Linking Antecedents and Semantic Representation*

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This paper will be concerned with certain cases of pronominalization and their implications for semantic representation. Basically, pronominalization can be divided into two types: coreferential and non-coreferential pronominalization as illustrated below.

(1) Max married a nurse, because she was an expert at acupuncture. (coreferential)

(2) a. Max chased a klipspringer and Mary chased one too. (non-coreferential)

b. Because Zap comics turn me on, I bought one today. (non-coreferential)

In (1), it is presupposed that a nurse, the antecedent of she, and she refer to the same individual in the universe of discourse. In (2), a klipspringer, the antecedent of one, is not presupposed to be coreferential to one. In fact, the 'unmarked' reading in (2) is that a klipspringer and one refer to different individuals in the discourse. To get a coreferential reading in (2), one must add something to the sentence like 'and they were the same animal'. The observation that an antecedent and an anaphoric pronoun need not be coreferential led Lakoff (1969) to claim that the notion of 'antecedent' should be defined structurally, i.e., independently of semantic considerations such as coreference. This viewpoint will be adopted here.

Crucial for the characterization of pronominalization are the notions of (i) antecedency and (ii) coreference. Earlier accounts of (coreferential) pronominalization regarded it merely as a transformation that operated on identical NPs, replacing one of them by a pronoun. The notion of referential indices was soon added since syntactic identity was not sufficient (Chomsky, 1965). More recently, (coreferential) pronominalization has been considered to be a process that 'fills' variables (indices) with pronouns (McCawley, 1970). This newer approach entails adding the notion of 'binding' to linguistic theory. Summarizing, the following (not necessarily compatible) claims have been made about (coreferential) pronominalization:

(3) a. Pronominalization operates on full NPs, replacing one of them with a pronoun.

b. Pronominalization 'fills' variables (indices) with pronouns.

For the purpose of this paper it will be assumed that (3)b is the appropriate way to handle coreferential pronominalization (for arguments supporting this view see, for example, McCawley, 1970 and references cited therein; for counterarguments see

Karttunen, 1969, 1970). For example, (1) might be represented roughly as follows.

(4) (Ex ε NURSE)(MAX MARRIED x BECAUSE x EXPERT AT ACUPUNCTURE)[1]

In (4), the existential quantifier, Ex, binds both occurrences of x within the second set of parentheses. The first x is filled by (Ex ε NURSE), which is subsequently realized as a nurse; the second x, which is a bound variable, is 'filled' by the appropriate pronoun, she.

This approach accounts for some interesting sentences in a simple manner. There are a number of English sentences which have a superficially singular antecedent, but a coreferential, plural anaphoric pronoun. For example:

(5) No one was hurt, were they?
(6) No one was hurt seriously, so the hospital released { them / *him } within an hour after { their / *his } arrival.
(7) Everyone likes to believe they are a decent person.
(8) A tiger is dangerous... They have big, sharp teeth!

Assuming that claim (3)b can account for all coreferential pronominalization, we are led to postulate a variable under they in the above examples. Considering (5), a rough underlying representation of the main clause would be:

(9) (Ax ε P) NOT (x HURT) where P represents the set of people under discussion.

They in (5) refers to all members of the set P and it can be considered to be the surface realization of a variable bound by the universal quantifier in (9), (Ax). Hence, the pronouns in (5) - (8) can be accounted for in the same manner as in example (1). Notice that in the above examples, the surface, singular antecedents, e.g., no one, have 'absorbed' a universal quantifier. There are similar sentences in English where this is not the case, rather an existential quantifier occurs within the scope of a universal quantifier (for some discussion of such sentences see Hirschman, 1972):

(10) Every day we rented a canoe, and they did not sink.
(11) Every day we bought a flower, because they were inexpensive and, as you know, they cheer people up.

This phenomenon is not restricted to the universal quantifier, but occurs with any 'set' quantifier: many, most, etc.

(12) Most of the students did an experiment and they were complicated ones, too.

Such sentences can be handled by bound variables. For instance, (9) could be represented along the lines of

(13) (Ax ε DAY) (Ey ε CANOE) (WE RENTED y AND y NOT SINK)

Given this analysis, the rule of 'pronoun filling' must be made sensitive to the scope of quantifiers, that is, if an existential

quantifer occurs within the scope of a set quantifier it is filled with the plural pronoun they.[2]

There are two other examples of coreferential pronominalization that I would like to discuss:

(14) Guess what I heard today ... Max married a Norwegian.
That's not correct - She's Swedish.
Nonsense, she isn't Norwegian ... she's Swedish.

(15) Ollie has decided to squander his money. He's decided to go downtown today, buy either a porsche or a ferrari, pay for it in cash and drive it home.

Looking at (14), she refers to the same individual as does a Norwegian. That is, there is one individual under discussion who has been described by two conflicting descriptions. The pronoun in (14) can be accounted for by simply considering there to be a variable under it which is bound by the same operator that binds the first NP, a Norwegian. The implicit claim is that particular descriptions are irrelevant to binding. However, in certain cases it appears to be just this property that gives rise to contradictions and meaningless statements.[3] Additional machinery will have to be used to determine when descriptions constitute contradictions or meaningless statements rather than merely conflicting opinions of two individuals. Thus, (14) might be represented as (16):

(16) (Ex) (x IS NORWEGIAN AND MAX MARRY x .... x IS SWEDISH)

The solution to (15) depends upon an adequate analysis of 'either/or' phrases. Suppose that

(17) Max will buy either a porsche or a ferrari

has the same underlying structure as

(18) Max will buy a ferrari or Max will buy a porsche.

(18) might be represented as follows:

(19) (Ex ϵ PORSCHE) (MAX BUY x) OR (Ey ϵ FERRARI) (MAX BUY y).

Given (19) there is a problem as far as binding goes, since there is no appropriate operator to bind the pronoun it. However, suppose (18) is represented along the lines of (20):

(20) (Ex) (x IS PROSCHE OR FERRARI AND MAX BUY x ... PAY FOR x IN CASH) ...

then there is an appropriate and unique quantifier that binds the variable under it in (15). (20) represents the fact that only one car is being discussed and that this car is either a porsche or a ferrari. Furthermore it excludes the possibility that there might be more than one car that Ollie might buy, (i.e., the inclusive or reading), which seems correct.

There is another distinction relevant to pronominalization: definiteness versus indefiniteness. This distinction cuts across the coreferential/non-coreferential distinction:

(21) a. Max married a nurse, because she is an expert at acupuncture.
b. Max chased a klipspringer and Mary chased one, too.
c. Max married a model, because he thinks they are rich.

A nurse and she in (21)a is an example of definite, coreferential pronominalization; a klipspringer and one in (21)b of indefinite, non-coreferential pronominalization, and a model and they in (21)c is an example of definite, non-coreferential pronominalization. There is, of course, no example of indefinite, coreferential pronominalization. Sentence (21)c is superficially similar to sentences (5) - (8), (10) - (12): the pronoun is definite and plural and the antecedent is singular. Sentence (21)c is an example of an interesting type of pronominalization. The antecedent of the plural, anaphoric pronoun in (21)c is singular, but it has not 'absorbed' a universal quantifier and it is not within the scope of a 'set' quantifier. The meaning of they is directly dependent upon the meaning of its antecedent, that is, the antecedent and anaphoric pronoun must be 'defined' by the same predicate. Compare sentence (14) where this is not the case.

(22) *Max dated Maria, because he thinks they are sexy.

Considering sentences such as (2)a, b and (21)c, there are several striking similarities although (2)a and b are instances of indefinite pronominalization and (21)c is an instance of definite pronominalization. The antecedent/anaphor pairs in these sentences are not presupposed to be coreferential. The antecedent of a coreferential pronoun can not occur within the scope of a negative provided the antecedent is indefinite. This is not true for non-coreferential antecedents, including the ones that are the antecedents for definite pronouns:

(23) *Max did not marry a Norwegian and she is pretty.
(24) Max did not marry a Norwegian, although he would like to marry one.
(25) Max did not marry a Norwegian, although he thinks they make the best wives.

Non-coreferential pronouns, definite or indefinite, always introduce new individuals into the universe of discourse (unless explicitly stated otherwise). Just as there are two klipspringers in the universe of discourse in (2)a they in (21)c introduces a set of models into the discourse.

Several other observations can be made concerning sentences with plural, non-coreferential anaphoric pronouns. The antecedent can not be in an anaphoric island:

(26) a. *Max's wife models, so don't put them down when you talk to her.
b. Max's wife is a model, so don't put them down when you talk to her.

The same holds for one-pronominalization:

(27) *Max's wife models, so if you want to meet one, let's go over to his house and meet her.

Although judgments probably vary widely from speaker to speaker, the antecedent appears to have to be the closest noun phrase to the anaphoric pronoun which has primacy over it (see Langacker, 1969 for a formulation of the notion of 'primacy').

(28) ??Max brought a nurse to the party, because they need more social life.

(29) a. *Ollie refused to show a nurse his wound, because he thinks they're horny.

b. Ollie refused to show his wound to a nurse, because he thinks they're horny.[4]

(30) a. I heard that an intern was upset, because their hours are too long and irregular.

b. ≠ I heard that an intern complained to a doctor, because their hours are too long and irregular.

The 'closest NP principle' which appears to be at work here would explain the fact that they in (30)b cannot be understood as 'interns and doctors'. Why there is a 'closest NP principle' is another mystery. Also, indefinite noun phrases make better antecedents than unstressed definite noun phrases which, in turn, make better antecedents than stressed definite noun phrases:

(31) Max dated a nurse, because he thinks they are loose.
(32) ?Max dated that nurse, because he thinks they are loose.
(33) *Max dated THAT nurse, because he thinks they are loose.

There are many other interesting properties of this type of non-coreferential pronominalization which have not been systematically investigated.

The question arises as to how such cases should be characterized. Can they be accounted for in terms of bound variables? The solution to this problem is dependent upon the representation of indefinite noun phrases in the underlying structure. For example, consider the sentence:

(34) Max caught a klipspringer, because he is afraid they will soon become extinct.

Suppose it were proposed that the underlying representation of the main clause of (34) is roughly:

(35) (Ex)(KLIPSPRINGER x AND MAX CAUGHT x)

If this were the case, then they cannot be a bound variable underlyingly since there is only one quantifier in (35), (Ex), which can bind a variable. Clearly, the putative variable underlying they cannot be considered to be bound by this quantifier.

Suppose one were to claim that a klipspringer should be represented as 'an x that is a member of the set of klipspringers'. One might then propose that there is a set forming operator involved in (34) as well as the existential quantifier. Let SET stand for

the set forming operator where SETyFy means the set of all y such that y has property F). The main clause of (34) might be represented along the lines of:

(36) (Ex ε SETyKLIPSPRINGERy)(MAX CAUGHT x)

(36) would be interpreted as 'there exists an x which is a member of the set of all klipspringers such that Max caught x'. Given this analysis, one might claim that the set operator in (36), SETy, could bind a variable later on in the sentence, in particular, a variable under they in the second clause of (34). (34) would then be something like:

(37) (Ex ε SETyKLIPSPRINGERy)(MAX CAUGHT x BECAUSE HE IS AFRAID y WILL SOON BECOME EXTINCT)

In (37), x is bound by the existential quantifier and y is bound by the set forming operator, SETy. The variable y would be interpreted to refer to the set of klipspringers, which gives the correct reading for the second clause of (34).

Even if there is a second operator underlying indefinite noun phrases such as a klipspringer that can bind variables, this will not be adequate to characterize the type of pronominalization under discussion. Consider a sentence such as

(38) Max married a nurse, because he thinks they are sexy.

They in (38) is generic, that is, it does not refer to all nurses but to a 'typical' nurse. The set operator does not give this reading: A variable bound by it refers to the set of all y such that y is a nurse. Furthermore, they in they are sexy does not refer to the set of nurses, but rather sexy is predicated of each individual nurse.

In the foregoing, they has been used with two logically different types of predicates: 'set' predicates such as extinct, disperse numerous and 'individual' predicates such as sexy, rich. Lakoff (1970:118-20) has argued that this logical distinction is linguistically relevant. For example, one cannot use their own when it is followed by a 'set' predicate: (Lakoff's examples):

(39) a. Whenever you put former servicemen in a room, they start discussing their numerousness.
b. Whenever you put former servicemen in a room, they start discussing their own problems.
c. *Whenever you put former servicemen in a room, they start discussing their own numerousness.

Lakoff points out that reflexive markers like own can occur only where there are 'propositional functions with the same variable', e.g., (40)a as opposed to (40)b.

(40) a. x starts discussing x's numerousness.
b. x starts discussing y's numerousness.

Lakoff concludes that 'there must be different variables for the individuals and for the class'. Put differently, a variable which

refers to a class and a variable which refers to individuals must be bound by different operators. Now consider the following sentence:

(41) Max caught a klipspringer, because he thinks they$_1$ are beautiful animals and he is afraid they$_2$ will soon be extinct.

In (41) there is one antecedent, a klipspringer, for two theys: they$_1$ refers to each individual klipspringer, they$_2$ refers to the set of klipspringers (only a species as a whole, i.e., a set, becomes extinct, not each individual animal. Conversely, the set is not beautiful, but only each individual animal). Suppose that (41) is represented as follows:

(42) (Ex ε SETyKLIPSPRINGERy)(MAX CAUGHT x BECAUSE HE THINKS z ARE BEAUTIFUL ANIMALS AND HE IS AFRAID y WILL SOON BE EXTINCT)

There is no operator in (42) which can bind they$_1$, z. The set operator can only bind a variable that refers to a set, and z does not refer to a set, but to the individuals of a set. In other words, since they$_1$ and they$_2$ refer to logically different things, they are not coreferential and hence cannot be bound by the same operator, that is (43) would not be an appropriate representation of (41):

(43) (Ex ε SETyKLIPSPRINGER)(MAX CAUGHT x BECAUSE HE THINKS y ARE BEAUTIFUL ANIMALS AND HE IS AFRAID y WILL SOON BE EXTINCT)

where both theys are underlyingly the same variable, y.

The semantics of non-coreferential pronouns, the binding 'problem', and the fact that they always introduce new individuals into the universe of discourse can all be accounted for quite simply (in terms of the semantic representation) if we assume the following revision of claim (3)a:

(44) All non-coreferential pronouns have all the semantic material that underlie corresponding nonpronominal NPs in the underlying structure.

Given the current theory of generative semantics, claim (44) entails that there are quantifiers underlying all non-coreferential pronouns. For example, (11), (38), and (2)a would be underlyingly (45), (46), and (47) respectively.

(45) a. (At ε DAY)(Ex ε FLOWER)(WE BOUGHT x BECAUSE x INEXPENSIVE) AND AS YOU KNOW (Tz ε FLOWER)(z CHEER PEOPLE UP)[5]

b. Everyday we bought a flower, because those flowers were inexpensive and, as you know, flowers cheer people up.

(46) a. (Ex ε NURSE)(MAX DATED x) BECAUSE (Ty ε NURSE)(MAX THINK y SEXY)

b. Max dates a nurse, because he thinks nurses are sexy.

(47) a. (Ex ε KLIPSPRINGER)(MAX CHASED x) AND (EyεKLIPSPRINGER) (MARY CHASED y)

b. Max chased a klipspringer and Mary chased a klipspringer too.

From the claim that quantifiers introduce new individuals into the universe of discourse it follows that the type of pronouns that are derived from underlying representations such as (45)a, (46)a, and (47)a will be non-coreferential. Furthermore, since these pronouns have quantifiers underlying them, there is no binding problem. (44) is claimed to be the basic difference between coreferential pronominalization and non-coreferential pronominalization. This analysis would necessitate either a replacement rule which would replace certain NPs with pronouns under the appropriate circumstances or a 'partial' deletion rule like that suggested in McCawley (1968: 142) which would convert NPs with full semantic material into constant indices. These 'created' indices could then be 'filled' with pronouns along with underlying indices by the same rule of 'index-filling'. At this point, I don't see how to decide between the two approaches.

In conclusion, it was argued that within a non-interpretive theory (in the linguistic sense of the term), all non-coreferential anaphoric pronouns must have the semantic material of full NPs underlying them.

FOOTNOTES

*I am grateful to Georgia Green, Jerry Morgan, George Lakoff, and Jessica Johnson for helping me get together some news that is fit to print.

[1]The semantic representations given here are for expository purposes and they have been doctored slightly to make them easier to read. All irrelevant (hopefully!) details have been omitted. Also, (Ax) NOT has been arbitrarily chosen over the logically equivalent expression NOT (Ex).

[2]Actually, the situation is more complicated, since the plural anaphoric pronoun is sometimes optional:

(i) Everyone likes to believe he is a decent person.

and sometimes impossible (for some speakers, anyway):

(ii) Everyone believes *themselves / himself to be a decent person.

[3]Karttunen (1969, 1971) discusses the importance of particular descriptions of individuals for the interpretation of sentences involving opaque contexts. Also, this analysis claims implicitly that there is binding across sentences of the discourse. For the purposes of this paper, I am assuming this to be correct (cf. sentence (8)). This viewpoint does not, however, entail binding across speakers, since each speaker must set up in his own head a representation of each sentence of the discourse.

[4]This interaction with dative movement was pointed out to me by G. Green.

[5]As mentioned earlier, two noun phrases can be asserted or, in certain cases, even be inferred to be the same individual (see Postal, 1968 for discussion). Moreover, the claim that quantifiers always introduce new individuals into the universe is not obviously correct. For example, in

(i) Max bought an eagle and a kangaroo. The marsupial is large and furry.

the definite NP, the marsupial, appears to be anaphoric to the NP, a kangaroo. One might claim that the marsupial has an underlying quantifier in it and that this constitutes a counterexample to the claim that operators always introduce a new individual into the universe of discourse unless it is explicitly stated otherwise in the discourse.

This might turn out to be correct, but without evidence in favor of this, one can just as well consider examples such as (i) as evidence that not all definite NPs contain underlying operators, i.e.,

(i) Would be something like:

(ii) (EX)(Ey)(MAX OWNS (EAGLE x AND KANGAROO y ... MARSUPIAL y IS LARGE).

In (ii) the variable y in MARSUPIAL y is bound by the same quantifier that binds y in KANGAROO y.

'T' stands for the 'generic' operator.

REFERENCES

Chomsky, N. 1965. Aspects of the Theory of Syntax. M.I.T. Press, Cambridge.

Hirschman, L. 1972. 'A: specific, non-specific, and generic'. Unpublished manuscript, University of Pennsylvania. Paper given at winter LSA meeting, Atlanta, Georgia.

Karttunen, L. 1969. 'Pronouns and variables'. In Papers from the Fifth Regional Meeting of the Chicago Linguistic Society. Chicago Linguistic Society, Chicago.

_____. 1971. 'Definite descriptions with crossing coreference'. Foundations of Language, 7:2.

Lakoff, G. 1969. 'Pronouns and reference'. Unpublished manuscript, Harvard University. Available through Indiana Linguistics Club.

_____. 1970. 'Linguistics and natural logic'. Studies in Generative Semantics, No. 1. The University of Michigan, Ann Arbor.

Langacker, R. 1969. 'Pronominalization and the chain of command'. In D. Reibel and S. Schane (eds.), Modern Studies in English. Prentice-Hall, Englewood Cliffs, New Jersey.

McCawley, J.D. 1968. 'The role of semantics in a grammar'. In E. Bach and R. Harms (eds.), Universals in Linguistic Theory. Holt, Rinehart, and Winston, New York.

McCawley, J.D. 1970. 'Where do noun phrases come from?' In R. Jacobs and P. Rosenbaum (eds.) Readings in English Transformational Grammar. Ginn and Co., New York.

Postal, P.M. 1968. 'Some remarks on repetition binding'. Unpublished manuscript, Thomas J. Watson Research Center, IBM Corporation.