

1989

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PRONOUNS AND THE REPRESENTATION OF DISCOURSE

A Thesis Presented

by

JOHN S. HUITEMA

Submitted to the Graduate School of the
University of Massachusetts in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE

September 1989

Department of Psychology

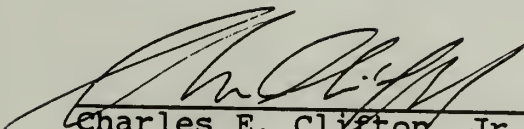
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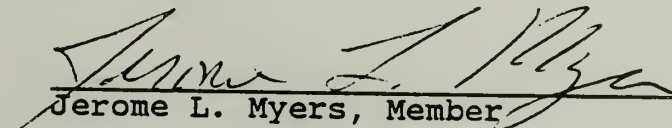
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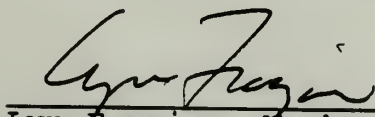
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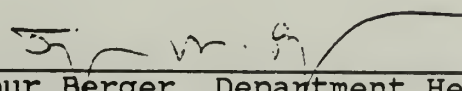

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CHAPTER 1

INTRODUCTION

Background

Research on anaphora has burgeoned in recent years, leading to a better understanding of anaphoric reference in particular and language comprehension in general. The predominant view of how anaphors are comprehended is that the occurrence of an anaphoric expression -- be it a pronoun, a definite noun phrase, or a verbal ellipsis -- triggers a process which searches through the representation of the text in memory, looking for an antecedent that fits the constraints imposed by the referring expression and by the discourse context. Once the antecedent has been located, the anaphor can be interpreted and integrated into the discourse representation. Given this view, several questions immediately suggest themselves as candidates for research. First, what is the order in which the representation of the preceding text is searched? Second, when do the constraints on what is an appropriate antecedent come into play? Third, what exactly happens once the antecedent has been located? And, fourth, what is the nature of the mental representation in which the antecedents are located?

The first three questions have received the most attention among researchers so far. Early work on the order

of the search process (Clark & Sengul, 1979; Ehrlich, 1983a; Ehrlich & Rayner, 1983) showed that comprehension of pronouns and definite noun phrase anaphors takes longer when the antecedent is further back in the text (in terms of number of clauses) than when it is closer to the anaphor, suggesting a linear backwards search of the preceding text and perhaps a privileged status for the immediately preceding clause. Some more recent investigations, though, have found evidence that distance to the antecedent is less important than whether or not the antecedent is currently the topic of the sentence or discourse (Clifton & Ferreira, 1987; Crawley, 1986; cf. also Ehrlich, 1983b). Clifton & Ferreira (1987), for example, found evidence that "an anaphor is read quickly even when its antecedent is rather far back in the text, so long as the antecedent is still the topic of the sentence" (p.643). These findings suggest that the current topic of a discourse is maintained in working memory (as would be predicted by the van Dijk & Kintsch (1983) model of comprehension), and hence is easily accessible to serve as the antecedent for a pronoun. This view is in fact consistent with the earlier literature that suggested a linear backward search, for in those experiments (e.g., Clark & Sengul, 1979; Ehrlich & Rayner, 1983) distance was confounded with topichood. Thus, for example, Ehrlich & Rayner (1983) found an effect of distance only when the antecedent of the pronoun was farther back than the

preceding sentence, in which case it was also no longer the current topic of the discourse.

Felicitous use of a pronoun, in fact, requires that its antecedent be readily accessible to the comprehender. Using a pronoun rather than a name or a full definite noun phrase signals that the antecedent should be in the foreground of the comprehender's representation of the discourse. In fact, it is awkward to use a name to refer to an individual again when you have just done so: "Sebastian went to the store. Sebastian needed to pick up some milk." Empirical support for this observation comes from an experiment by Fletcher (1984). He asked subjects to rewrite brief passages and found that they were more likely to use a pronoun as a reference device when the referent was still the topic of the discourse. A shift in topic made it more likely that the subjects would use a name or other, more marked form of reference.

The second question -- how and when are the constraints on what is an appropriate antecedent used -- has also received some attention. Clearly, many factors affect the final interpretation assigned to an anaphor. The underlying semantics of a sentence (Caramazza, Grober, Garvey, & Yates, 1977; Ehrlich, 1980) can determine how an ambiguous pronoun is understood. In the sentence, "Jack threw a snowball at Phil, but he missed" (from Corbett & Chang, 1983), the determination that the pronoun "he" refers to Jack rather

than Phil is due to real-world semantic knowledge about the situation and is not uniquely determined by the constraints of gender and number imposed by the pronoun. Furthermore, the local and global topics of a passage (Crawley, 1986) have been shown to affect interpretation of an ambiguous pronoun in the second clause of a sentence, and Gernsbacher (1986) has shown that people have no difficulty comprehending a plural pronoun that refers to a singular but conceptually plural antecedent, even though the pronoun does not match the antecedent in number (e.g., "Ask a professor - - they always know the answer"). In fact, in such cases she found that people actually prefer the plural pronoun to the singular.

But the crucial question -- exactly when during processing are these various constraints used -- has only begun to be addressed, so a clear consensus of the evidence is not yet available. Corbett & Chang (1983), measuring recognition time to a probe following a sentence, found that reaction time to a probe of the nonantecedent was faster when the second clause of the sentence contained an (ambiguous) pronoun than when it contained a proper name. They took this as evidence that an ambiguous pronoun initially activates both potential antecedents rather than waiting for disambiguating information. Gernsbacher (1989) tested this hypothesis further by examining response times to probes immediately before and after a pronoun or name.

She found that the occurrence of a pronoun did not alter the activation level of its referent. In fact, in all her experiments, only the non-antecedent was affected by the occurrence of a pronoun: at the end of the sentence it was less active than the antecedent. This was true when preceding material clearly disambiguated an otherwise ambiguous pronoun, and -- surprisingly -- even when the pronoun matched the gender of only one of the sentence participants.

Gernsbacher's experiments suffer from methodological flaws, however, that make it unlikely that her results reflect comprehension processes used during normal reading. Instead, several aspects of the experiments suggest that the results may be due to strategies adopted by the subjects in response to the specific demands of the experiments. For instance, the word-by-word presentation rate was an exceedingly slow, even plodding, rate of 433 ms for a five-letter word (as compared to a normal reading rate of about 240 ms for a five-letter word); average response time to the probes was on the order of 900 ms, considerably slower than in most experiments using recognition times to assess activation (e.g., Dell, McKoon & Ratcliff, 1983); all the probes and answers to the comprehension questions were names, making it likely that subjects paid special attention to the names; and all the sentences used in the experiments had the same structure, so that the positions where a probe

was likely to occur were obvious. In sum, it seems unlikely that the results of Gernsbacher's experiments are informative about pronoun comprehension during normal reading.

A more tightly-controlled experiment by Nicol (1988) yielded evidence that, within a sentence at least, a pronoun initially re-activates all nouns that match its number and gender and that do not violate any syntactic constraints on co-reference. Nicol (1988) used a cross-modal lexical-decision task to measure priming following the pronoun in sentences like "The landlord told the janitor that the fireman with the gas-mask would protect him/himself from getting hurt." When the anaphor was a non-reflexive pronoun ("him"), associates of both "landlord" and "janitor" but not "fireman" were primed relative to unrelated control words matched on length and frequency. Just the opposite result was observed when the pronoun was reflexive and hence could grammatically refer only to the fireman. Nicol (1988) also found that the number and gender of a pronoun limit the potential antecedents that are initially activated. Thus, it appears that the anaphoric search process makes immediate use of constraints imposed by the grammar and by the pronoun's gender and number to initially activate a set of potential antecedents, which are then examined by higher-level processes to choose the antecedent appropriate for the sentence and its context.

Experiments by Dell, McKoon, & Ratcliff (1983; McKoon & Ratcliff, 1980) and others (Chang, 1980; O'Brien, Duffy, & Myers, 1986) have shed light on the third question -- what happens when the correct antecedent has been located. In a series of experiments using an on-line probe-recognition task, Dell et al. (1983) showed that an anaphoric definite noun phrase rapidly (within 250 ms) activates its antecedent and other concepts in the proposition containing the antecedent. Over the course of the sentence containing the anaphor, the antecedent remains activated while the other concepts do not. Furthermore, McKoon & Ratcliff (1980) showed, by looking at priming in a delayed item-recognition task, that the process of anaphor resolution results in a representation in memory in which the proposition containing the anaphor is linked to the earlier one containing the antecedent (at least in the case of definite noun phrase anaphora, which is what they studied). Once the antecedent has been located, the sentence containing the anaphor can be interpreted and then integrated with the preceding text.

The final question concerns the nature of the representation that is searched for antecedents. How are these antecedents represented? A likely possibility is that they are elements in a linguistic structure. After all, if, as Nicol (1988) showed, the anaphoric search process can initially make use of grammatical constraints, then it must have a syntactic representation available to it. An

alternative possibility is that the antecedents are represented as tokens in a mental model of the discourse, a model that mirrors the state of affairs in the world described by the discourse (cf. Johnson-Laird, 1983; van Dijk & Kintsch, 1983). Glenberg, Meyer, & Lindem (1987), for example, found evidence in a probe-recognition task that a reader's mental model of a text influences which discourse entities are foregrounded. More to the point, they also found that reading time for a sentence containing a pronoun was faster when the referent was spatially associated with the main character than when it was not. While it is tempting to interpret this latter finding as support for a view that pronouns find their antecedents in a mental model representation, it may be the case that the differences in sentence reading time in the Glenberg et al. (1987) experiment were not due to differences in locating the antecedent as a function of the mental model but to differences in how well the target sentence fit with the preceding text (which unarguably would be influenced by the reader's mental model). Furthermore, the use of a pronoun in these passages was infelicitous, because the antecedent was more than one sentence back and was clearly no longer the topic of the text. So, rather than checking the representation that is usually checked initially when finding a pronoun's antecedent, subjects may have had to check a different sort of representation in order to figure

out what the pronoun referred to. Thus, the experiment does not succeed in ruling out a linguistic representation as the medium in which pronouns find their antecedents.

An experiment by Clifton & Ferreira (1987) found evidence suggesting that a pronoun finds its antecedent in a non-linguistic representation. They compared reading time for the segment containing the word "they" in a sentence like "John and Mary pushed toward the head of the line, but suddenly /they discovered/ that all their money was missing" with reading time for the same segment in a sentence like "John pushed Mary to the head of the line, but suddenly /they discovered/ that all their money was missing." Clifton & Ferreira reasoned that if a reader first examines a syntactic representation in search of the antecedent for a pronoun, then he or she should be slower in the second version of the sentence, where the pronoun ("they") does not refer to a single syntactic constituent of the preceding clause. In fact, they found no difference between the two sentences in a self-paced segment-by-segment reading task, which implies that "a pronoun does not take a surface structure constituent as antecedent, but instead must find its antecedent in a constructed representation, e.g. a discourse representation or a mental model" (Clifton & Ferreira, 1987, p.638). However, as Clifton and Ferreira themselves are quick to point out, the task may not have been sufficiently sensitive to detect a difference. Also,

the pronoun "they" may impose fewer constraints on its antecedents, insofar as it is frequently used to refer to singular entities (cf. Gernsbacher, 1986). So the nature of the representation employed for pronoun interpretation is still not clear.

In an attempt to learn more about that representation, the two experiments conducted here examined how noun phrases are represented in memory during comprehension, looking specifically at the case of conjoined noun phrases (like Clifton & Ferreira, 1987).

The Questions

Are the members of a conjoined noun phrase represented in the mind of the reader as two separate entities (as they could be in a mental model) or as a single unit (as they must be in a linguistic representation)? Linguistically, in a sentence such as "Mary and John left the party," the two participants are represented as together making up a conjoined noun phrase which is the (plural) subject of the sentence. (Figure 1 illustrates the syntactic structure of such a sentence). If the constituents of the conjoined noun phrase are represented this way in the mind of the reader, then a pronominal reference back to just one of them should be difficult compared to a case where the antecedent noun phrase contains just a single member. This is because, in

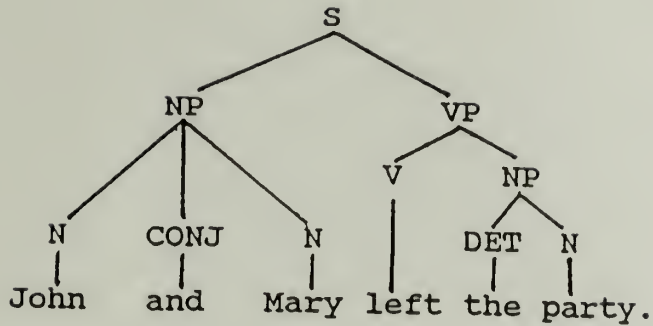


FIGURE 1. The Syntactic Structure of a Sentence Containing a Conjoined Noun Phrase.

the case with the conjoined noun phrase, the process that searches memory to find the antecedent for the (singular) anaphor will at first have available to it only the (plural) conjoined noun phrase, which does not match the anaphor. Only by accessing the constituents of the conjoined noun phrase can the antecedent to the anaphor be found. In contrast, when the antecedent is not a member of a conjoined noun phrase but is a singular noun phrase, there will be no initial mismatch between the number of the anaphor and the number of the antecedent noun phrase.

If, by contrast, a mental model is used to interpret pronouns, there is little reason to expect that unambiguous reference to an entity introduced in a conjoined noun phrase should be any harder to comprehend than reference to an entity making up a singular noun phrase, as long as the two entities are equally prominent in the mental model. An

unambiguous pronoun should be able to pick out the appropriate token in the mental model in a more or less deictic fashion in both cases.

CHAPTER 2

EXPERIMENT ONE (EYETRACKING)

The first experiment measured subjects' eye fixations during reading. Many previous studies have demonstrated that eye movements are affected by various language comprehension processes (see Rayner, Sereno, Morris, Schmauder, & Clifton, in press, for a review and discussion). If it is harder to find the antecedent of a pronoun (and hence takes more comprehension time) when the antecedent is a member of a conjoined noun phrase than when it is not, then the average amount of time readers spend fixating a pronoun and the words immediately following it should be longer when the pronoun's antecedent is part of a conjoined noun phrase than when it is not.

There is reason, however, to expect that the pattern of eye movements may not show any effect of such a subtle manipulation. Recall that Ehrlich & Rayner (1983) observed an increase in fixation times only with their most extreme manipulation, when the antecedent was two sentences back (and no longer the topic of the discourse). Furthermore, the process that instantiates anaphors may continue to operate even as the reader moves past the anaphor, so that any slow-down in its operations will be diluted or obscured by later processing.

Method

Subjects

The subjects were 20 students at the University of Massachusetts. They all had normal uncorrected vision and were native speakers of English. They received either course credit or \$5.00 for their participation in the experiment, which lasted approximately 40 minutes.

Materials

Thirty experimental passages were composed. (The Appendix lists all the experimental passages.) Each passage consisted of varying numbers of introductory sentences, a critical sentence, and a target sentence. Table 1 presents a sample passage from Experiment One.

There were four versions of each passage. In the Separate Noun Phrases condition, the subject of the critical sentence was a singular noun phrase and the other participant was the singular subject of a subordinate clause: "Mary saw John leave the party at twelve o'clock."

In the Conjoined Noun Phrase condition, the subject of the critical sentence was a conjoined noun phrase, as in, "Mary and John left the party at different times." Thus in both versions of the critical sentence the participants were in the same order and were the same number of words from each other and from the end of the sentence. The

TABLE 1

Sample Passage from the Experiments

INTRODUCTORY SENTENCE(S):

After several hours, the party was winding down and guests had started departing.

CRITICAL SENTENCE:

Conjoined NP version:

Mary and John left the party at different times.

Separate NPs version:

Mary saw John leave the party at twelve o'clock.

TARGET SENTENCE:

Pronoun version:

Consequently, she got a ride from a friend of hers.

Name version:

Consequently, Mary got a ride from a friend of hers.

participants were of different genders so that pronominal reference could be unambiguous. (Three of the passages used gender-marked noun phrases instead of names. These will be treated as equivalent to the name conditions.)

The critical sentences in the Conjoined Noun Phrase condition were written to encourage an interpretation in which the two participants would be separate in a mental model representation. This was to obviate the potential criticism that in a sentence such as "Mary and John left the party" the two participants are assumed to have left together and hence would be spatially closer in a mental model than they would be in a sentence such as "Mary saw John leave the party." Hence, most of the sentences with conjoined noun phrases used in the experiment were written so that in their simplest and most plausible interpretation the two participants would not be spatially associated in a reader's mental model. In cases where this was not possible, the sentences were written so that they designated a mental model that was substantially equivalent to the mental model designated by the critical sentence in the Separate Noun Phrases condition.

The target sentence used either a pronoun or a proper name to refer to the participant that was a subject of the main clause in both versions of the critical sentence (always the first participant). For this example, the target sentence was, "Consequently, she/Mary got a ride from

a friend." In fourteen of the target sentences, the name or pronoun was the first word in the sentence, and in sixteen it was preceded by other material (as in this example).

The names were included to control for discourse-level effects. Unlike pronouns, proper names are "rigid designators." Their reference does not depend on the preceding discourse; they always identify the same individual within a discourse, regardless of what the current discourse topic is or how long it has been since the name was last mentioned. Therefore, if the same effect predicted for the pronouns (longer fixation durations when the antecedent is in a conjoined noun phrase) is observed for the proper names, it would suggest that the effect in the pronoun case is not due to difficulty locating the antecedent but to difficulty integrating the two sentences or perhaps to a violation of a pragmatic expectancy that the text will continue to discuss the two people who had been mentioned in the preceding sentence.

The thirty experimental passages were presented along with fifteen filler passages, as well as forty-five single sentences that were part of a different experiment. The filler passages were similar to the experimental passages except that they contained no unusual uses of pronouns or names.

One or two true/false comprehension questions were made up for each passage. The questions were included to encourage careful reading of all the passages.

Design

The design was a two (Conjoined or Separate NPs) X two (target is pronoun or proper name) repeated measures design. Assignment of a given passage to one of the four conditions was counterbalanced across subjects. Each subject read seven experimental passages in two of the four conditions and eight in the other two, as well as the sixty filler items. The order of presentation was randomized for each subject.

Apparatus

Subjects' eye movements were recorded by a Stanford Research Institute Dual Purkinje Eyetracker interfaced to an AT-class personal computer that controlled the experiment. The eyetracker has a resolution of 10 minutes of arc. The horizontal and vertical position of the right eye was sampled every millisecond by the computer, and the existence of a fixation was determined by the occurrence of five successive identical samplings. Subjects were seated 78 cm from a Sony Trinitron 1302 CRT on which the experimental items were displayed. Four-and-a-half characters of text equalled one degree of visual angle. Letters were presented

in lower case except for the first letter of a sentence. Eye movements were recorded from the right eye, and viewing was binocular. The brightness of the screen was adjusted for each subject to a comfortable level and was held constant through the experiment.

Procedure

When a subject arrived for the experiment, a bite bar was prepared which served to eliminate head movements, and the eyetracking system was calibrated for the subject. The subject was instructed to read each passage for comprehension and was told that one or two comprehension questions would follow each item. The subjects were encouraged to read as they normally would. A five-minute practice session familiarized the subject with the procedure and the types of items that would be presented during the experiment. The practice consisted of five passages and eight single sentences. After reading each item, the subject pressed a key which removed the item from the screen. Then the word QUESTION was displayed on the screen for 600 ms, and the question was presented below it. Subjects pressed one of two keys to answer True or False to the questions, and incorrect responses resulted in an error message appearing on the screen for 1500 ms. The entire session lasted approximately 40 minutes.

Results

Each subject's data were processed to remove short fixations standing alone, which are believed to be part of saccades rather than actual fixations, and to merge short fixations adjacent to longer fixations, which are probably due to the eye overshooting its intended fixation position and then moving to the intended position. Fixations shorter than 80 milliseconds in duration and only one character away from the prior or next fixation were merged with that prior or next fixation. Fixations shorter than 40 milliseconds and less than three characters away from the prior or next fixation were deleted. Overall, 7% of the data were lost due to track losses.

Pronouns, being very short words, are rarely fixated. In this experiment, subjects fixated the target pronouns on only 16% of the trials and the target names on 39% of the trials. In those cases where the subject did not fixate the anaphor (pronoun or name) or the space after it directly, encoding of the anaphor was assumed to have occurred on the nearest fixation falling within six characters to the left of the anaphor. This is the same algorithm used by Ehrlich & Rayner (1983) to determine when encoding of the pronouns occurred in their studies, and in the current study it resulted in the scoring of an encoding fixation on 73% of the trials.

The data of primary interest were the durations of the fixation on which the anaphor was encoded and the three fixations following encoding. The mean for each of these fixations in each of the experimental conditions is presented in Table 2. The means for the fixations following encoding include data from trials when no encoding fixation was scored, because the anaphor was presumably encoded either before or during this series of fixations, so the data are relevant even if it is impossible to determine when exactly the anaphor was encoded. As inspection of Table 2 readily shows, there were no differences between the conditions. An analysis of variance confirmed that there were no significant main effects or interactions (all $F_s < 2.1$).

Additional analyses also revealed no significant effects bearing upon the hypothesis. Table 3 shows the average total reading time for two regions of interest. The first is the critical sentence, beginning with the first word of the sentence and extending up to the space before the anaphor in the target sentence. The second region starts with the target anaphor and extends to the end of the target sentence. The pattern of results was different for the two regions, with Type of Antecedent interacting with Region ($F_1[1,19] = 6.29$, $p = .02$; $F_2[1,29] = 14.81$, $p < .001$). The Separate Noun Phrases versions of the critical sentences were read an average of 329 ms more

TABLE 2

Mean Fixation Duration (msec)

<u>Type of Antecedent</u>	<u>Type of Anaphor</u>	<u>Fixation</u>			
		<u>Encoding</u>	<u>1 after</u>	<u>2 after</u>	<u>3 after</u>
Conjoined Noun Phrase	Pronoun	213	229	222	240
	Name	228	220	224	231
Separate Noun Phrases	Pronoun	221	235	237	231
	Name	225	220	227	234

TABLE 3

Total Time (msec) Spent Reading
the Critical and Target Sentences

<u>Type of Antecedent</u>	<u>Type of Anaphor</u>	<u>Critical Sentence</u>	<u>Target Sentence</u>
Conjoined Noun Phrase	Pronoun	2315	1382
	Name	2368	1370
Separate Noun Phrases	Pronoun	2766	1381
	Name	2576	1420

slowly than the Conjoined Noun Phrase versions ($F_{1[1,19]} = 5.91, p < .03; F_2 = 15.52, p < .001$), undoubtedly because they were slightly longer (containing a verb instead of the word "and") and also syntactically more complex. Total reading time for the target sentences did not vary among the conditions (all $F_s < 1$).

Evidence that subjects had difficulty comprehending the target sentences in some conditions might show up as a greater likelihood of regressing to earlier portions of the text. In this experiment, though, the percentage of trials on which a subject looked back from the target sentence to an earlier region of the text was nearly identical in all four conditions, varying only 4% across conditions (with a mean of 39%). In particular, regressions from the target sentence to the critical sentence (which contained the antecedent of the target anaphor) similarly varied by only 3% across the conditions (with a mean of 26%). Hence, the pattern of regressive eye movements provides no evidence that subjects encountered any difficulty in reading sentences containing a pronoun whose antecedent was a member of a conjoined noun phrase.

Discussion

The results of Experiment 1 provide no support for the hypothesis that the time needed to comprehend a pronoun is

longer when the pronoun's antecedent is a member of a conjoined noun phrase. However, given the cautions raised in the introduction to the experiment, it is not too surprising that the experiment showed no effects. After all, the effect on reading time should be a very small one, since in all conditions the antecedent was presumably still in short-term memory, having just been encountered in the sentence preceding the anaphor.

An additional factor that may have reduced the chances of observing the predicted effect is that when the eye moves from the end of one line of text to the start of the next line, there is often a brief fixation (100 to 150 ms) several characters into the next line before a fixation close to the left margin begins an orderly succession of fixations across the line. In cases where the target anaphor fell close to the left margin, some of these brief fixations were scored as encoding fixations (according to the criteria described in the Results section), even though it is not known whether the reader is taking in linguistic information or merely realizing that the eye has not landed close enough to the beginning of the line. (In eleven of the experimental passages the anaphor began 10-15 character spaces from the left margin, and in two it began on the 7th character space.) Although the occurrence and duration of these short fixations should not be influenced by the experimental manipulation (since the position of the target

anaphor was constant across the different versions of a passage), their presence undoubtedly increased the variance of the fixation data, making it less likely to observe the predicted effect.

CHAPTER 3

EXPERIMENT TWO (PROBE RECOGNITION)

The second experiment provided a more direct test of the hypothesis that the discourse representation used in pronoun comprehension is a linguistic one. If the two members of a conjoined noun phrase are indeed represented as a linguistic unit, then referring to one of them should affect the activation level in memory of the other one. If the two constituent noun phrases are NOT joined together in the representation used to interpret pronouns, then there is little reason to expect that referring to one of them with a pronoun should influence the activation level in memory of the other one. The second experiment used a probe-recognition task to measure the activation level of the non-antecedent member of a conjoined noun phrase following a pronoun referring back to the antecedent member.

The logic of the experiment, which used the same experimental passages as the first experiment, is as follows: Presenting a probe of the non-antecedent immediately prior to the anaphor (pronoun or name) in the target sentence provides a baseline measure of the non-antecedent's availability in memory following each version of the critical sentence. In order to assess what effect the anaphor in the target sentence has on the availability of the non-antecedent, the non-antecedent is probed following the anaphor, and reaction time at this point is

compared to the baseline reaction time. The prediction is that the non-antecedent will be more active, relative to the baseline measure, in the Conjoined Noun Phrase condition than in the Separate Noun Phrases condition. Either of two mechanisms could be responsible for the predicted effect: going into the conjoined noun phrase unit to access the antecedent member could by itself boost the activation level of the non-antecedent member, or residual activation of the conjoined noun phrase unit due to accessing the antecedent member could speed access to the non-antecedent member. For present purposes, it is irrelevant which mechanism is actually responsible, since both depend on the assumption that access to the constituents of the conjoined noun phrase is mediated by the conjoined noun phrase unit.

As discussed earlier, proper names designate their referents independently of the immediately preceding text, so no difference is predicted between the Conjoined Noun Phrase and the Separate Noun Phrases conditions for the proper names.

Method

Subjects

The subjects were 30 students at the University of Massachusetts at Amherst. An additional 14 subjects were run in the experiment but not used in the data analysis

because they failed to meet the criteria set out in the Results section. All subjects were native English speakers and naive as to the purposes of the experiment. Subjects received course credit or \$5.00 for their participation in the experiment, which lasted approximately 50 minutes.

Materials

The 30 experimental passages were identical to those used in Experiment One. The probe word (always the name of the non-antecedent) could appear either immediately before the name or pronoun in the target sentence or immediately after.

Sixty filler passages were also composed. Of these, fifty contained probes and ten did not. Of the filler passages that contained probes, twenty probed a name that had not occurred in the passage (false name probes), twenty probed a non-name word that had occurred in the passage (true non-name probes), and ten probed a non-name word that had not occurred in the passage (false non-name probes). Probes in the distractor passages appeared at various positions in different passages so that subjects would not be able to anticipate the occurrence of a probe. (No subject reported being able to predict when a probe would occur.) There was never more than one probe in a passage.

One or two true/false comprehension questions were made up for each passage. The correct response was True for 49%

of the questions and False for the other 51%. The questions were included to encourage attentive reading of all the passages.

Design

The design was a two (Conjoined Noun Phrase or Separate Noun Phrases) X three (probe comes before anaphor in target sentence, after pronoun, or after proper name) repeated measures design. Six test lists were prepared, so that each subject read five experimental passages in each of the six conditions as well as all sixty distractor passages. Across test lists each passage appeared once in each of the six experimental conditions. A given subject read only one version of any particular passage. The order of presentation within a test list was randomized for every subject.

Procedure

A practice session lasting approximately ten minutes familiarized the subject with the procedure and gave him or her practice at making quick responses to probe items. The practice session consisted of, in this order: (1) two long passages without probes but with questions, to familiarize the subject with the manner in which the passages were displayed; (2) six sentences containing probes but not followed by questions, in order to give the subject practice

at responding to the probes; and (3) fourteen passages, with and without probes and followed by questions, to provide an example of what the experiment itself would be like. The instructions emphasized accuracy on the comprehension questions and quick and accurate responses to probe words.

The subject initiated presentation of each passage on a CRT screen by pressing the thumb button on the response console. Following the thumb press, a fixation mark appeared for 500 ms on the screen to indicate where the first word of the passage would appear. Then the first sentence of the passage was displayed, with dashes instead of letters. The first set of dashes changed into the first word, then disappeared, and the second set of dashes changed to a word, and so on through the sentence. Each word was displayed for 180 ms plus 17 ms per character. Hence, a five-letter word was presented for 265 ms, very slightly slower than average reading speed, which, at 250 words per minute, would be 240 ms per five-letter word. After the last word of a sentence disappeared, the screen was blank for 660 ms before the dashes for the next sentence were displayed, in order to allow the subject to complete processing of the previous sentence. The next sentence was displayed in the position it would have if it were on a page of text. (See Figure 2 for an example of the display sequence.)

The example text:

Bill ran home. He was
late.

<u>Display</u>	<u>Duration</u>
==>	(500 ms)
Bill --- ----.	(248 ms)
ran ----.	(231 ms)
home.	(248 ms)
	(660 ms)
-----, He ---	(214 ms)
-----, was	(231 ms)
late.	(248 ms)

FIGURE 2. An Example of the Display Sequence in Experiment 2.

Probes were presented in red and in all capital letters, two spaces to the right of the previous word (i.e., where the next word of text would normally appear). While the probe was displayed the rest of the screen was blank. The subject pulled the right-hand trigger if the probe word had appeared anywhere in the passage. If the word had not appeared in the passage, the subject pulled the left trigger. If the subject responded incorrectly to a probe, the word ERROR was displayed for one second. If the subject was correct but took more than 900 ms to respond, the message TOO SLOW!! was displayed for one second. This deadline procedure was used to encourage fast, relatively automatic responding that would reflect the activation level of concepts in memory rather than response strategies adopted by the subject. After the subject had responded to the probe, the passage continued in the same manner as before.

After the last word of the passage, the word QUESTION was displayed along with a comprehension question. The subject pulled the right-hand trigger if the statement presented was true, and pulled the left-hand trigger if the statement was false. If the subject made a mistake, the word ERROR was displayed on the screen for one second. Subjects were instructed to be as accurate as possible in answering the comprehension questions and to take as much time as they needed. Passages containing probes were

followed by a single comprehension question, those containing no probes were followed by two questions.

A microcomputer controlled presentation of the stimuli and also recorded the subject's responses and reaction times to the probes and the comprehension questions.

Results

Only data from the 30 subjects who were at least 80% correct both on the experimental probes and on the comprehension questions and who had a mean response time under the 900 ms deadline in every experimental condition were used in the analysis. These criteria eliminated data from 14 subjects: four subjects did not meet the criterion for accuracy on the experimental probes, five did not meet the criterion for the comprehension questions, and five responded too slowly. Responses exceeding 1500 ms (less than 2% of the data) were eliminated from the analysis. The statistical analyses were based on the mean correct response time for each subject in each condition. All analyses of variance were conducted with subjects as a random effects variable (F1, "subjects analysis") and also with items as a random effects variable (F2, "items analysis").

Name conditions

The name conditions and the pronoun conditions were analysed separately. The mean response times for the name conditions are shown in Table 4. An analysis of variance with factors of Probe Position and Type of Noun Phrase revealed no significant effects (all $F_s < 1.6$). The occurrence of a name had no effect on the activation level of the non-antecedent, regardless of whether or not it had occurred in a conjoined noun phrase. This is in sharp contrast to the findings of Gernsbacher (1989) reported in the Introduction. She found that response time to a non-antecedent is inhibited after the occurrence of a name. Gernsbacher (personal communication) suggested that the response times to the pre-anaphor probes in the present study may be inflated in the items where the anaphor is the first word of the target sentence, because the subject may still be processing the preceding sentence. (Remember that for these items, the pre-anaphor probe occurs between the end of the critical sentence and the start of the target sentence.) If Gernsbacher's suggestion is right, then the slow times for these items in the pre-anaphor conditions would mask any inhibition of the non-antecedent following the target name. To test this suggestion, separate analyses were run on the 14 items in which the target anaphor was the first word of the target sentence ("Target Initial" items)

TABLE 4

Mean Response Time (msec) to Probe
Words in the Name Conditions

<u>Type of Antecedent</u>	<u>Before Anaphor</u>	<u>After Name</u>
Conjoined Noun Phrase	670	662
Separate Noun Phrases	666	649

and on the 16 items in which the target anaphor was not the first word of the sentence ("Target Non-Initial" items).

The data for the name conditions of the Target Initial items and the Target Non-Initial items are displayed in Table 5. An overall analysis of variance with factors of Type of Item (Target Initial or Non-Initial), Type of Antecedent (Conjoined or Separate), and Probe Position confirmed what is clear from the table, namely that the pattern of results differed across the two sets of items. The analysis revealed marginally significant interactions between Type of Item and Probe Position ($F_{1[1,29]} = 5.46$, $p < .03$; $F_{2[1,28]} = 2.78$, $p < .11$) and between Type of Item and Type of Antecedent ($F_1 = 3.95$, $p < .06$; $F_{2[1,28]} < 1$). There were no other significant main effects or interactions (all $F_s < 2.1$).

For the Target Initial items, there was a main effect of probe position ($F_{1[1,29]} = 6.70$, $p < .02$; $F_{2[1,13]} = 4.05$, $p < .07$): probes coming before the name were an average of 38 ms slower than probes coming after. No other effects reached significance (all $F_s < 1$).

For the Target Non-Initial items, by contrast, there was no effect of probe position ($F_s < 1$): the occurrence of the name did not have an inhibiting or facilitating effect on the non-antecedent. Although it appears from the table that the occurrence of a name had different effects on response times to the probe depending on the type of

TABLE 5

Mean Response Time (msec) to Probe Words
in Target Initial and Target Non-Initial Items
in the Name Conditions

TARGET INITIAL ITEMS

<u>Type of Antecedent</u>	<u>Before Anaphor</u>	<u>After Name</u>
Conjoined Noun Phrase	691	637
Separate Noun Phrases	686	655

TARGET NON-INITIAL ITEMS

<u>Type of Antecedent</u>	<u>Before Anaphor</u>	<u>After Name</u>
Conjoined Noun Phrase	659	683
Separate Noun Phrases	650	637

antecedent, this interaction did not reach significance ($F_s < 1.73$). Rather, there was a main effect of Type of Antecedent, which was significant in the subjects analysis ($F1[1,29] = 11.74, p < .005$) but not in the items analysis ($F2[1,15] = 2.05, p < .18$). Thus, probes in the Conjoined Noun Phrase condition were responded to more slowly than probes in the Separate Noun Phrases condition, but there was no evidence that the occurrence of a name lowered the activation level in memory of other discourse participants.

Pronoun conditions

The results for the pronoun conditions are presented in Table 6. The pattern of the data was consistent with the predictions: there was more facilitation of the non-antecedent in the Conjoined Noun Phrase condition (42 ms) than in the Separate Noun Phrases condition (13 ms). An analysis of variance, however, provided only limited statistical support for this conclusion. It indicated no main effect of Type of Noun Phrase ($F_s < 1.3$), a marginally significant effect of Probe Position ($F1[1,29] = 3.62, p < .07$; $F2[1,29] = 3.55, p < .07$), and some evidence in the items analysis for an interaction ($F2[1,29] = 4.40, p < .05$; $F1[1,29] = 1.81, p < .19$). Because the evidence for the predicted interaction was equivocal (not significant by subjects but significant by items), two simple effects t -tests were computed to give a clearer picture of the data.

TABLE 6

Mean Response Time (msec) to Probe
Words in the Pronoun Conditions

<u>Type of Antecedent</u>	<u>Before Anaphor</u>	<u>After Pronoun</u>
Conjoined Noun Phrase	670	628
Separate Noun Phrases	666	653

In the Conjoined Noun Phrase condition, response times were reliably faster after the pronoun than before ($t[1,29] = 2.53$, $p < .02$, with a 95% confidence interval ranging from 8 ms faster to 76 ms faster), but this was not the case in the Separate Noun Phrases condition ($t[1,29] < 1$).

As with the name conditions, the data for the Target Initial items and the Target Non-Initial items were also analyzed separately. These data are presented in Table 7. An overall analysis of variance with factors of Type of Item, Type of Antecedent, and Probe Position confirmed that the pattern of results differed across the two sets of items. The analysis revealed a significant interaction between Type of Item and Probe Position ($F_1[1,29] = 4.34$, $p < .05$; $F_2[1,28] = 4.22$, $p < .05$) and a marginally significant interaction between Probe Position and Type of Antecedent ($F_1 = 2.71$, $p = .11$; $F_2[1,28] = 4.22$, $p < .06$). This latter interaction was not qualified by a further interaction with Type of Item ($F_s < 1.06$).

For the Target Initial items, the only significant effect was that responses were slower when the probe came before the pronoun than when it came afterward ($F_1[1,29] = 15.38$, $p < .001$; $F_2[1,29] = 18.83$, $p < .002$). The interaction of Type of Antecedent and Probe Position was not significant ($F_s < 1$), although the pattern of means was

TABLE 7

Mean Response Time (msec) to Probe Words
in Target Initial and Target Non-Initial Items
in the Pronoun Conditions

TARGET INITIAL ITEMS

Type of <u>Antecedent</u>	Before <u>Anaphor</u>	After <u>Pronoun</u>
Conjoined Noun Phrase	691	626
Separate Noun Phrases	686	646

TARGET NON-INITIAL ITEMS

Type of <u>Antecedent</u>	Before <u>Anaphor</u>	After <u>Pronoun</u>
Conjoined Noun Phrase	659	623
Separate Noun Phrases	650	663

consistent with the prediction of greater facilitation in the Conjoined Noun Phrase condition.

The data looked quite different for the Target Non-Initial items. Firstly, there was no effect of Probe Position ($F_s < 1$). Secondly, the predicted interaction of Type of Antecedent and Probe Position was nearer to significance in the subjects analysis ($F_1[1,29] = 2.73$, $p < .11$; $F_2[1,29] = 4.07$, $p < .06$). There were no other significant effects (all $F_s < 1$). A comparison of response times following the pronoun showed a marginally significant effect of Type of Antecedent: responses were faster in the Conjoined Noun Phrase condition (623 ms) than in the Separate Noun Phrases condition (663 ms) ($t[1,29] = 1.67$, $p < .11$, with the 95% confidence interval extending from 9 ms slower to 89 ms faster).

Discussion

In contrast to Experiment 1, Experiment 2 provided some support for the hypothesis that the members of a conjoined noun phrase are represented together as a unit even when they are semantically separate. Although the statistical support for this conclusion was not as robust as could be hoped for, the pattern of means was clearly consistent with the predictions derived from the hypothesis. Furthermore, when the Target Initial items were excluded from the

analysis, the predicted interaction became statistically stronger, despite being based on approximately half as many items as in the complete analysis. Hence, it seems likely that the effect is a real one for which an identical experiment employing only Target Non-Initial items would easily find evidence. The fact that the names showed a completely different pattern than the pronouns means that the pronoun data can be safely taken not to reflect discourse-level processes (which would also apply to the names) but rather to reflect local pronoun-instantiation processes.

CHAPTER 4

GENERAL DISCUSSION

Overall, the results from the two experiments were more tantalizing than satisfying. Experiment 1 showed no effects whatsoever, and Experiment 2 lacked sufficient power to provide strong statistical support for the results, although their pattern was consistent with the predictions.

Assuming that the pattern of results in Experiment 2 represents a real effect, the following conclusions at least can be drawn. First, the processes used to understand a name are not identical to those used to understand a pronoun. This follows from the fact that the names and pronouns had different effects on the activation level of non-antecedents. A second conclusion that can be drawn is that the pronoun comprehension process makes use of a representation that preserves at least some of the syntactic relations present in the input sentence. This follows from the finding that the effect the occurrence of a pronoun had on the activation level of a non-antecedent differed as a function of the syntactic relationship between the antecedent and the non-antecedent. The results suggested that, following a pronoun, the non-antecedent was more activated when it had been part of the same noun phrase as the antecedent than when it had been in a separate noun phrase.

These conclusions, taken together with the findings of previous research summarized in the Introduction, suggest a tentative sketch of how the referents of names and pronouns are determined. Because in the present studies response time following a name was unaffected by the syntax of the clause containing a previous mention of the name, it seems fair to conclude that names do not access their referents via a syntactic representation. Rather, they locate their referents in a semantic or mental-model representation of the discourse. Hence, the syntax of the preceding text should not affect the speed with which the referent of a name is determined, but factors that influence the semantic representation or the discourse or the activation level of concepts in long-term memory (such as recency of mention) should affect the ease with which the referent of a name can be located.

The results of the second experiment suggest that pronoun instantiation, unlike name comprehension, makes use initially of a syntactic representation of the preceding sentence. The process might go as follows. When the reader encounters a pronoun, he or she initiates a top-down search through a parse-tree of the preceding sentence, looking for noun phrases that match the number and gender of the pronoun and do not violate any syntactic constraints imposed by the pronoun (Nicol, 1988). If no matching noun phrase is found, than any noun phrase that does not mismatch the gender of

the pronoun (e.g., a plural noun phrase in English, which is not gender marked) is examined further. So, if the noun phrase is a conjoined one, its members are examined to see if any of them matches the pronoun. This second step of the search process, required when no matching antecedent is found initially, may be so quick that it has no detectable effect on subject's eye movements during reading, which would explain the failure to find any such effect in Experiment 1. While this second step may be quick, it should nonetheless have an effect on the activation levels of the members of the conjoined noun phrase, an effect that should be detectable in a task such as the probe recognition task of Experiment 2, which is sensitive to the activation level of concepts in memory. If no noun phrase in the parse tree of the preceding sentence matches the pronoun, then the search may switch to a more semantic type of representation, such as a mental model. This would explain the Glenberg et al. (1987) finding that a reader's mental model influences the time needed to comprehend a sentence containing a pronoun that refers to an entity more than one sentence back in the text.

A recent set of studies by Cloitre & Bever (1988) challenges the view presented here that the comprehension of pronouns depends on accessing the linguistic form of an antecedent while the comprehension of noun phrases does not. The materials they used were discourses consisting of two

sentences, and an example is presented in Table 8. The subject noun of the first sentence of the discourse was modified by an adjective, which was either concrete (referring to a physical attribute of the noun's referent, e.g., "gangly") or abstract (referring to a non-physical attribute, e.g., "proud"). The second sentence of the discourse ended either with a repetition of the noun that had been the subject of the first sentence or with a pronoun whose antecedent was the noun. In a control condition, the second sentence did not contain a reference to any character in the first sentence. Immediately after reading or hearing the discourse, the subjects responded to a probe of the modifying adjective. Response time to this probe was taken to reflect the activation level of the antecedent.

The results, averaged over the visual and auditory presentation modes, are summarized in Table 9. The nouns and pronouns produced faster response times than the control condition, indicating that they had accessed the antecedent. The pronouns resulted in faster times than the repeated nouns. Cloitre & Bever interpreted this finding as evidence that pronouns provide access to their referents more quickly than do noun phrases. Other interpretations are possible, however. For instance, the slower times following the nouns may have been due to the awkwardness of repeating a noun when its referent is still the topic of the discourse. A pronoun would be more felicitous in such cases, and the

TABLE 8

Sample Materials from Cloitre & Bever (1988)

PASSAGE WITH CONCRETE ADJECTIVE:

The stocky gigolo visited the baroness every week.

A detective had been hired to spy on him.

A detective had been hired to spy on the gigolo.

A detective had secured incriminating evidence.

PASSAGE WITH ABSTRACT ADJECTIVE:

The proud king handed down the crown to the somber princess.

It was an occasion of great satisfaction for him.

It was an occasion of great satisfaction for the king.

It was an occasion celebrated throughout the land.

TABLE 9

Summary of Cloitre & Bever (1988) Results:
Response Time (msec) to Probe Words

<u>Type of Passage</u>	<u>Adjective</u>		<u>Mean</u>	<u>A - C Difference</u>
	<u>Concrete</u>	<u>Abstract</u>		
Control	1184	1225	1205	41
Noun	1112	1136	1124	24
Pronoun	1014	1107	1061	93

pronoun condition resulted in the fastest times. More to the point, Cloitre & Bever assumed that a difference in response time to probes of concrete and abstract adjectives indicates that a "conceptual" representation, as opposed to a "surface" or linguistic representation, has been accessed. Consequently, because the concrete/abstract difference was greater following pronouns than nouns in their study, they concluded that pronouns give immediate access to a conceptual representation of their antecedents while nouns do not. However, the awkwardness of repeating the noun in the second sentence may have caused the subjects to pay more attention to the linguistic form of the first sentence, thereby attenuating the concrete/abstract difference in the noun condition.

A second experiment reported by Cloitre & Bever (1988) poses problems for this explanation, however. They used the same materials as the experiment just described, but the subjects' task was to make a lexical decision to the adjective rather than a recognition judgement. The assumption was that the lexical decision task is not as sensitive to conceptual information as a task such as probe recognition. Under these circumstances there was in fact no effect of the concreteness of the adjective, and responses following the nouns were significantly faster than responses following the pronouns (829 ms versus 854 ms; the control condition was 889 ms). Furthermore, correct "no" judgements

to non-words that were similar to the adjectives (e.g., "kangly") were inhibited following nouns but not pronouns. Cloitre & Bever took these findings as evidence that nouns access a surface representation of discourse, priming the orthographic/phonetic form of the adjective. If the account proposed earlier to account for Cloitre & Bever's probe recognition data is true, then similar results would be predicted for the lexical decision data. However, interpretation of the results depends crucially on the assumption that the subjects read the passages the same way in the lexical decision study as in the probe study. With such a different task, it quite possible and even likely that subjects adopted a rather different approach to encoding the passages, thus rendering the critical cross-experiment comparisons meaningless. A further point about both experiments is that the concreteness of the adjective was manipulated between, rather than within, items, so some of the effects may be due to differences between the items.

So, while neither the Cloitre & Bever (1988) findings nor the results presented here are conclusive, taken together they point out that there is still much research to be done to elucidate the process by which pronouns meet up with their antecedent nouns and to characterize the medium in which they do so. The present research offers some evidence that the process is a search and that the medium is a linguistic one.

APPENDIX

List of Materials

After several hours, the party was winding down and guests had started departing.

Mary and John left the party at different times.

Mary saw John leave the party at twelve o'clock.

Consequently, she/Mary got a ride from a friend of hers.

01

Lately, everyone at the office has been talking about their plans for the summer. Nathan is taking his family to Yellowstone National Park.

Jim and Beth are planning vacations abroad.

Jim heard Beth is planning a vacation abroad.

He/Jim hopes to make it to France.

02

Kate and Tony visited the art museum on the same day.

Kate thought Tony visited the art museum last weekend.

From the newspaper, she/Kate had learned there was a Picasso exhibit.

03

Having lived in an apartment for many, many years, Paul really wanted to get into a house of his own. In fact, he wanted to build it himself. His friend Jane also wanted to build her own house. The two of them got lucky and were able to buy two plots of land on the Connecticut River.

Paul and Jane built houses on opposite sides of the river.

Paul helped Jane build a house on the western side of the river.

The amount of work involved surprised him/Paul greatly, since such a large project had never been undertaken by him before.

04

Things were very busy at the corner diner.

By coincidence, Kim and Gary came into the diner at the same time.

By coincidence, Kim noticed Gary come into the diner at about noon.

At the counter, she/Kim ordered a cup of black coffee.

05

Bill and Meg live in beautiful brick houses.

Bill knows Meg lives in a beautiful brick house.

He/Bill is a real estate agent for a large company.

06

Ellen thinks the accountant who shares an office with her at work has poor taste in TV shows. She is always making

fun of the shows he watches and telling him to watch educational shows like she does.
Ellen heard the accountant happened to watch a public television show last night.
Ellen and the accountant happened to watch a public television show last night.
It was one she/Ellen watches at every possible opportunity.
07

The snow had been falling for hours, creating a real mess outside.

Greg and Lori came in from the blizzard through different doors.

Greg heard Lori come in from the blizzard through the back door.

Immediately, he/Gary put on some water for tea.
08

It was a typical busy Saturday morning for David and Pam. There were so many things to take care of.
David and Pam took both cars to run errands.
David discovered Pam took the car to run errands.
He/David needed to get some milk at the grocery store.
09

Judy and her son Tom had been camping on the mountain for a week. They hiked everywhere together every day.
For a change, Judy and Tom hiked on separate trails today.
For a change, Judy let Tom hike on a separate trail today.
At around noon, she/Judy ate lunch alone and watched a deer.
10

Due to a scandal, Dynamic Electronics had been forced to sell its subsidiary, Computer Chips Unlimited. At the investment firm of Merrill Lynch, brokers were hastily analyzing the strengths of Dynamic Electronics to determine whether it was still a good investment.

Simon and Elaine prepared independent reports on the company.

Simon believed Elaine prepared an independent report on the company.

He/Simon was Chief of the Analysis Division.
11

On a breezy Saturday afternoon, Joan headed downtown with her friend Mike to attend a No Nukes rally. More and more people showed up, though, and they got split up.
By the time the protest got under way, Joan and Mike were standing very far apart in the big crowd.
By the time the protest got under way, Joan saw Mike was standing very far away in the big crowd.

After the first speech, she/Joan applauded vigorously, as did the rest of the crowd.

12

In law school, Sandra had gone out with Max, but they split up during their last year. She started going out with someone else, and they never spoke after that. They have each gone their own way.

Ironically, Max and Sandra work at rival law firms in Boston.

Ironically, Max discovered Sandra works at a rival law firm in Boston.

He/Max is a partner at Smith, Sedgwick, & Burns.

13

Carol and Mark are living apart these days.

Carol remembered Mark is living far away these days.

She/Carol is very lonely and depressed.

14

Steve and Tanya threw holiday parties on the same day last week.

Steve helped Tanya throw a holiday party on Sunday last week.

As usual, he/Steve had a marvellously good time.

15

Outside the castle, a big green dragon was frightening the peasants.

The witch and the king had differing opinions of the dragon.

The witch thought the king had a bad opinion of the dragon.

She/the witch believed it was harmless and would go away.

16

The annual party given by the Duke and Duchess was in full swing. The ancient castle, which had been in the family for centuries, was alive with activity. In the kitchen, the cooks were whipping up tray after tray of delicious tidbits.

In the front room, the butler and the maid were flirting with the guests.

In the front room, the butler watched the maid flirting with the guests.

For once, he/the butler was enjoying himself at one of these parties.

17

Every day, Lucy and Alex talked on the telephone.
 Every day, Lucy saw Alex talk on the telephone.
 But at the end of the month she/Lucy was still surprised by
 the big bill.
 18

Andre and Yvette are chefs at competing French restaurants
 downtown.
 Andre knows Yvette is a chef at a competing French
 restaurant downtown.
 He/Andre despises all other chefs, even if they are good.
 19

Although Anna and Russ were both English professors
 studying late Victorian literature, they had never met,
 even at conferences.
 Anna and Russ frequently wrote articles on the standard
 topics.
 Anna learned Russ frequently wrote articles on the standard
 topics.
 She/Anna preferred to use unusual methods of analysis.
 20

Breaking up is hard to do, as everyone knows.
 Ted and Liz said good-bye over the phone.
 Ted heard Liz say good-bye over the phone.
 He/Ted couldn't believe it.
 It was completely unexpected.
 21

Tonight was the night for the big pot-luck dinner at Dianne
 and Nancy's house. Once a year, they threw a big bash and
 invited all their single friends. Everyone brought
 something delicious to eat.
 Sally and Joel were bringing cakes.
 Sally forgot Joel was bringing a cake.
 She/Sally brought a chocolate one with fudge frosting.
 22

Failing to agree on the best route, Jeff and Rita travelled
 to Seattle by different routes.
 Failing to agree on the best route, Jeff let Rita travel to
 Seattle by a different route.
 As luck would have it, he/Jeff got there first by several
 hours.
 23

A record album was being made to raise funds for Oxfam
 activities around the world.
 Madonna and Bruce Springsteen were among those contributing
 new songs.
 Madonna heard Bruce Springsteen

was among those contributing new songs.
She/Madonna thought the album would raise lots of money.
24

Donald and Brenda drove to the restaurant separately.
Donald insisted Brenda drive to the restaurant separately.
He/Donald hated having to pick people up.
25

Alice and Ned were both being honored by their employer, Acme Industries, Incorporated, for a new procedure they had invented. It had already saved the company close to a million dollars in the seven months since it had first been used.

Alice and Ned had come up with the idea independently.
Alice realized Ned had come up with the idea independently.
Even so, she/Alice didn't like sharing the honors.
26

Over lunch, people were talking about the different ways they travel to their jobs.

Robert and Sue commute by bicycle every day.
Robert said Sue commutes by bicycle every day.
He/Robert claimed it was very good exercise.
27

Christie's was auctioning an extremely valuable diamond that had once belonged to Napoleon.

Maria in New York and Ken in Tokyo had sent in sealed bids.
Maria in New York suspected Ken in Tokyo had sent in a sealed bid.

Hopefully, she/Maria would not be outbid by him or anyone else.
28

Keith was from a small town in Iowa, and Helen grew up in Manhattan. They had both entered the prestigious van Cliburn piano competition in Dallas and were expected to do very well. The contestants who made it to the final round would have to play Tchaikovsky's first piano concerto with an orchestra.

Keith and Helen practiced for hours every day.
Keith assumed Helen practiced for hours every day.
As the competition drew near, he/Keith practiced more and more, staying up later and later each night.
29

Frank had lived next door to Cheryl since first grade. Now, though, she was moving to a different state and he wouldn't be able to see her very often.
Frank and Cheryl promised to keep in touch by telephone.

Frank made Cheryl promise to keep in touch by telephone.
Writing letters was something he/Frank hated to do,
although his mother tried to make him do it.

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