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38 EXAMPLES OF ELUSIVE ANTECEDENTS
FROM PUBLISHED TEXTS

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ABSTRACT

In a previous report, the author proposed a syntactic algorithm for resolving pronoun references and presented statistics showing its remarkable effectiveness on a sample of 300 examples from published texts. This report lists those examples on which the algorithm failed. A brief discussion of each example is included.

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1. Introduction

In Hobbs (1976), I proposed an algorithm for resolving pronoun references that depended only on the surface syntax of the sentences in the text. It stated in precise detail a method that many others have felt is highly effective. Statistics on its effectiveness were included. One hundred consecutive examples of "he", "she", "it", and "they" and their variants were examined from each of three different texts -- a Newsweek, Arthur Hailey's novel Wheels, and an archaeology book, William Watson's Early Civilization in China. The algorithm worked on 265 of the 300 examples, and if simple selectional constraints were taken into account, it worked on 275 examples.

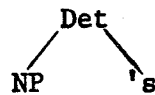
Eugene Charniak, in a personal communication, has suggested that I make available the examples on which the algorithm did not work. That is the purpose of this technical report. The 35 examples on which the algorithm initially failed are given below. Three other interesting examples are also included. Each of the examples is accompanied by a brief comment. In some cases this describes the semantic processing required for correct pronoun resolution.

For the sake of completeness, the algorithm is described again here. Section 2 is a slightly amplified version of section 2.2 of Hobbs (1976).

2. The Algorithm

In what follows reference will be made to the "surface parse tree". By this is meant the tree that exhibits the grammatical structure of the sentence--its division into subject, verb, objects, adverbials, etc.--without permuting or omitting any of the words in the original sentence. That is, the terminal nodes of the tree taken in left-to-right order form the English sentence. It will be assumed, however, that certain syntactically recoverable omitted elements are available as antecedents, as is described below.

Several assumptions will be made about the structure of the noun phrase. It will be assumed that a pronoun is immediately dominated by an NP node, and that a possessive noun or pronoun has the structure



These assumptions are a matter of convenience and anyone objecting to them will have no difficulty adjusting the algorithm to his own views of surface structure. A more crucial assumption is that the NP node has an \bar{N} node below it to which a prepositional phrase containing an argument of the head noun may be attached. Truly adjunctive prepositional phrases are attached to the NP node. This assumption, or something equivalent to it, is necessary to distinguish between the following two sentences:

- (1) Mr. Smith saw a driver in his truck.
- (2) Mr. Smith saw a driver of his truck.

In (1) "his" may refer to the driver, but in (2) it may not. The structures we are assuming for the relevant noun phrases in (1) and (2) are shown in Figures 1a and 1b, respectively.

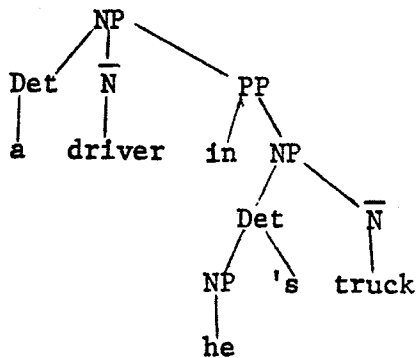


Figure 1a

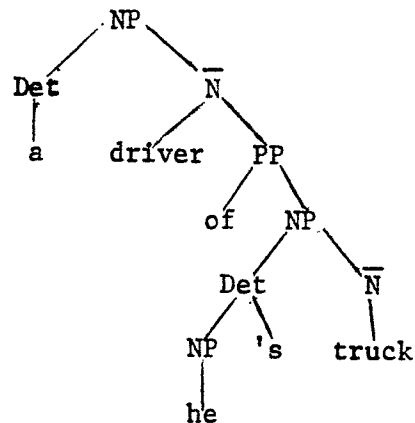


Figure 1b

The naive algorithm traverses the surface parse tree in a particular order looking for a noun phrase of the correct gender and number. The traversal order is as follows:

1. Begin at the NP node immediately dominating the pronoun.
2. Go up the tree to the first NP or S node encountered. Call this node X, and call the path used to reach it p.
3. Traverse all branches below node X to the left of path p in a left-to-right, breadth-first fashion. Propose as the antecedent any NP node that is encountered which has an NP or S node between it and X.
4. If node X is the highest S node in the sentence, traverse the surface parse trees of the previous sentences in the text in order of recency, the most recent first; each tree is traversed in a left-to-right, breadth-first manner, and when an NP node is encountered, it is proposed as an antecedent. If X is not the highest S node in the sentence, continue to step 5.

5. From node X, go up the tree to the first NP or S node encountered. Call this new node X, and call the path traversed to reach it p.
6. If X is an NP node and if the path p to X did not pass through the \bar{N} node that X immediately dominates, propose X as the antecedent.
7. Traverse all branches below node X to the left of path p in a left-to-right, breadth-first manner. Propose any NP node encountered as the antecedent.
8. If X is an S node, traverse all branches of node X to the right of path p in a left-to-right, breadth-first manner, but do not go below any NP or S node encountered. Propose any NP node encountered as the antecedent.
9. Go to step 4.

A breadth-first search of a tree is one in which every node of depth n is visited before any node of depth n+1. Steps 2 and 3 of the algorithm take care of the level in the tree where a reflexive pronoun would be used. Steps 5-9 cycle up the tree through S and NP nodes. Step 4 searches the previous sentences in the text.

For the sake of concreteness, suppose we have the following context-free grammar for generating the surface structures of a fragment of English:

S → NP VP

NP → $\left\{ \begin{array}{l} (\text{Det}) \bar{N} \left(\begin{array}{l} \text{PP} \\ \text{Rel} \end{array} \right) * \\ \text{pronoun} \end{array} \right\}$

Det → $\left\{ \begin{array}{l} \text{article} \\ \text{NP}'\text{s} \end{array} \right\}$

\bar{N} → noun (PP)*
PP → preposition NP
Rel → wh-word S
VP → verb NP (PP)*

Words in lower case letters mean any word of that category; parentheses, (. . .), indicate optional elements; the asterisk means 0 or more copies of the element that precedes it; braces, { . . . }, contain alternatives.

Figure 2 illustrates the algorithm working on the sentence

The castle in Camelot remained the residence of the king
until 536 when he moved it to London.

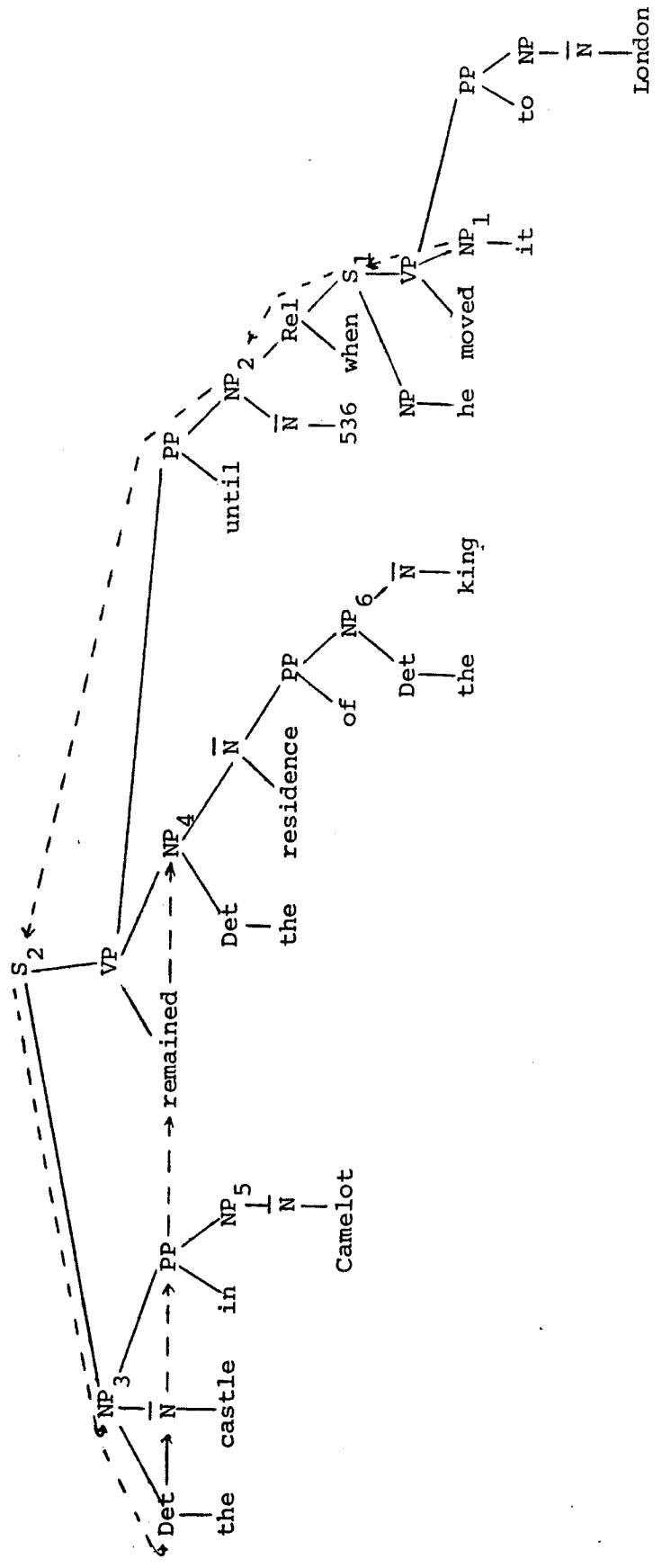
Beginning from node NP_1 , step 2 rises to node S_1 . Step 3 searches the left portion of S_1 's tree but finds no eligible NP node. Step 4 does not apply. Step 5 rises to NP_2 which step 6 proposes as antecedent. Thus, "536" is recommended as antecedent of "it".

The algorithm can be improved somewhat by applying simple selectional constraints, such as

Dates can't move;
Places can't move;
Large fixed objects can't move.

The utility of these constraints is limited. They never help with the pronoun "he", since what one male human can do another can do too. Even with "it" the utility is limited since most English words can occur in such a wide variety of contexts. However, in the present example, they help.

After NP_2 is rejected, steps 7 and 8 turn up nothing, and control is returned to step 4 which does not apply. Step 5 rises to S_2 , where step 6 does not apply. In step 7, the breadth-first search first suggests



(Indices are for reference by the text.)

Figure 2

NP₃ (the castle), which selectional constraints reject. It then continues to NP₄ where it correctly settles upon "the residence" as antecedent of "it".

If we were searching for the antecedent of "he", the algorithm would continue, first rejecting NP₅ because of gender and finally lighting upon NP₆, the king.

When seeking an antecedent for "they", the algorithm accepts plural and collective singular noun phrases and also collects selectionally compatible entities. In

John sat on the sofa. Mary sat before the fireplace.

They faced each other.

the algorithm would pick "Mary" and "John" rather than "Mary" and "the fireplace". Also, when two plurals are conjoined, the conjunction is favored over either plural, as in

Human bones and relics were found at this site. They were associated with elephant tusks.

It should be assumed that the algorithm is part of a larger left-to-right interpretation process which also recovers syntactically recoverable omitted material and records coreference and non-coreference relations. The algorithm then handles the case of "missing antecedents". In

My uncle doesn't have a spouse, but your aunt does,
and he is lying on the floor.

the interpretation process first expands the second clause into

... but your aunt does have a spouse ...

and the algorithm then selects the aunt's spouse as antecedent of "he". The algorithm also avoids choosing "the man" as antecedent of "him" in

John said his mother would sue the man who hit him
for "the man" is necessarily coreferential with the omitted subject of "hit", which is necessarily non-coreferential with "him".

In dialogue it is assumed that the implicit "A said to B ..." has been recovered before the algorithm is applied to quoted sentences and that rules are available to exclude the speaker and listener as possible antecedents of third person pronouns inside quotes.

The algorithm does not handle sentence pronominalization, as in

Ford was in trouble, and he knew it

One might suggest that the algorithm be modified to accept an S node as the antecedent of a pronoun occurring in certain contexts. However, the problem of avoiding spurious antecedents would then be quite severe. In

The newspaper reported that Ford had claimed the economy
was improving, but I didn't believe it

the algorithm allowing both S and NP nodes would recommend the following as plausible antecedents, in the given order:

The newspaper reported that Ford had claimed the economy
was improving

the newspaper

Ford claimed the economy was improving

the economy was improving.

This is quite the opposite of one's intuitive feelings about which readings are preferred.

3. Examples from Watson

1. They were at once assigned an important place among the scanty remains which record the physical developments of the human race from the time of its first appearance in Asia.¹

If, as is likely, the sentence is parsed incorrectly and "from the time" is attached to "the human race", the algorithm will yield the right antecedent. If, however, the correct parse is used, in which "from the time" modifies "the physical development", that NP will be chosen as antecedent first, and "the human race" only second.

2. Caves existing in the limestone were inhabited by men and animals and the remains of both were preserved in the clay and stony rubble which eventually filled up their lairs.²

Before selection, the plausible antecedents, in order, are "the clay and stony rubble", "the remains", "both", "caves", and "men and animals". "Lair" is specific enough that a selectional constraint could be stated to eliminate the first two.

3. The geological age of the cave filling can be broadly estimated. It belongs to the Middle Pleistocene.³

It is the cave filling, rather than the geological age of the cave filling, that belongs to the Middle Pleistocene, although the difference is subtle. The algorithm would pick the geological age, and "belong" is too general a word to rule this out on selectional grounds.

4. Their [Neolithic farmers'] weapons, at least those with imperishable parts, were the bow and arrow, and probably a sling or pellet-bow. Apart from what is implied in the simple grave-goods, we know nothing of their superstitions and customs.⁴

"The simple grave-goods" and "their weapons" are chosen first by the algorithm, but "superstition" and "custom" are specific enough to restrict the antecedent to humans. After selection, the "they" of "their weapons" is chosen.

5. The origins of the Yang Shao culture present a considerable archaeological problem. It is now claimed to have been a phase of long duration.⁵

It is not quite clear whether the antecedent is "the origins" or "the Yang Shao culture", but it is probably the former. The algorithm would not choose "the origins" because there is no number agreement. It would choose "a considerable archaeological problem" over "the Yang Shao culture" since a breadth-first rather than a depth-first search is used; in fact, this is the only example in the sample where a depth-first search would have done better. Presumably a selectional constraint on "phase" can rule out "problem", but it is not quite clear how it would be stated.

6. The stratigraphy of the often extensive habitation sites offers no help in this respect, although on many sites in Central China, it marks off the Yang Shao from a supervening culture.⁶

"Central China" would be chosen first, and "marks off" is too general to exclude this selectionally to allow "the stratigraphy" to emerge. The previous sentence speaks of criteria for subdividing the period. Assuming the stratigraphy is recognized as such a criterion, the semantic similarity of "subdivide" and "marks off" leads to the antecedent.

- 7 - 8. The thin, hard, black-burnished pottery, made in shapes of angular profile, which archaeologists consider as the clearest hallmark of the Lung Shan culture, developed in the east. The site from which it takes its name is in Shantung. It is traced to the north-east as far as Liao-ning province.⁷

The algorithm's first choice for the "it" of "it takes", "the site", cannot be excluded purely on syntactic grounds, because in the syntactically similar sentence --

The man from whom he is taking the money is only himself "he" and "the man" are coreferential. The second choice is "Shantung" because of the algorithm's rightward search. The third choice is the pottery, and it is possible that this is the intended antecedent, although "the Lung Shan culture" seems slightly better. Before "the Lung Shan culture" is chosen, however, "the east", "angular profile", and "the clearest hallmark" would also have to be rejected.

For the "it" of "it is traced" the choices in order are "the site", "Shantung", and the "it" of "it takes", the last of which is correct.

In both examples, semantic processing would resolve the reference by recognizing the three sentences as semantically parallel--they all outline the geographical boundaries of the Lung Shan culture.

9. Such cultural coherence can be paralleled in the river valley civilizations of the Near East rather than among the more isolated populations of prehistoric Europe, and, as in the Near East, it was the prelude to a rapid growth of high Bronze Age culture.⁸

The problem here is to exclude "the Near East" so that "cultural coherence" can be chosen. If we can assume there are no dangling modifiers, then we can identify "it" with the omitted subject of the subordinate clause "as (it was ...) in the Near East", and reject "the Near East" as antecedent on syntactic grounds. If not, we ought to be able to reject it using the selectional constraint that a geographical region cannot be a prelude. On

the other hand,

Spain was only a prelude to Morocco
is a plausible traveller's report.

10. The positions of pillars in one hall were marked by river boulders and a shaped convex cushion of bronze that had served as their footings.⁹

"River boulders and a shaped convex cushion of bronze", "river boulders", and finally "the positions" would be chosen before the correct antecedent, "pillars". To exclude the first two on syntactic grounds, we would have to know more about the environments in which the particle "own" is obligatory. Consider for example

- (3) He served as his butler.
(4) He served as his own butler.

In (3) "he" and "his" are not coreferential, while in (4) they are. "The positions" can presumably be excluded on selectional grounds.

11. How far the king himself was looked on as a god is not clear, but the spirits of his ancestors, in a scale of descending importance as the list of them reached back to the beginning of the royal rule of Shang and beyond, were very real gods.¹⁰

"The spirits" would be chosen over "his ancestors", although semantically the difference is not great.

12. Sites at which the coarse grey pottery of the Shang period has been discovered do not extend far beyond the southernmost reach of the Yellow river, or westward beyond its junction with the Wei.¹¹

"The southernmost reach" is chosen over "the Yellow river", and southernmost reaches can have junctions. Semantically, there is a parallel,

reinforced by "or", between "extend ... beyond the southernmost reach ..." and "(extend) ... beyond ... junction with the Wei". The parallel is strengthened if we assume the identity of "of the Yellow river" and "its".

13. But it is improbable that the river valleys and highlands which were the homes of the Chou confederacy before their eastward move stood on a much lower cultural level at the time of the conquest than the Shang state itself.¹²

"Before their eastward move" is an adverbial in the relative clause "which were the homes ...". Hence, the omitted subject of "were", "the river valleys and highlands", and then "the homes" are chosen first. Selectional constraints reject these and allow the collective NP, "the Chou confederacy", to be chosen.

14. The residence remained, however, at Tsung Chou in Shensi until 771 B.C., when it was moved to a pre-existing Chou city near the modern Loyang.¹³

The example of Figure 2 is modelled after this sentence.

15. He had the duty of performing the national sacrifices to heaven and earth: his role as source of honours and material rewards for services rendered by feudal lords and ministers is commemorated in thousands of inscriptions made by the recipients on bronze vessels which were eventually deposited in their graves.¹⁴

In this sentence, before selection, "their" has thirteen eligible antecedents. In order, they are "bronze vessels", "thousands", "recipients", "inscriptions", "honours and material rewards", "honors", "material rewards", "services", "feudal lords and ministers", "feudal lords", "ministers", "the national sacrifices", and "heaven and earth". Selection eliminates the first two and the correct "the recipients" is chosen.

4. Examples from Wheels

Examples 1-5 occur in a passage describing a conversation between the President of General Motors and his wife about charges a Ralph Nader character has made against the automobile industry.

1 - 4. She continued, unperturbed, "Mr. Vale quotes the Bible about air pollution."

"For Christ's sake! Where does the Bible say anything about that?"

"Not Christ's sake, dear. It's in the Old Testament."

His curiosity aroused, he growled. "Go ahead, read it. You intended to, anyway."

"From Jeremiah," Coralie said. "'And I brought you into a plentiful country, to eat the fruit thereof and the goodness thereof; but when ye entered, ye defiled my land, and made mine heritage an abomination.'" She poured more coffee for them both. "I do think that's rather clever of him."¹⁵

There are four interesting examples here:

It is not clear whether the "it" of "it's in the Old Testament" even has an antecedent. It could be the "thing" of "anything", i.e., that which the Bible says about pollution is in the Old Testament, in which case "it" refers to the substance or meaning of the quote. Or it could refer to the actual quote, which is only implicit in the first sentence. The algorithm, assuming it would miss the NP "Christ's sake", would pick "the Bible".

For the "it" of "read it", the algorithm would chose "his curiosity" first, but selectional constraints could presumably disqualify this. Next the "it" of "it's in the Old Testament" would be chosen correctly, thus blocking "the Old Testament" and "the Bible".

"Them" of "for them both" presents a good illustration of what must be done in resolving plural pronouns. The antecedent can be a set, and we demand that the entities chosen for the set be selectionally compatible. Thus, the set {she, more coffee} is rejected. We assume the phrase "Coralie said" would be expanded into "Coralie said to her husband", so that the set {Coralie, her husband} is available as antecedent. This is chosen.

The "him" of "rather clever of him" refers to "Mr. Vale", who is last mentioned nine sentences back. Nevertheless, the algorithm works on this example, assuming Jeremiah, Christ, and the "I" of the Biblical quotation can be rejected. The husband is rejected since he is being spoken to in the quote. This distance between pronoun and antecedent is possible since the intervening text is all an expansion of one part of the first sentence, leaving the first sentence on the "frontier" of the text.

5. "Shouldn't someone answer?"

"If some bright reporter gets to Henry Ford, he's
apt to."¹⁶

It is Mr. Vale's charges that should be answered by the automobile industry, of which Henry Ford is a representative. The requirement that the second sentence be recognized as an answer to the first leads us to expand "he's apt to" into "he's apt to answer" and to identify "he" with "Henry Ford". But the algorithm yields "some bright reporter".

Next Hailey follows the early morning routine of an executive vice-president of Ford:

6 - 9. He [the executive vice-president] had already breakfasted alone. A housekeeper had brought a tray to his desk in the softly lighted study where, since 5 A.M., he had been alternately reading memoranda and dictating crisp instructions into a recording machine. He had scarcely looked up.¹⁷

These examples are interesting since ten years ago, when we could have assumed the housekeeper was female, the algorithm would have worked. It no longer does. The algorithm picks "a housekeeper" for "his" and for the "he" of "he had scarcely". For the "he" of "he had been", the algorithm picks the "his" of "his desk" and hence is correctly resolved if and only if "his" is.

10. One of the executive vice-president's responsibilities was to approve or veto projects, and allocate priorities. He had once been asked if such rulings on the disposition of immense wealth, worried him. He replied, "No, because mentally I always knock off the last three figures. That way it's no more sweat than buying a house."¹⁸

There are two plausible antecedents -- "one of the ... responsibilities" and "the disposition of immense wealth". The algorithm would choose the latter, and semantically, would not be far wrong. In fact, it is not clear what the antecedent really is or if there is an explicit antecedent at all. Some other possibilities:

"to approve or veto projects": Not an NP.

"(to) allocate priorities": Not an NP.

"such rulings": Plural and hence not eligible.

"(the making of) such rulings": Intuitively the best choice, but not explicit.

- 11 - 13. While he continued to work, a barber would come in to cut his hair. Dinner -- in the penthouse, one floor above the executive suite -- would include a critical discussion about new models with division managers.

Later still, he would stop in at the William P. Hamilton Funeral Chapel to pay respects to a company

colleague who had dropped dead yesterday from a coronary brought on by overwork.¹⁹

The algorithm would choose "a barber" for all three. For the first "he" this is due to the shallow search to the right included in the algorithm to accommodate Langacker's examples of antecedents commanding but not preceding the pronoun. Semantically, resolution rests on the fact that what ties this text together is the parallel relation between the sentences, matched by recognizing them all as planned activities of the executive vice-president. The focus on the executive vice-president is one of the manifestations of this fact.

14. The Jetstar engines started as the party of eight climbed aboard and they were taxiing before the last people in had fastened seatbelts.²⁰

Before selection, "the Jetstar engines" would be chosen. However, a very limited number of things can taxi, and an engine is not one of them. After selection, "the party of eight" would be chosen, since collective noun phrases are eligible antecedents for "they".

5. Examples from Newsweek

1. "I guess people who were waiting to see which way the wind was blowing have stopped waiting."

TURNABOUT: The wind could change, and Ford knew it.²¹

A sentential example.

2. Ford's popularity might also peak too soon. But, said an aide, "his blood is starting to churn" for the race -- and, last week at least, he was in rare running form.²²

Since the last clause is not in quotes, "an aide" is an eligible antecedent. If "said an aide" is viewed as the main assertion of the

second clause, then the algorithm picks "an aide". If we were to view it as an adverbial and "his blood" as the subject of the main assertion, then it is a toss-up whether "an aide" or "his" would be chosen -- it depends on the vagaries of the surface syntax representation.

The relevant semantic information is the redundancy implicit in "peak", "blood starting to churn", and "rare running form", which all involve training for a race.

3. "Madam Chairwoman," said Colby at last, "I am trying to run a secret intelligence service."

It was a forlorn hope.²³

Another sentential example. If the algorithm accepted S nodes, Colby's saying would be picked first, then his trying, and only finally the correct antecedent -- Colby's running a secret intelligence service.

Semantically, what is significant is the redundancy between "trying" and "hope".

4. Confirming that the CIA had files on 75 members of Congress, he explained that many of them had voluntarily assisted the agency somehow.²⁴

"Files" would be chosen first, but since files cannot voluntarily assist, it would be rejected in favor of "75 members".

5. When their bodies were recovered after the shoot-out, Coler had been picked clean of credentials and weapons, he had been stripped to the waist, and an FBI spokesman said his jacket was found on the body of Joseph Stuntz.²⁵

This is similar to example 2. "An FBI spokesman" would be chosen first. The semantic information used to resolve correctly is the semantic parallel pattern among the three clauses, and the fact that if Coler had been stripped to the waist, his garments above the waist, including his jacket, are located somewhere else.

6. But in Rapid City another AIM spokesman, Mark Tilsen, agreed: "That's what started the whole thing."

In fact, however, "what started it" was probably more complicated.²⁶

"That" would be chosen over "the whole thing". It is the parallel between the two quotes, reinforced by the quotation marks themselves, that leads to the correct antecedent.

7. The FBI said it had tentative identifications on the fugitive Indians but didn't know where they were.²⁷

This example is discussed in Section 4.2, Hobbs (1976).

8. In Washington CITMOCO asked the Commerce Department for an export license -- and got it within two days.²⁸

"CITMOCO" is the omitted subject of "got" and is syntactically recoverable, hence cannot be the antecedent. However, there is no obvious way to state a selectional restriction that will rule out "the Commerce Department" as object for "get", so it would be chosen. The real antecedent is found by using knowledge of the causal relation between asking and getting.

6. A Final Example

I will conclude this report with an example from Shakespeare's

Titus Andronicus:

Titus: What, villain boy!

Barrst me my way in Rome?

Mutius: Help, Lucius, help! He kills him.²⁹

Who kills whom? The algorithm would process "he" first and pick Mutius. It would then process "him" and pick Lucius:

Mutius kills Lucius.

A number of investigators of the pronoun problem have claimed that there are often cases where a pronoun cannot be resolved until subsequent sentences in the text are processed. I would contend that, in published texts at least, this is extremely rare. No such case occurred in the sample of 300. Yet the present example may seem just such a case. The next line is the stage direction:

[Enter Lucius.]

and the next two lines are spoken by Lucius and Titus, so it must be that Titus killed Mutius.

On the other hand, notice that Titus' words have an aggressive cast to them, whereas Mutius is on the defensive. Even without look-ahead, maximum redundancy would be served if Titus were to kill Mutius.

Footnotes

1. Watson, William, Early Civilization in China, New York, 1966, p. 21.
2. *ibid.*
3. *ibid.*
4. *ibid.*, p. 29.
5. *ibid.*, p. 30.
6. *ibid.*
7. *ibid.*, p. 38.
8. *ibid.*, p. 44.
9. *ibid.*, p. 48.
10. *ibid.*, p. 58.
11. *ibid.*, p. 62.
12. *ibid.*, p. 63.
13. *ibid.*
14. *ibid.*
15. Hailey, Arthur, Wheels, New York, 1971, p. 2.
16. *ibid.*, p. 3.
17. *ibid.*, p. 4.
18. *ibid.*
19. *ibid.*, pp. 4-5.
20. *ibid.*, p. 5.
21. Newsweek, July 7, 1975, p. 13.
22. *ibid.*, p. 14.
23. *ibid.*
24. *ibid.*
25. *ibid.*, p. 15.
26. *ibid.*
27. *ibid.*, p. 16.
28. *ibid.*
29. Shakespeare, William, Titus Andronicus, Act 1, Scene 1, lines 302-304.

Acknowledgements

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Bibliography

Hailey, Arthur, Wheels, New York, 1971.

Hobbs, Jerry R., Pronoun Resolution, Research Report 76-1, Dept.
Comp. Sci., City College, CUNY, July, 1976.

Newsweek, July 7, 1975.

Shakespeare, William, Titus Andronicus.

Watson, William, Early Civilization in China, New York, 1966.