to reveal the quantificational commitments of natural language sentences (see Davidson

1977; Higginbotham 1993). We will consider a dramatic example below in the event analysis of action sentences.

One response to the divergence of surface and logical form is to treat propositions or possible facts as the primary bearers of logical form. Sentences then have the same logical forms if and only if the propositions or possible facts they express do. This gives us, though, only a temporary illusion of progress. As Ayer put it,

> This would be all very well, if we had any means of determining the logical forms . . . other than through the grammatical forms of the sentences which are used to state them. What happens, in practice, is that we decide, on other grounds, which forms of sentences convey this information most perspicuously, and that these are not always the grammatical forms in which the sentences are originally cast.
>
> (1984: 29–30)

Ayer's last remark points to a popular way of talking about logical form, according to which the logical form of a natural language sentence is the form of a sentence in a specially regimented, "ideal," typically formal language, that translates it—or the forms of the sentences that translate it if it is structurally ambiguous (Kalish 1952; Harman 1972; Audi 1995: 511–12; Sainsbury 2001). These sentences are sometimes said *to be*, and sometimes *to give*, the logical forms of the originals. The ideal or regimented language is to have no ambiguities and to encode in its syntax all differences in the logical or semantic roles of terms in them. An interpreted formal language for a first-order logic, designed to make shared validity-relevant semantic features correspond to the construction of a sentence out of its parts, would be an example. Natural language sentences have the same form if and only if they are translated by sentences of the regimented language of the same form.

This is not, however, a satisfactory account, for it leaves us with the question of what the form of the sentence in the ideal language is (Grandy 1974). If we think of it in terms of the pattern of terms in it, perhaps the pattern of logical terms, then this makes the notion of logical form relative to the choice the favored language, and there are many that would do equally well. Russell's analysis of "The King of France is bald" can be rendered into a standard infix logical notation or into Polish or prefix notation (with "f(x)" for "x is a king of France," "b(x)" for "x is bald," and "i(x,y)" in prefix notation for "x = y"), as in 15 and 16.

15. $(\exists x)((f(x) \, \& \, (\forall y)(f(y) \supset x = y)) \, \& \, b(x))$
16. $\Sigma x K K f(x) \Pi y C f(y) i(x,y) b(x)$

The logical form of "the king of France is bald" cannot be identified with either, or with the patterns of the terms in them, since they are distinct and the choice arbitrary. We can only say what the logical form is relative to a system of regimentation. Yet, the original and its translations (if they are) *share* logical form. Sensitivity to this point explains why philosophers often talk of such renderings as *giving* the logical form of the original. But this leaves us with the question of *what* it gives and *how* it is doing it.

The idea that logical form attaches first to propositions points to a resolution, for propositions (in the Frege–Russell tradition) were introduced to be simultaneously the objects of thought and the meanings of (declarative) sentences. This suggests

looking midway between the sentence and the proposition it expresses to a comprehensive semantic theory that details how words and structures contribute to fixing truth conditions for sentences.

An influential suggestion of Donald Davidson's along these lines is that the notion of logical form is best placed in the context of an interpretive truth theory for a natural language.

> What should we ask of an adequate account of the logical form of a sentence? Above all . . . such an account must lead us to see the semantic character of the sentence—its truth or falsity—as owed to how it is composed, by a finite number of applications of some of a finite number of devices that suffice for the language as a whole, out of elements drawn from a finite stock (the vocabulary) that suffices for the language as a whole. To see a sentence in this light is to see it in the light of a theory for its language. A way to provide such a theory is by recursively characterizing a truth predicate, along the lines suggested by Tarski.
>
> (Davidson 1968, [1984] 2001c: 94)

The suggestion in full is that the logical form of a sentence is revealed in the context of a compositional meaning theory for the language that takes the form of an interpretive Tarski-style truth theory (Tarski [1934] 1983, 1944; Davidson 1967b, 1970, 1973). Restricting attention to a context-insensitive language, an interpretive truth theory for an object language L is a finitely axiomatized theory whose axioms provide satisfaction conditions for the semantically primitive expressions of the language by using metalanguage expressions which translate them. With an adequate logic, the theory will entail all sentences of the form (T), where "s" is replaced by a description of a sentence of L as constructed out of its semantically primitive components (the need to regiment natural language sentences introduces a complication which we return to below) and "p" is replaced by a metalanguage sentence that translates it.

(T) s is true$_L$ iff p

In (T), "is true$_L$" is a metalanguage truth predicate for sentences of L. Given that what replaces "p" translates s, we can replace "is true$_L$ iff" with "means$_L$ that" and preserve truth. A sentence of the form (T) in which this replacement yields a true sentence we call a *T-sentence* and we say that it provides interpretive truth conditions for its object language sentence. (The morals developed extend to a language with context-sensitive elements, though we cannot take the extension up here. See Lepore and Ludwig 2005: chs. 4–5 for more detail and the relation of this way of putting the project to Davidson's own.)

A *canonical proof* issues in a T-sentence for s by drawing intuitively only on the content of the axioms for words in s. The canonical proof of a T-sentence shows the semantic role of each primitive expression in the sentence in fixing its interpretive truth conditions, and in this sense shows what its semantic structure is. According to Davidson's suggestion, this is to know the logical form of the sentence: "To know the logical form of a sentence is to know, in the context of a comprehensive theory, the semantical roles of the significant features of the sentence" ([1980] 2001a: 146).

A simple informal theory, A1–A8, stipulated to be interpretive, will illustrate. The vocabulary of L consists of the variables, "x," "x$_1$," "x$_2$," . . ., names "Ned" and "Sally,"

the one-place predicate "is honest," the two-place predicate "loves," the connectives "~" and "&" (for negation and conjunction), and an existential quantifier formed with parentheses around "∃" followed by a variable, e.g., "(∃x)." Square brackets will form a structural description of a sentence. Thus, "[Ned loves Sally]" is equivalent to "'Ned'⌢'loves'⌢'Sally'"—the concatenation of "Ned," "loves," and "Sally." Similarly, where "v" and "v'" are metalinguistic variables for variables and names (terms) of L, "[v loves v']" is equivalent to "v⌢'loves'⌢v'," etc. 'iff' abbreviates "if and only if." We use functions from terms to objects as satisfiers of formulas. Axioms A1–2 specify assignments to names for the functions we quantify over. For any α, [f(α)] refers to the object f assigns to α. "ϕ" and "ψ" take object language formulas as values.

A1. For any function f, f("Ned") = Ned.

A2. For any function f, f("Sally") = Sally.

A3. For any function f, term v, f satisfies$_L$ [v is honest] iff f(v) is honest.

A4. For any function f, terms v, v', f satisfies$_L$ [v loves v'] iff f(v) loves f(v').

A5. For any function f, for any formula ϕ, f satisfies$_L$ [~ϕ] iff it is not the case that f satisfies$_L$ ϕ.

A6. For any function f, for any formulas ϕ, ψ, f satisfies$_L$ [ϕ & ψ] iff f satisfies$_L$ ϕ and f satisfies$_L$ ψ.

A7. For any function f, for any formula ϕ, variable v, f satisfies$_L$ [(∃v) ϕ] iff for some f' such that f' is a v-variant of f, f' satisfies$_L$ ϕ.

A8. For any sentence ϕ, ϕ is true$_L$ iff every function f satisfies$_L$ ϕ.

The satisfaction relation generalizes the 'true of' relation. If 'Ned loves Sally' is true, then 'loves' is true of Ned and Sally taken in that order. Thus, a function f that assigns Ned to "x" and Sally to "x_1" satisfies "x loves x_1." A function f' is a v-variant of f iff f' is like f except at most in what it assigns to v.

A canonical proof is a sequence of metalanguage sentences such that (i) the last member is a sentence of the form (T) with no semantic vocabulary on the right hand side and (ii) each member of it is an axiom or derived from axioms or previously derived sentences by rules applied so as to permit drawing only on the content of the axioms.

Axioms A1–4 are base axioms; axioms A5–7 are recursive axioms. A1–2 are reference axioms for "Ned" and "Sally." A3–4 are predicate satisfaction axioms, for one- and two-place predicates. A5–6 provide recursive satisfaction conditions for formulas constructed with truth-functional connectives. A7 provides recursive satisfaction conditions for quantified formulas. A8 connects satisfaction with truth of closed sentences. The form of the axioms may be said to give the role of the object language term in determining truth conditions of sentences in which it appears and the logico-semantic form of the vocabulary item for which it is an axiom. Then the forms of the axioms which are used in the proof of a T-sentence for s and how they are employed reveal the logical form of s.

A parameter in characterizing semantic form is the classification of axioms. The framework allows for various classifications. A natural classification for tracing truth-relevant semantic structure is to treat the singular reference axioms as having the same form, axioms for predicates with the same number of argument places as having the same form, and axioms for distinct truth–functional connectives and distinct quantifiers as having the distinct forms.

A proof of a T-sentence for $[(\exists x)(\text{Ned loves } x) \ \& \ (\exists x_1)(x_1 \text{ loves Sally})]$ would instantiate A6 for "&" to this sentence. Then we would instantiate A7 for the existential quantifier to each of the conjuncts on the right hand side. With A4 for "loves" and A1 for "Ned" we can then deduce "For any function f, f satisfies $[(\exists x)(\text{Ned loves } x)]$ iff some x is such that Ned loves x" and similarly for $[(\exists x_1)(x_1 \text{ loves Sally})]$ with A4 and A2. Then instantiating A8 to the sentence, a series of valid substitutions yields the T-sentence "$[(\exists x)(\text{Ned loves } x) \ \& \ (\exists x_1)(x_1 \text{ loves Sally})]$ is true iff some x is such that Ned loves x and some y is such that y loves Sally."

What is the point of the exercise? The proof displays the semantic structure of the object language sentence in what axioms of what forms are applied at what points in arriving at a T-sentence for it. The axioms give the type of contribution of the term for which they are axioms, and how they contribute is given by the place in the derivation at which it is applied.

The notion of form we arrive at by this method, as Davidson noted, is relative to both the metalanguage and its logic. We seem to face the same problem as we did earlier in identifying logical form with sentences in a particular ideal language. We want to abstract away from incidental features of canonical proofs. A suggestion extending Davidson's proposal is to fix sameness of logical form of two sentences in their respective languages in terms of their admitting of corresponding canonical proofs (Lepore and Ludwig 2002b: 67).

> A proof P_1 of a T-sentence for s_1 in T_1 corresponds to a proof P_2 for a T-sentence for s_2 in T_2
>
> iff$_{df}$
>
> (a) P_1 and P_2 are sentence sequences identical in length;
> (b) at each stage of each proof identical rules are used;
> (c) the base axioms employed at each stage are of the same semantic type, and the recursive axioms employed at each stage interpret identically object language terms for which they specify satisfaction conditions (with respect to contributions to truth conditions).

In terms of this notion, the suggestion is that (loc. cit.)

> For any sentences s_1, s_2, languages L_1, L_2, s_1 in L_1 has the same logical form as s_2 in L_2
>
> iff$_{df}$
>
> there are interpretive truth theories T_1 for L_1 and T_2 for L_2 such that
>
> (a) they share the same logic;
> (b) there is a canonical proof P_1 of the T-sentence for s_1 in T_1;
> (c) there is a canonical proof P_2 of the T-sentence for s_2 in T_2, such that:
> (d) P_1 corresponds to P_2.

This yields an unrelativized characterization of sameness of logical form. It does not tell us what *thing* the logical form of a sentence is but rather when any two sentences in any

languages are the same in logical form. An entity can be introduced using this equivalence relation—the logical form of s_1 in L_1 = the logical form of s_2 in L_2 iff s_1 in L_1 has the same logical form as s_2 in L_2—but this provides no additional insight.

This approach can be extended to imperatives and interrogatives by extending truth-theoretic semantics to fulfillment-theoretic semantics. Sentences have fulfillment conditions of different sorts: truth conditions for declaratives, and compliance conditions for imperatives and interrogatives. Compliance conditions are spelled out recursively using the machinery of the truth theory. This is required even for non-declaratives since they can appear in molecular sentences, and we can quantify into mood markers: e.g., "if you are going to the store, buy some milk," "Invest every penny you earn." Then the definition of a canonical proof can be generalized to a fulfillment theory, and likewise that of a corresponding proof, to generalize the account to nondeclaratives (Lepore and Ludwig 2002b: 74–6; Ludwig 2003).

Our illustration elides an important stage in the application to natural languages. Minimally, structural ambiguity and syntactic elision that leaves inexplicit aspects of how words contribute to truth conditions in natural language sentences require a translation first into a regimented notation to which the truth theory can be applied (Lycan 1984: ch.1). Much of the work of uncovering the logical form of natural language sentences is expressed in appropriate regimentation. In practice, regimentations draw heavily on structures we already know how to incorporate into a truth theory, with the attendant danger that familiar structures will prove a Procrustean bed for the original (we review an example below).

Thus, giving a sentence's logical form with a regimented sentence comes down to producing a sentence whose semantic structure is presumed (a) to be well understood and (b) to be the same as that of the original. The property indicated, however, is exhibited only in the light of the semantic theory for the regimented sentence.

What are the constraints on regimentation? An interpretive truth theory requires that axioms use terms and structures that translate or interpret object language terms and structures. The meaning of a term or a structure is a matter of the rules for its use, realized in speakers' linguistic competencies. These involve both the grammar of sentences and their interpretation, and are expressed in judgments about grammaticality and entailments and in patterns of usage. Recovering these rules from reflection on judgments and observations of usage is constrained (i) by the need to incorporate expressions into a comprehensive semantic and syntactic theory for the language, and (ii) by the need to take into account the role of pragmatic factors in communicative contexts—for the theory must distinguish responses to sentences based solely on meaning and responses based in part on what is pragmatically implied by a speaker (Grice 1989: chs. 1–4). There is no simple general way to describe how to do this, but two examples will give the flavor of the enterprise and show the power of the method.

Return first to Russell's analysis of 'The king of France is bald' in 15, repeated here.

   15. $(\exists x)((f(x) \mathbin{\&} (\forall y)(f(y) \supset x = y)) \mathbin{\&} b(x))$

Evidence for this is that the target sentence appears to be true as a matter of meaning if and only if there is a king of France, there is at most one king of France, and whoever is king of France is bald. Additional evidence comes from the power of the analysis to solve certain puzzles. For example, if 17 is a logical truth, an instance of the law of the

excluded middle, how do we avoid the conclusion that it is a logical truth that there is a king of France?

17. The king of France is bald or the king of France is not bald.

The answer on Russell's theory is that the second disjunct has two readings, as 'not' is treated as modifying the predicate (taking narrow scope) or the whole sentence (taking wide scope), as shown in 18a and 18b.

18a. $(\exists x)((f(x) \mathbin{\&} (\forall y)(f(y) \supset x = y)) \mathbin{\&} \sim b(x))$
18b. $\sim(\exists x)((f(x) \mathbin{\&} (\forall y)(f(y) \supset x = y)) \mathbin{\&} b(x))$

If we give it the construal in 18a, then 17, though it is committed to there being a king of France, is not a logical truth, while if we give it the construal in 18b, it is a logical truth but not committed to there being a king of France. "The king of France is not bald" is assimilated to "All that glitters is not gold," which has a true and a false reading as we take "not" to modify "gold" or the whole sentence. "The king of France is not bald" then contrasts with "Louis XIV is not bald," where whether "not" modifies the predicate or the whole sentence makes no difference to its evaluation.

Strawson (1950) objected famously that when there is no king of France, an assertion of "The king of France is bald" is not false but lacks a truth value because that there is a king of France is a mere presupposition rather than an entailment of it. For when there is no king of France, we respond to assertions of "The king of France is bald" not by denying it but by saying "There is no king of France." Against this, we feel no hesitation in saying some assertions of sentences containing a nondenoting definite description are false: for example, "My father is the present king of France" (Neale 1990: 26–7). The identified pattern of response, moreover, can be explained on Russell's theory together with a theory of conversational pragmatics (Grice 1989: chs. 1–4). If one denies that the king of France is bald, one will typically be taken to be denying it because one thinks the king of France is hirsute, since the point of the sentence is to pick out something to ascribe a property to it, and, thus, attention is focused on the predicate. If one denies it because there is no king of France or there are two or more, one must be more specific to avoid misunderstanding.

There are other grounds to modify Russell's account, however. Russell offers a construal in terms of unrestricted quantifiers. The practice goes back to Frege, who rendered "All philosophers are rich" as "For all x, if x is a philosopher, x is rich" and "Some philosophers are rich" as "Some x is such that x is a philosopher and x is rich." This introduction of logical connectives can seem unmotivated from the standpoint of syntax. Reflection on related constructions gives substance to this concern and shows the way to a resolution. Prima facie, "All philosophers are rich" and "Most philosophers are rich" should have the same semantic structure, differing only in the quantificational determiner (Neale 1990: 38–44, 2002). However, "Most philosophers are rich" is not logically equivalent to any first-order construal using unrestricted quantifiers (Rescher 1962). It is not equivalent to "Most x are such that if x is a philosopher, then x is rich" because the original is false, while this is true because most things are not philosophers. It is not equivalent to "Most x are such that x is a philosopher and x is rich" because most things are neither philosophers nor rich—nor to any other representation using only unrestricted quantifiers. "Most philosophers" must be treated a distinct semantic unit, "[Most x: x is a philosopher]," which restricts the domain to philosophers and requires most to

satisfy the following predicate. But we should then construe "All philosophers are rich" as "[All x: x is a philosophers](x is rich)" and "Some philosophers are rich" as "[Some x: x is a philosopher](x is rich)" and "The king of France is bald" as "[The x: x is king of France] (x is bald)." We can thus retain Russell's quantificational account of definite descriptions without reading any truth functional structure into our understanding of them. We see here an example of how regimentation in a familiar notation can distort logico-semantic form, and how placing the project in the context of a comprehensive semantic theory for the language can provide a correction. For further discussion, see Neale 1990, Reimer and Bezuidenhout 2004 and Ludlow (Chapter 3.7) in this volume.

Another celebrated example of the discovery of logical form is the event analysis of action sentences (Davidson 1967a). The event analysis was introduced to explain the semantic function of adverbs of action, and in particular to explain modifier drop entailment. In 20, the action verb is modified by four adverbials; 20 entails each sentence obtained by removing one or more of them, and together with 21 entails 22.

20. Brutus stabbed Caesar [violently] [with a knife] [at the Curia of Pompey] [on the ides of March]
21. Brutus stabbed Caesar only once.
22. Brutus's stabbing of Caesar was violent, was done with a knife, at the Curia of Pompey, on the ides of March.

That these entailments are independent of the particular adverbials and verb shows that they are a matter of form (this holds of event verbs generally, and of state verbs that admit of adverbial modification). That 20 together with 21 entails 22 is of particular interest because 22 contains a description of an event: namely, the event of Brutus's stabbing Caesar, and "was violent," "was done with a knife," etc., are predicates of the event described. It can scarcely be an accident that variants of these appear in the adverbials in 20. Davidson suggested that these entailments fall into a familiar pattern, which explains in a uniform way the function of the recurring words in 21–22, if we take 20 to involve an implicit existential quantifier over events introduced by the action verb, and the adverbials as contributing predicates of events, as in 23 (we set aside tense for this abbreviated discussion; see Lepore and Ludwig 2002a for a quantificational treatment).

(∃e)(stabbing(e, Brutus, Caesar) & violent(e) & with(e, a knife) & at(e, the Curia of Pompey) & on(e, the ides of March)).

Modifier drop entailment is then an instance of conjunction elimination in the scope of an existential quantifier; 22 is analyzed as in 24, and so "violent," "with a knife," etc., are exhibited as playing the same semantic role in each of these sentences, and the formal entailment of 22 by 20 and 21 is made transparent.

24. [the e: stabbing(e, Brutus, Caesar)](violent(e) & with(e, a knife) & at(e, the Curia of Pompey) & on(e, the ides of March))

In a comment on Davidson's suggestion, Casteñeda suggested separating out the role of agent and object (or patient) of the action as separate conjuncts to accommodate entailments like those between 25 and 26 on the one hand, and 25 and 27 on the other (1967).

25. He flew the spaceship	$(\exists e)(agent(e, he)$ & $object(e,$ the spaceship$)$ & flying$(e))$
26. He did something	$(\exists e)(agent(e, he))$
27. The spaceship flew	$(\exists e)(object(e,$ the spaceship$)$ & flying$(e))$

This has become a standard feature of the event analysis, now the dominate view of the semantics of adverbial modification. (See Ludwig 2010 and Graff Fara and Schein's chapters (2.8 and 3.9) in this volume for further discussion and refinements.)

The event analysis shows vividly the relation between logical form and descriptive metaphysics. If the event analysis is correct, then, as we are committed to the truth of action sentences, we are committed to the existence of events, though there are no overt quantifiers or terms for events in them.

Let us return now to relate this conception of logical form to formally valid arguments. The truth-theoretic (or fulfillment-theoretic) account characterizes logical form in terms of semantic structure. In virtue of the meaning of a sentence with a certain semantic structure (perhaps on a reading), its truth may require the truth of another, as in the case of modifier drop entailment above. Similarly for a set of sentences and one or more sentences. The truth theory does not state these relations. However, the logic of the truth theory, which is needed to carry out proofs of T-sentences, if fully adequate to the meanings of the terms and structures over which it operates, will determine what entailments there are based on the forms of sentences. Thus, the truth theory together with an adequate logic will provide an account of the formal entailment relations among object language sentences.

What is the relation of this to logical validity? An argument is logically valid on the standard account if no uniform reinterpretation of its nonlogical elements, holding fixed the interpretations of its logical terms, makes its premises true without making its conclusion true. Logical validity is therefore relative to a division of terms into logical and nonlogical. However, there is no settled view on the correct extension of "logical constant." While there is general agreement on the requirement that logic be topic neutral, and on the classification of certain terms, there are various ways of developing the idea that lead to different extensions. (See Gomez-Torrente 2002 and MacFarlane 2010 for an overview.) Consequently, there is no settled view on the extension of 'logically valid'.

However, no matter what the criterion, logical validity, if understood in terms of the notion of a logical constant, is narrower than that of formal validity. For example, 28 entails 29. This is intuitively a formally valid argument, but neither 28 nor 29 contain any logical terms.

28. Brutus is an honorable man
29. Brutus is a man
30. Brutus is honorable and Brutus is a man

Of course, the representation of the logical form of 28 in 30 contains a logical constant. But this is to say that 28 and 30 share logical form on the criterion introduced, not that 30 contains any logical terms. On this ground, Evans (1976) distinguished between logical and structural consequences. Logical consequences hinge on the presence of logical terms, structural consequences on the patterns of types of terms in them. Entailments like that from 28 to 29 are structural but not logical. Still, this distinction does not seem

significant from the standpoint of semantic theory. That the pattern is created in the one case by the use of a term and in the other by arrangement of categories of terms seems a matter of what device is used to subserve a purpose. Thus, it seems a matter of terminology whether we speak of logical syntax as a semantic structure characterized indifferently by a pattern formed partly without or entirely without particular terms, or of formally valid arguments, and distinguish them, as Evans does, into those valid in virtue of a pattern created by certain terms, or a pattern created by a structure in the types of expressions used (Lepore and Ludwig 2002b: sec. IV and appendix C).

Returning to logical constants, there seems little point in insisting that one of the competing criteria in the literature identifies the true coin of logic. Each refines the initial observation that there are terms that form salient patterns relevant to validity. When we are clear about what distinctions each draws, nothing further is revealed about the machinery of language by the choice of what terms to bring under the heading "logical." In a comprehensive truth or fulfillment-theoretic account of the language, the role of each expression and structure, whether classified as logical or not, is fully revealed. The choice lies with the purposes for which the distinction is deployed.

A final topic is the relation of nonovert levels of syntactic description to logical form. The first suggestion of an alignment between the theory of syntax and logical form was made by Gilbert Harman (1975), who suggested that deep structure in transformational grammar could be identified with logical form. More recently, with changes in the Chomskian program, it has been suggested that syntactic representations at a level called "Logical Form" or "LF," distinct from surface structure and deep structure, might be identified with the logical forms of sentences (Neale 1993). LF is a level of representation of syntax in Chomskian grammar that provides an interface with a semantics for the language in the sense that the LF representation makes explicit whatever is relevant to semantic interpretation, such as quantificational structure (May 1985, 1987, 1989). This motivates calling it "Logical Form."

That there are levels of syntactic representation, how many, and how realized, is an empirical issue (many linguists, following Chomsky (1995), now posit only Phonetic Form and LF). As usually understood, a level of syntactic representation, distinct from surface form, is a psychologically real level of representation by speakers over which rules of syntax are defined. It is conceivable that the hypothesis of LF be shown to be empirically inadequate. This would not, however, be a reason to say that sentences did not have logical form. The notion of the logical form of a sentence, then, is not to be analyzed in terms of LF. We can also note that our earlier argument against identifying logical form with a sentence in a formal language which makes explicit its semantic structure, relative to a semantic theory, applies here as well. Still, LF is clearly relevant to logical form. If LF is real, then a psychologically real level of syntactical description encodes structural semantic features of sentences. This provides a representation that can guide regimentations that serve as input to an interpretive truth theory and an important empirical constraint on them (see e.g. Hornstein 2002). Work on LF, then, if LF has the relevant properties, will interact in a straightforward way with a theory of logical form for natural languages, and vice versa.

Related Topics

References

Audi, R. (ed.) (1995) *The Cambridge Dictionary of Philosophy*, Cambridge: Cambridge University Press.

Ayer, A. J. (1984) *Philosophy in the Twentieth Century*, New York: Vintage Books.

Casteñeda, H.-N. (1967) "Comments on Donald Davidson's 'The Logical Form of Action Sentences'," in N. Rescher (ed.) *The Logic of Decision and Action*, Pittsburgh: University of Pittsburgh Press.

Chomsky, N. (1995) *The Minimalist Program*, Cambridge: MIT Press.

Davidson, D. (1967a) "The Logical Form of Action Sentences," in N. Rescher (ed.) *The Logic of Decision and Action*, Pittsburgh: University of Pittsburgh. Reprinted in (Davidson 2001b).

——. (1967b) "Truth and Meaning," *Synthese*, 17: 304–23. Reprinted in (Davidson 2001c).

——. (1968) "On Saying That," *Synthese*, 19: 130–46. Reprinted in (Davidson 2001c).

——. (1970) "Semantics for Natural Languages," in *Linguaggi nella Societa e nella Tecnica*, Milan: Comunita. Reprinted in (Davidson 2001c).

——. (1973) "In Defense of Convention T," in *Truth, Syntax and Modalit*, Amsterdam: North-Holland Publishing Company. Reprinted in (Davidson 2001c).

——. (1977) "The Method of Truth in Metaphysics," *Midwest Studies in Philosophy*, 2: 244–54. Reprinted in (Davidson 2001c).

——. (2001a) "Comments and Replies," in *Essays on Actions and Events*, New York: Clarendon Press. Original publication, 1980.

——. (2001b) *Essays on Actions and Events*, 2nd ed., Oxford: Clarendon. Original publication, 1980.

——. (2001c) *Inquiries into Truth and Interpretation*, 2nd ed., New York: Clarendon Press. Original publication, 1984.

Evans, G. (1976) "Semantic Structure and Logical form," in J. McDowell and G. Evans (eds.) *Truth and Meaning*, London: Oxford University Press.

Gomez-Torrente, M. (2002) "The Problem of Logical Constants," *The Bulletin of Symbolic Logic*, 8 (1): 1–37.

Grandy, R. (1974) "Some Remarks about Logical Form," *Noûs*, 8 (2): 157–64.

Grice, P. (1989) *Studies in the Way of Words*, Cambridge: Harvard University Press.

Harman, G. (1972) "Logical Form," *Foundations of Language*, 9: 38–65.

——. (1975) "Deep Structure as Logical Form," in D. Davidson and G. Harman (eds.) *Semantics of Natural Language*, Dordretch: Reidel.

Hornstein, N. (2002) "A Grammatical Argument for a Neo-Davidsonian Semantics In Logical Form and Language," in G. Preyer and G. Peter (eds.) *Logical Form and Language*, Oxford: Clarendon, 345–64.

Higginbotham, J. (1993) "Grammatical Form and Logical Form," in J. Tomberlin (ed.) *Philosophical Perspectives: Language and Logic*, Atascadero: Ridgeview.

Kalish, D. (1952) "Logical Form," *Mind*, 61: 57–71.

Lepore, E., and K. Ludwig (2002a) "Outline of a Truth Conditional Semantics for Tense," in Q. Smith (ed.) *Tense, Time and Reference*, Cambridge: MIT Press.

——. (2002b) "What Is Logical Form?," in G. Preyer (ed.) *Logical Form and Language*, Oxford: Clarendon Press.

——. (2005) *Donald Davidson: Meaning, Truth, Language, and Reality*, Oxford: Oxford University Press.

Ludwig, K. (2003) "The Truth about Moods," in G. Preyer, G. Peter and M. Ulkan (eds.) *Concepts of Meaning: Framing an Integrated Theory of Linguistic Behavior*, Dordrecht: Kluwer Academic Publishers.

——. (2010) "Adverbs of Action," in T. O'Connor and C. Sandis (eds.) *Blackwell Companion to the Philosophy of Action*, Oxford: Wiley-Blackwell.

Lycan, W. (1984) *Logical Form in Natural Language*, Cambridge: MIT Press.

MacFarlane, J. (2010) "Logical Constants," in E. Zalta (ed.) *The Stanford Encyclopedia of Philosophy*

May, R. (1985) *Logical Form: Its Structure and Derivation*, Cambridge: MIT Press.

——. (1987) "Logical form as a Level of Linguistic Representation," in E. LePore (ed.) *New Directions in Semantics*, London: Academic Press.

——. (1989) "Interpreting Logical Form," *Linguistics and Philosophy*, 12: 387–435.

Neale, S. (1990) *Descriptions*, Cambridge: MIT Press.

——. (1993) "Logical Form and LF," in C. Otero (ed.) *Noam Chomsky: Critical Assessments*, London: Routledge.

——. (2002) "Abbreviation, Scope, Ontology," in G. Preyer and G. Peter (eds.) *Logical Form and Language*, Oxford: Clarendon.

Quine, W. V. O. (1948) "On What There Is," *Review of Metaphysics*, 2: 21–38.

Reimer, M., and A. Bezuidenhout. (2004) *Descriptions and Beyond*, Oxford: Oxford University Press.

Rescher, N. (1962) "Plurality Quantification," *Journal of Symbolic Logic*, 27: 373–4

Russell, B. (1905) "On Denoting," *Mind*, 14: 479–93.

——. (1985) *The Philosophy of Logical Atomism*, La Salle: Open Court. Originally published 1918–19 in four consecutive issues of *The Monist*, from a transcript of lectures delived Jan.–Mar. 1918.

——. (1993) *Our Knowledge of the External World: As a Field for Scientific Method in Philosophy*, New York: Routledge. Original publication, 1914.

Sainsbury, M. (2001) *Logical Forms*, 2nd ed, Oxford: Blackwell.

Strawson, P. F. (1950) "On Referring," *Mind*, 59: 320–44.

——. (1959) *Individuals: An Essay in Descriptive Metaphysics*, London: Methuen.

Tarski, A. (1944) "The Semantic Conception of Truth and the Foundations of Semantics," *Philosophy and Phenomenological Research*, 4: 341–76.

——. (1983) "The Concept of Truth in Formalized Languages," in *Logic, Semantics, Metamathematics*, Indianapolis: Hackett Publishing Company. Original publication, 1934.

Wittgenstein, L. (1961) *Tractatus Logico-Philosophicus*. Edited by D. F. Pears and B. F. McGuinness, London: Routledge & Kegan Paul Ltd. Original publication, 1921.