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REFERENCE AND INFORMATION CONTENT: NAMES AND DESCRIPTIONS

Language is primarily a medium of communication, particularly the communication of information. (Of course, language is more than just a device for communication.) Declarative sentences are the primary vehicles for the communication of information. Declarative sentences have various semantic attributes. They have truth value, either truth or falsehood. They have semantic *intensions*, i.e. correlated functions from possible worlds to truth values, and so on. But the fundamental semantic role of a declarative sentence is to encode a piece of information.[1] This fundamental semantic role of encoding information lies behind many of the other semantic and pragmatic characteristics of declarative sentences. For example, since declarative sentences encode information, they may be used not only to communicate information to others, but also to record information for possible future use, and perhaps even to register information with no anticipation of any future

[1] A word or clarification is needed concerning my use of the semantic predicates 'encode' and 'information'. The term 'information' is used here in a broad sense to include misinformation and even pieces of information that may be neither true nor false. Throughout this article we shall be concerned with discrete units of information that are specifiable by means of a 'that'-clause, e.g. the information that Socrates is wise. These discrete units are ***pieces of information***. We shall generally use the mass noun 'information' as if it were shorthand for the count noun phrase 'piece of information', i.e. as a general term whose extension is th class of pieces of information. Thus, we shall write 'information that is such-and-such' to mean "pieces of information that are such-and-such", 'the same information' to mean "the same piece(s) of information", 'different information' to mean "different pieces of information", and so on. We shall use the verb 'encode' in such a way that an unambiguous declarative sentence encodes (with respect to a given possible context c) a ***single*** piece of information, which is referred to (with respect to c) by the result of prefixing 'the information hat' to the sentence and which is to be called 'the information content' of the sentence (with respect to c). A declarative sentence may encode (with respect to a given context) two or more pieces of information, but if it does so, it is ambiguous. Pieces of information encoded by the proper logical consequences of an unambiguous sentence are not themselves encoded, in this sense, by the sentence. The (piece of) information that snow is white and grass is green is different information (a different piece of information) from the (piece of) information that snow is white, though intuitively the latter included as part of the former. The sentence 'Snow is white and grass is green' encodes only the former, not the latter. This constitutes a departure from at least one standard usage, according to which the information content of a sentence is perhaps something like a class of pieces of information, closed under logical consequence.

We shall not be concerned in this article with a notion of an *amount* of information which arises in the mathematical theory of communication or information. The information ***that snow is white and grass is green and Socrates is Socrates*** may be no more or less information than the information ***that both snow is white if and only if grass is green and either snow is white or grass is green.*** Nevertheless general considerations involving Leibniz's Law strongly suggest that they are numerically distinct pieces of information. For instance, the first concerns Socrates whereas the second does not.

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use. A declarative sentence may be said to *contain* the piece of information it encodes, and that piece of information may be described as the *information content* or *cognitive content* of the sentence. The piece of information encoded by a sentence is what philosophers generally mean when they speak of the 'proposition' expressed by the sentence.

Some of the central and most puzzling questions in the philosophy of language arise from these simple observations. To begin with, what is the nature of information, and what is the nature of the semantic connection between a declarative sentence and its information content?

A preliminary philosophical investigation reveals that pieces of information are ontologically complex; they have components. This is apparent from consideration of distinct pieces of information having components in common. The information that Socrates is wise has some component in common with the information that Socrates is snub-nosed, since both of these are directly about Socrates, and some other component again in common with the information that Plato is wise, since both of these directly ascribe wisdom. These two components of the information that Socrates is wise are separately semantically correlated with the two components that make up the sentence 'Socrates is wise' — the name 'Socrates' and the predicate 'is wise'. Together, these two information components exhaust the information encoded by the sentence.

Let us call the information component semantically correlated with an expression the *information value* of the expression. The information value of the name 'Socrates' is that which the name contributes to the information encoded by such sentences as 'Socrates is wise' and 'Socrates is snub-nosed', and similarly the information value of the predicate 'is wise' is that which the predicate contributes to the information encoded by such sentences as 'Socrates is wise' and 'Plato is wise'. The systematic method by which it is secured which information is semantically encoded by which sentence is, very roughly, that a sentence semantically encodes that piece of information whose components are the information values of the sentence parts, with these information values combined in a manner parallel to that in which the sentence parts are themselves combined to form the sentence.[2] In or-

[2]The latter clause is needed in order to distinguish 'Bill loves Mary' from 'Mary loves Bill', where the sequential order of composition is crucial. This succinct statement of the rule connecting sentences and their information contents is only an approximation to the truth. A complicated difficulty arises in connection with the latter clause of the rule and with such quantificational locations as 'someone' in 'Someone is wise'. Grammatically the sentence 'Someone is wise' is analogous to 'Socrates is wise', though logically and semantically they are disanalogous. In 'Socrates is wise', the predicate 'is wise' attaches to the singular term 'Socrates'. This situation is reversed in 'Someone is wise', wherein the restricted quantifier 'someone' attaches to the predicate 'is wise'. Thus, whereas grammatically 'someone' is combined with 'is wise' to form the second sentence, the information values of 'someone' and 'is wise' are combined very differently from the way the information values of 'Socrates' and 'is wise' are combined.

A perhaps more important qualification to the general rule arises in connection with

der to analyse the information encoded by a sentence into its components, one simply decomposes the sentence into its information-valued parts, and the information values thereof are the components of the encoded information. In this way, declarative sentences not only encode, but also codify, information.

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quotation marks and similar devices — since the information value of the numeral '9' is no part of the information content of the sentence 'The numeral '9' is a singular term'. Yet another important qualification concerns overlaid quantifiers. It is necessary to distinguish between the information contents of such constructions as:

(A) For everyone x there is someone y such that x loves y.

and

(B) For everyone x there is someone y such that y loves x.

One method, due to Alonzo Church and pointed out to me by David Kaplan, employs Russellian propositional functions, i.e. functions from an individual to a singular proposition involving that individual. (Church himself applies the general method in such a way as to invoke only Fregean functions from pure concepts of individuals to Fregean purely general propositions, although the general method can also accommodate anti-Fregean theories by invoking propositional functions.) A variant of this method (closer to the spirit of the naive and modified naive theories defined below) invokes attributes (properties and relations) in place of these functions. The information values of the quantifiers 'for everyone' and 'there is someone such that' are certain higher order properties. (Specifically, they are properties of classes of individuals.) The former proposition may be regarded as made up of the property of being an individual x such that x loves someone or other y, together with the information value of 'for everyone'. The latter proposition may be regarded as made up of the property of being an individual x such that someone or other y loves x, together with the information value of 'for everyone'. (Alternatively, the property of loving someone may be replaced by that of loving someone at t, where t is the time of utterance, and the property of being loved by someone by that of being loved by someone at t.) The information content of sentence (A) may thus be assimilated to the following complex proposition: that the class of individuals who someone or other includes everyone whatsoever. Likewise, the information content of sentence (B) is assimilated to the proposition that the class of individuals loved by someone or other includes everyone whatsoever. (For more details, see my *Frege's Puzzle*, Appendix C, pp. 143–151.)

This method need not assign any information value to an open sentence such as 'x loves y', except relative to an assignment of values to its free variables. Unlike some other possible proposals, it thus generates no counter examples to a certain principle of compositionality (or interchange) for information value, commonly attributed to Frege, according to which the information value of a compound expression such as (A) or (B) is a function solely of the information values of its information-valued components. (See Church, 'Intensional Isomorphism and Identity of Belief', *Philosophical Studies*, **5**, 65–73, 1954, for a similar but more sharply articulated principle.) However, the method does generate counterexamples to a stronger compositionality principle, also attributable to Frege, according to which the information value of a compound expression is a complex made up entirely of the information values of its information-valued components. If the first element of the information content of sentence (A) is the information value of any component of the sentence — for example, the component 'x there is someone y such that x loves y' — then the information value of that component is not made up of the information values of its information-valued components.



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