INTENSIONAL VERBS AND FUNCTIONAL CONCEPTS: MORE ON THE "RISING TEMPERATURE" PROBLEM

Sebastian Löbner,
University of Tokyo

Jackendoff (1979) deals with what one might call the "rising temperature problem" raised by Barbara Partee, namely, the invalidity of the inference from (1) and (2) to (3).

(1) The temperature is ninety.
(2) The temperature is rising.
(3) Ninety is rising.

According to Jackendoff, this problem does not exist if the first sentence is analyzed as he suggests. I shall show below that this claim is incorrect. The rest of Jackendoff's discussion is devoted to refuting two claims cited from Hacking (1975): that *the temperature* should denote a function from times to numbers, and that sentences like (2) should be similar to mathematical statements such as *The function x^2 increases monotonically*. On these two points I agree with Jackendoff, though my own analysis of the meaning of *temperature* is probably nearer to Hacking's than to the one that Jackendoff may have in mind. Thus, in the following discussion, I shall concentrate on the rising temperature problem.

I would suggest that Jackendoff sidesteps this problem, rather than solving it. (The same is true of Partee (1974). The publications on Montague Grammar also for the most part either ignore or avoid the issue.) Jackendoff's strategy is to claim (p. 174) that "(1) is not an assertion of identity but an assertion of location on a scale . . . and . . . is synonymous with (4)", (4) being

(4)   The temperature is (already) at ninety.

Thus, "there is no reason to expect the inference (3) to be valid" (p. 174), just as in the following "comparable" case, one would not expect (5) and (6) (= Jackendoff's (6) and (7)) to entail (7):

(5)   The airplane is at 6000 feet.
(6)   The airplane is rising.
(7)   6000 feet is rising.

This strategy can easily be countered by replacing (1)–(2)–(3) with an appropriate paradigm which presents the same problem without meeting this or other superficial objections, say (1')–(2')–(3'):

(1')   The temperature of the air in my refrigerator is the same as the temperature of the air in your refrigerator.
(2')   The temperature of the air in my refrigerator is rising.
(3')   The temperature of the air in your refrigerator is rising.

To my mind, (1') is unquestionably an identity statement. Again the first two sentences do not entail the third. However, the choice of example is not a vital point here, and I will turn instead to the details of Jackendoff's analysis.

Of course I agree that (7) does not follow from (5) and (6), and I take for granted—not being a native speaker of English— that (1) and (4) are equivalent (if *(already)* is omitted from (4)). But there is a crucial difference between the paradigms (4)–(2)–(3) and (5)–(6)–(7).

In fact, the "comparability" of (2) and (6) does not reach far beyond mere syntactic coincidence. While (6) expresses the

fact that some real physical substance is rising, in space and time, according to (2) nothing is really rising at all in that sense of *rising* (unless we adopt the naïve point of view that the tip of a column of mercury in some thermometer is rising—which would entail that the temperature is falling instead of rising if the thermometer were turned upside down). What is actually happening is that the average value of the kinetic energy of a certain volume of particles, that value being regarded as a function of time, is continuously changing to a higher value. To express this as "rising" is a mere metaphor, as is the use of "higher" in the previous sentence. And in this case the use of the metaphor affects the logical analysis.

Spatial position is only one of infinitely many conceptual dimensions of a physical substance like an airplane. In addition it has shape, weight, color, age, price, function, route, owner, users, etc. By a "conceptual dimension" I understand a set of mutually exclusive properties which is complete in the sense that any thing of the relevant type necessarily has one and only one such property. Thus, for example, the set of all properties that consist in being at a certain spatial position constitutes a conceptual dimension of physical substances. As a result of that definition, a thing (in the broadest sense of the word) has at least as many conceptual dimensions as there are mutually logically independent statements about that thing. This number is virtually infinite for all "real" things. (5) and (6) are statements about just one of the dimensions of the airplane.

The temperature of any substance, itself one such dimension, is one-dimensional. The only dimension is the "height" of the temperature. One-dimensionality is characteristic of those things which I would like to call "fictitious" (in contrast to real things). Various properties can be attributed to the temperature of a substance—it may be high, low, pleasant, unwholesome, threatening, informative, etc.—but all such statements are logically dependent on the height of the temperature.[1] Consequently, (1) and (4) *are* assertions of identity. Because the temperature of any substance has height as its sole dimension, placing it on a scale means identification. In contrast, (6) is not an identity statement, since it specifies only one of the infinitely many dimensions of the airplane.

[1] There are also fictitious things having more than one dimension, e.g. the spatial position of a substance, which can be considered as consisting of three independent coordinates. According to the definition of *dimension*, a finite number of dimensions can be combined into one complex dimension by conjunction of the respective properties. Thus, in a sense, all fictitious things are essentially one-dimensional, though possibly of considerable finite complexity. In contrast, the totality of the dimensions of a real thing is incomprehensible. Presumably the number of dimensions is infinite, because it is impossible to specify all properties of a real thing exhaustively.

I regard *the temperature of x* as denoting a certain value on a certain scale (thus not simply a certain number). (1) and (4) specify the value of ninety, presumably on the Fahrenheit scale, as the denotation (extension) of *the temperature*, and (2) expresses a temporal change of the value, i.e. a change of the extension of the subject. Thus, the predicate *is rising* in (2) is intensional. The intensionality of the predicate in (2) is the point of the problem. This fact remains and has to be explained independently of determining the proper analysis for the sentences (1) and (3).

Intensional verb phrases which contain statements about several values of the intension of a complement term are an interesting phenomenon in at least some natural languages: they state change (or constance) by making use of the fact that the extensions of the respective term vary with time, place, and world. Note that extensional verbs do not require complementary terms with variable intensions. As such statements go beyond the actual extension of the term by referring to more than one extension, they are more complex than simple extensional statements. If a paraphrase by means of extensional statements is possible, it takes at least two. In German this type of intensionality is not restrained to terms that denote fictitious things. Consider the following example:

(8)   Der Bürgermeister wechselt.
      the mayor   changes

This sentence can roughly be paraphrased by two extensional sentences:

(9)   Until now a certain person A was the mayor. From now on a different person B will be the mayor.

From this analysis it is obvious that (8) and (10) do not entail (11):

(10) Der Bürgermeister ist der Ehemann von Helga.
      the mayor   is the husband of   Helga
(11) Der Ehemann von Helga wechselt.
      the husband of   Helga changes

There is no doubt about what kind of thing the subjects of (8) and (11) denote and that (10) is an identity statement. Again the inference is invalid because the predicate *wechselt* of (8) is intensional in that it expresses a change in the extension of the subject term.

What is interesting about this type of intensional verb is that it divides the class of all count nouns[2] into two basic subclasses. These verbs require as subjects or other complements

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[2] In the following discussion, I use *noun* to refer to both complex and simple members of that syntactic category.

terms which contain what I would like to call *functional nouns* (*Funktionalbegriffe*). Functional nouns determine their referents by means of a world-, time-, and space-dependent function. This function is a partial function in any case (a fact that can be neglected in the following discussion), which varies with the world (i.e. the constellation of facts) and, eventually but not necessarily, with time and/or space. Besides these three standard coordinates, additional arguments can be employed.

There are several subclasses of functional nouns, but I shall confine myself to the group of nouns based on a single function, having at most one additional argument. While *weather* is a functional noun without additional arguments, *temperature* requires the specification of a further coordinate, namely the substance whose temperature is referred to. (Note that an addition as in *temperature of the air in my refrigerator* yields a functional noun of the first kind.) In the same group as *weather* are *President of the US, wife of x, price of wheat*. The noun *President of the US*, for example, contains several specifications that provide a certain person for every world, time, and place (the latter being irrelevant in this case). It is essential to these specifications that there always be a unique referent. Thus, they establish a function from the set of all world–time–places to the set of persons. Similarly, the meaning of *temperature* is based on a function which assigns a certain temperature value to every ordered pair of a world–time–place and a substance. The majority of noncomplex functional nouns includes an additional argument: *father, height, price, address, name, meaning, structure, personality*, etc. Inherent uniqueness of the referent is a characteristic feature of all functional nouns based on a single function. Thus, the definite article is typically used with such nouns.

In contrast, the kind of verb discussed here cannot be used intensionally with terms from the second basic subclass of count nouns: the *generic nouns* (*Gattungsbegriffe*). Generic nouns, in the sense I intend here, refer to a set of referents by means of characteristic extensional properties, for example, words like *linguist, rose, noun* or phrases like *old man with a long beard*. The set referred to contains an undetermined number of elements; and thus, unless it has been mentioned previously, such a noun normally takes the indefinite article.

Functional nouns are also required in the case of a second type of intensionality, which is closely related to the one discussed before. Jackendoff himself provides an example (though not as such) (p. 174):

(12)   I feel the temperature of the water.

In the sense that seems to be intended, (12) is intensional with regard to the object term. (12) and (13) do not entail (14):

(13) The temperature of the water is the same as the temperature of the whisky.

(14) I feel the temperature of the whisky.

(12) can be paraphrased by (15):

(15) I feel what temperature the water has.

Clearly, this is not equivalent to the corresponding paraphrase of (14).

The first kind of intensionality, represented by (2) and (8), deals with the temporal variation of the function in question. The intensionality of (12) is of a different kind in that it is not variation along the time coordinate that is involved there, but rather variation along the world coordinate. The temperature of the water has a certain value in this world, but in different worlds it may have different values. In technical terms the predicate of (12) can be interpreted as: determine by a certain procedure which value, among the possible values, the function underlying the subject has in the world provided by the context. The function mentioned is the intension of the subject term and hence the interpretation is clearly intensional. This kind of intensionality makes use of the range of possible referents in different worlds. The range of alternative referents or possible function values is naturally included in a functional noun, just as a question determines the range of possible answers. Hence, (12) can be paraphrased by (15).

In this discussion, I have simplified the matter by speaking of intensional or extensional verbs and functional or generic nouns. It would have been more correct to refer to intensional or extensional uses of verbs and functional or generic uses of count nouns, respectively. The examples (2) and (6) illustrate the point in the case of verb uses. In fact, most of the verbs having intensional uses of the kind discussed have extensional uses as well. On the other hand, a great variety of count nouns can be used both as functional and as generic nouns. For example, a *table* can be understood as a piece of furniture with certain characteristics distinguishing it from desks or stools, or as something with a certain function (for instance, the thing at which one is sitting during one's meals, even though it be a table (in the generic sense), a carton, or a rock).

In this short squib it has not been possible to go into the many details connected with the rising temperature problem. In Löbner (1979) I have discussed the syntactic and semantic phenomena more extensively, as well as establishing more precise definitions of the notions *functional noun, generic noun,* and *dimension* within the framework of intensional logic. In that study I collected approximately 1200 German verbs which can be used intensionally in one of the senses illustrated. The mere quantity may show that the rising temperature problem is by no means marginal, the more so since statements involving

this kind of intensionality play an important role in all areas of scientific speech. Furthermore, the distinction between functional and generic nouns arising from the problem seems to be actually a distinction between two very basic kinds of reference, probably not limited to the field of count nouns and perhaps in fact universal.

References

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