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# Linguistic Anaphors, Levels of Representation, and Discourse

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Four studies contrast the processing of anaphor resolution for two types of anaphors: pronouns and repeated nouns. The studies suggest that in short discourses anaphor resolution occurs more rapidly for pronouns than repeated nouns. In particular, pronouns provide direct access to a conceptual representation of the antecedent, whereas repeated noun anaphors do so indirectly, priming a surface (lexical) level of representation as a preliminary to accessing the conceptual representation. In each study, subjects were presented with an antecedent-related probe (a modifying adjective) following two sentence discourses ending in a pronoun or repeated noun. Subjects were required to make one of three kinds of judgements about the probe word: recognition, category decision, or lexical decision. Facilitation in the category and lexical decisions was compared to indicate the relative salience of either conceptual or surface information about the antecedent probe. Results showed stronger facilitation in the category task following the pronoun. In contrast, facilitation in the lexical decision task occurred only following the noun-anaphor. In the recognition study, response times to the probe words were faster following the pronoun and showed a greater facilitation for concrete than for abstract probes. The concreteness effect for the pronoun condition is taken as additional support for the notion that pronouns provided greater immediate sensitivity to the conceptual aspects of the antecedent. When the probe word was presented at a 250-msec delay, responses following the noun-anaphor also showed a greater facilitation to the concrete probes. This finding indicates that the noun-anaphor ultimately shows sensitivity to the conceptual information of the antecedent.

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## INTRODUCTION

An anaphor accesses a referent established elsewhere in the text and integrates it with current information. Anaphors such as pronouns and repeated nouns play a crucial role in language structure; they facilitate complex organization with specific discourses (Garrod & Sanford, 1977; Haviland & Clark, 1974) and provide cohesion within informationally complex discourses (Garnham, 1986; Halliday & Hasan, 1976; Kintsch, 1974). Pronouns and nouns used as anaphors comprise most of the anaphors in English; accordingly, an important question is how the anaphoric process may differ for the two kinds of anaphor.

Tanenhaus, Carlson, and Seidenberg (1985) refer to the distinction between surface and conceptual representations of linguistic information. They suggest that an anaphor may initially provide access to the antecedent representation at a surface level and determine the conceptual content via the surface level; alternatively, the anaphor may provide access to the conceptual aspects of the antecedent representation directly. The following studies investigate the relative accessibility of these two different levels of information for pronouns and noun-anaphors.

Our use of the distinction between surface and conceptual aspects of linguistic information refers to the way linguistic information is interpreted and stored in memory. We differentiate two levels of representation that are assigned to linguistic information as it is understood. At the level of *surface representation*, a lexical analysis distinguishes the words and their lexical representation. The lexical representation refers to the basic physical characteristics of a word such as its orthographic or phonetic organisation. At the ultimate level, a *conceptual representation* organises the psychological meaning of a word, phrase, or sentence, including knowledge about such non-linguistic entities as prototypes and images.

Many experimental studies have found differential recall and recognition abilities for surface and conceptual aspects of linguistic information. A consistent finding in cognitive psychology has been that memory for the surface properties of sentences is much poorer than "gist" or meaning memory (Anderson, 1974; Begg & Wickelgren, 1974; Olson & Filby, 1972; Sachs, 1967, 1974) and it has generally been concluded that speech or prose is attended to for word content with the word being discarded (Clark & Clark, 1977).

Despite the evidence that memory for the surface properties of linguistic information is poor, there have been a few studies in which verbatim memory has been shown to excel (Bates, Masling, & Kintsch, 1978; Keenan, Macwhinney, & Mayhew, 1977; Kintsch & Bates, 1977). Bates et al. (1978), for example, show that subjects have good verbatim memory for the particular word used to describe an individual under discussion (e.g.

"the baby"). The apparent discrepancy between these two sets of results is resolved when we observe that the studies focussed on different kinds of linguistic information. While the early studies show that memory for the exact form and syntactic organisation of sentential information is poor, the latter studies show excellent recall of lexical information specific to the referent or focus of discourse. That is, while subjects do not recall long word sequences or syntactic relationships, they remember the particular lexical labels associated with the objects or individuals being discussed.

Memory for the exact "expression" designating individuals in a discourse may facilitate the organisation of the interactions among the discourse referents and organise the overall semantic content of the discourse (e.g. Kintsch, 1974). Garrod and Sanford (1977), Anderson and Hastie (1974), and Walker (1980) have more specifically suggested that the reader's major task in discourse comprehension is to ensure that all information is connected and stored with its proper referents, with the referent information being "labelled" with the names of the individual objects and people in the text.

The empirical evidence and theoretical plausibility for the retention of surface as well as conceptual information of discourse referents raises the question of how these two kinds of information are assessed during anaphoric processing. In the following studies, we will compare the processing of antecedent information following pronouns and repeated noun-anaphors. A few studies have compared the effects of specific kinds of anaphor in discourse comprehension—they have either shown no effect (Clark & Sengul, 1977; Clifton & Ferreira, in press; Marslen-Wilson & Tyler, 1980) or a processing advantage for the use of a repeated noun compared with a pronoun (Chang, 1980). These results have led to speculation that the processing of pronouns and nouns differs primarily because of the amount of independent information they contribute to interpreting the discourse. Chang (1980) suggests that the noun-anaphor advantage he found is due to the fact that the noun-anaphor reinstates not only a "meaning code" but an additional "surface code", which facilitates the recognition of the antecedent.

Yet some work has shown that unambiguous pronouns can access their antecedents extremely rapidly (e.g. Stevenson, 1986); in fact, when there is no shift in discourse centre, sentences with pronouns are read faster than sentences with repeated proper nouns (Hudson, Tanenhaus, & Dell, 1986). The following research shows further that pronouns can access their antecedents more rapidly than repeated noun-anaphors. This advantage may derive in large part from the different ways in which antecedent information of different kinds is accessed by each type of anaphor. Specifically, our data suggest that pronouns access the conceptual representation of their antecedent directly, whereas noun-anaphors initially prime a

surface form of representation as a preliminary to accessing the conceptual information.

These findings are consistent with the discourse function of pronouns. When a pronoun is used to refer to discourse entities that have already been introduced by other expressions, the pronoun functions primarily to maintain a previous referent (Garrod & Sanford, 1982, 1985; Marslen-Wilson, Levy, & Tyler, 1981). This may occur when the pronouns refers to an antecedent that is the discourse focus (Karmiloff-Smith, 1980) or when the antecedent is foregrounded in the discourse by virtue or recent mention or introduction (Chafe, 1972). To the extent that the pronoun functions to maintain a previous discourse referent, it may reiterate the antecedent information and need only access the encoded conceptual representation of its antecedent into the current discourse.

Garrod and Sanford (1985) have suggested that pronouns which operate to maintain a discourse referent have a privileged interpretative status. They found that in discourses with an established referent focus, pronouns which referred to a focussed referent completed their search for the antecedent more rapidly than pronouns whose antecedents were not in focus. Noun-anaphors, in contrast, are not viewed as having such specialised functions, nor as having a privileged interpretative status. Garrod and Sanford's (1985) study of repeated nounphrase-anaphors, for example, showed that there was no differential sensitivity to the focus or thematic status of their antecedent. Our studies suggest another way that pronominal anaphors may have a privileged interpretative status, i.e. they access the conceptual representation of the antecedent directly.

In summary, the following studies investigate the processing of anaphoric relationships for two different kinds of anaphors: pronouns and repeated noun-anaphors. Chang (1980) has found an advantage for repeated non-anaphors in short texts and has argued that this advantage is a result of a match between the anaphor and antecedent at both a surface and conceptual level of the representation. We are suggesting, in contrast, that *pronouns* may have an advantage in the interpretation of their anaphors by accessing the conceptual level of representation directly. This hypothesis is motivated by recent studies showing relatively fast resolution of pronominal anaphors and by a functional explanation that pronouns may have a privileged interpretative status in the discourse.

In the following studies we have adapted the priming technique used by Chang (1980) as well as that used by McKoon & Ratcliff (1980) and Dell, McKoon, & Ratcliff (1983) in their investigations of anaphoric processing. The latter two studies have shown that recognition of a word from a discourse is facilitated when it is presented immediately following a word with which it has an anaphoric relationship. This facilitation has been taken to reflect the anaphor's access to antecedent information during the

interpretation of the discourse. Chang (1980) used the same method to compare the relative accessibility of antecedent information for pronouns and repeated proper nouns. Chang's (1980) finding of greater facilitation for the noun-anaphor, however, may be the result of a methodological confound.

As in the other studies, Chang (1980) used the antecedent as the probe word to present following the anaphor. While this technique poses no problem following a pronoun, the repeated noun-anaphor comparison entails that the anaphor and the following probe are identical lexical items. Hence, the facilitation to the probe word may be a result of matching or comparing it to the anaphor without any inferential process or association to the antecedent.

We modified Chang's (1980) paradigm in a way so that we could be sure that facilitation to the probe word would necessarily indicate sensitivity to antecedent information. We used a word that had modified the antecedent (a modifying adjective) rather than the antecedent itself. Any response facilitation to this probe would unambiguously indicate access of the antecedent, because it is information that is associated only with the antecedent and not the anaphor. We chose a modifying adjective because there is some evidence that nouns and modifying adjectives form a shared representation. It has been found that nounphrases are processed as an integrated unit (Johnson, 1965) and, more importantly, that a noun's meaning is retrieved in conjunction with its modifying adjective, even when the words are not presented contiguously in the sentence (Potter & Faulconer, 1979).

Our investigation involved three classes of experiments. The first experiment follows from Chang's (1980) paradigm in which we explore the relative ease of accessing antecedents with the two types of anaphors, using a simple word recognition task. Experiments 2 and 3 contrast responses to lexical decisions and category decisions following each type of anaphor to determine the relative salience of surface and conceptual information about the antecedent. Experiment 4 investigates the accessibility of the antecedent representation after a short delay.

## COMPARISON OF PRONOUN AND NOUN-ANAPHOR PROCESSING

### Experiment 1: Word Recognition Task

Two-sentence discourses were constructed so that the second sentence ended with either a repetition of one of the two nouns presented in the first sentence or with a pronoun which referred unambiguously to one of the

two nouns. The control condition included a second sentence which did not refer to any of the referents in the first sentence. The probe word in the test case was always the adjective which had modified the noun in the antecedent nounphrase. The following is an example of the discourse used in this study:

1. The gangly busboy spilled soup on the famous actress.
2a. A waiter ran to help the busboy.
2b. A waiter ran to help him.
2c. A waiter smothered a giggle.

PROBE: GANGLY

Repeated nounphrases were used rather than other types of anaphoric nouns (e.g. "bird–robin") so that the final representation of the referent might be the same for the pronoun and noun-anaphor. This was done in order to evaluate as fairly as possible the potential advantage of a noun-anaphor *per se*, independent of effects of additional integrational activities involving new information about the referent.

A secondary manipulation in the study concerned the concreteness of the test adjective. Half of the test adjectives used were concrete, such as "fat", "tanned", and "skinny"; the other half can be categorized as abstract, such as "stern", "glib", and "eager". Various studies have shown that concreteness of linguistic information may allow easier access to the memory representation (Begg & Paivio, 1969; Jorgensen & Kintsch, 1973). We were interested in assessing whether or not this effect would hold in the context of anaphoric processing. A heightening of the differential effect would indicate a facilitation of the conceptual features of the anaphor; a reduction in the effect would indicate that some aspects of anaphoric processing might delay processing of the antecedent or at least involve initial processing not related to the conceptual aspects of the anaphor.

Many studies have found that subjects comprehend (Moeser, 1974), recognise (Begg & Paivio, 1969), and recall (Holmes & Langford, 1976) concrete linguistic information better than abstract information. There is considerable debate about the mechanisms underlying these differential effects, but most explanations concern the nature of the conceptual representation, or the meaningfulness of the stimulus. Paivio and his colleagues argue that concrete information is better remembered because it is more easily imaged (Begg & Paivio, 1969) and involves more elaborative and inferential processes (Marschack & Paivio, 1977) which improve the extraction and retention of meaning. Begg and Paivio (1969) and Pezdek and Royer (1974) showed that while meaning changes are better detected in concrete than abstract sentences, recognition of word changes was better

for abstract material. This has been taken to support the hypothesis that concrete material is more likely to be stored in an imagistic (nonverbal semantic) form, whereas abstract material does not have a strong imagistic component and is represented more strongly in a verbal associative (surface) form.

In contrast, Moeser (1974), Holmes & Langford (1976), and Wattenmaker & Shoben (1987) have found an advantage for concrete information in the detection of changes in both meaning and wording. Moeser (1974) concludes that conceptual and surface aspects of linguistic information are not independently stored in the representational system and that, as the words themselves do not differ in frequency or surface (lexical and syntactic) dimensions, the advantage in the conceptual analysis of the concrete information (imagibility) affects the recall of surface information. Other researchers suggest alternative explanations for the facilitation of concrete information. Wattenmaker & Shoben (1987), for example, have argued that a concrete word or sentence is better remembered because it evokes a representation with more information (e.g. about the attributes of an object), not necessarily because it is more imagible. Under any explanation, however, the facilitation in response to concrete information is attributable to the conceptual dimension of linguistic information.

Finally, we presented the discourses in both a listening and reading format to assess whether mode-specific characteristics, such as intonation or stress patterns, might (unintentionally) influence subjects in their assessment of anaphoric relationships.

### *Method*

*Subjects.* A total of 48 subjects (29 male and 19 female) Columbia University and Barnard College undergraduates participated in this experiment as part of an introductory psychology course requirement. All were right-handed native speakers of English.

*Material and Design.* Eighteen two-sentence discourses like those shown in sentences 1 and 2a–c were designed so that the anaphor was in the final word-object position of the second sentence. The antecedent was always the subject nounphrase of the first sentence.

The adjectives were chosen so that they were not high associates of the antecedent they modified. In nine of the discourses, a concrete adjective modified the antecedent; in the other nine, the adjective was abstract. The adjectives were matched for frequency, length, and number of syllables (see Kucera & Francis, 1967). Furthermore, the adjectives had been determined in a pretest to be clearly discriminable as either abstract or concrete. Each third of the experimental trials had three abstract and

three concrete adjectives in the discourse. Each discourse had three versions—a pronoun, a noun-anaphor, and no anaphor at all. Three experimental sequences were constructed, balanced across the three discourse versions (see Appendix for stimuli).

The sentence pairs were constructed so that the referent at the end of the second sentence remained ambiguous until the presentation of the anaphor. At that point, the antecedent could be unambiguously determined by anaphor information alone in both the pronoun and the noun-anaphor conditions. In the above discourse, for example, the object of the second sentence may be either the busboy or the actress. These types of construction were developed so that discourse factors could not determine the antecedent nor engender an expectation of a particular type of anaphor.

A sentence completion study with 10 subjects showed that of those subjects choosing an anaphoric ending, 50% chose the subject, whereas the other 50% chose the object as the antecedent. A study of acceptability judgements by 20 subjects showed that acceptability ratings for the pronoun and noun-anaphor constructions of these stimuli were not significantly different. On a scale from 1 to 7, with 7 representing the most acceptable sentences, the average rating for the pronoun construction was 5.28 compared to 5.02 for the noun-anaphor—$t(1,17) = 0.54$. A further comparison was made between the test stimuli and distractor sentences, to evaluate whether subjects were showing a range of sensitivity to the stimuli. Subjects showed significantly higher acceptability ratings for the test stimuli (mean = 5.15) than to the (test-related) distractor stimuli—mean = 4.31, $t(1,34) = 3.0$, $P < 0.01$. The distractor stimuli were created by connecting the two test sentences with an "and", producing one longer sentence.

Each experimental sequence consisted of a total of 150 discourses of which 84% were distractor trials. Pilot studies had shown that subjects are quite sensitive to the systematic use of adjectives as probes, even when distractor trials constituted up to 60% of the presented discourses. Hence, 72% of the trials were followed by noun and verb probes. The noun and verb distractor probes were evenly drawn from all the syntactic positions available in the sentence pairs relative to their grammatical class. Overall, 50% of each of these probes were in the preceding discourse, whereas the other 50% were not. Each false probe word was semantically and syntactically similar to a word in the preceding discourse. Of the distractor probes, 12% were adjectives. Those selected from the first sentence subject position (i.e. the position from which the test adjectives were selected) were false. The rest of the adjective probes followed the same selection pattern as that described for the noun and

verb probes. The distractor discourses ranged in length from two to three sentences, so subjects would not be sure when to expect the probe word.

*Procedure.* We used two discourse presentation methods—auditory and visual. For the auditory condition, the discourses were recorded in conversational tone with reduced stress and intonation. The discourses were recorded on one channel, while on the other channel, a tone was superimposed at the end of the last syllable of the sentence. The output was arranged so that subjects heard only the discourses, which were presented binaurally through headphones. The tone was separately transmitted to a voice-activated relay which opened a shutter positioned over the lens of a slide projector, and started a timer. The shutter remained open for 1 second. The probe words were back-projected onto a screen. The height of the characters was approximately 1.52 cm. The subjects sat about 1 m from the screen.

The subjects were instructed to listen to each discourse and then answer quickly whether or not the probe word had occurred in the discourse. The subjects responded "yes" or "no" by pressing one of two telegraph keys with the right hand. The response stopped the timer and was signalled to the experimenter by an LED. The experimenter recorded the decision and response time. A third of the distractor trials were followed by comprehension questions, randomly distributed across the experimental session. There was a wide range of types of question asked, to discourage the subjects from adopting comprehension response strategies. Accuracy feedback was given for answers to these questions.

For the visual text presentation condition, the experiment was carried out on a Model I Radio Shack Computer, which displayed the stimuli on a video monitor with a standard character set. Characters were approximately 6.4 mm high and 2.5 mm wide. The sentences appeared phrase-by-phrase in the centre of the screen with normal upper- and lower-case punctuation (TEXTER PROGRAM; Sabella & Roitblat, 1983). Phrases were defined from left to right, in terms of the largest constituent, two to five words long (see Janus & Bever, 1985, for details). Subjects controlled the rate of presentation of the material by pressing the space bar after they had finished reading each phrase; each bar-press displayed the next phrase. At the bar press, following the final phrase of the first sentence in the discourse, the probe word automatically appeared. The probe word was presented in capital letters and enclosed in a box of asterisks. Because the filler discourses ranged between two and three sentences in length, the subject could never be certain when the probe word would appear. The subjects responded "yes" or "no" in the recognition task by pressing one of the two keys designated for each decision on the keyboard.

The experimenter first described the task verbally. The instructions were presented a second time on the video monitor in order to ensure that the subjects understood the task and to accustom them to reading phrase-by-phrase. As in the auditory condition, a third of the distractor trials were followed by comprehension questions, randomly distributed across the experimental session.

### *Results*

Incorrect responses (1.33%) were eliminated from the statistical analysis. Response times that were greater than 2.5 standard deviations for an individual subject were replaced by his or her own mean plus 2.5 standard deviations. The mean response times for each condition and associated error rates are shown in Table 1 (min $F'$ analyses are presented when they reach significance, otherwise subject and item analyses are presented).

The ANOVA performed contained 1 between-factor, discourse presentation (visual/auditory), and 2 within-factors, type of adjective (abstract/concrete) and type of anaphor (pronoun/noun-anaphor/control). The main effect for text presentation was not significant—min $F'(1,54) = 2.47$. Across both text presentations, type of anaphor was significant [min $F'(2,40) = 7.88, P = 0.01$], as was type of adjective [min $F'(1,19) = 5.35, P = 0.05$]. The interaction between anaphor and adjective was not significant.

TABLE 1
Word Recognition Studies: Mean Reaction Times and Associated Error Percentages for Anaphor Conditions and Type of Adjective Probes in Auditory and Visual Presentations

| | *Adjective* | | | | | | |
|---|---|---|---|---|---|---|---|
| | *Concrete* | | *Abstract* | | | *Combined Mean* | |
| *Anaphor* | *M* | *(E)* | *M* | *(E)* | *A–C* | *M* | *(E)* |
| *Auditory mode* | | | | | | | |
| Control | 1120 | (0.7) | 1162 | (0.1) | 42 | 1140 | (0.4) |
| Noun-anaphor | 1051 | (0.6) | 1074 | (0.9) | 23 | 1062 | (0.7) |
| Pronoun | 978 | (0.3) | 1052 | (0.6) | 74 | 1051 | (0.4) |
| *Visual mode* | | | | | | | |
| Control | 1248 | (1.7) | 1287 | (1.4) | 39 | 1268 | (1.6) |
| Noun-anaphor | 1172 | (0.7) | 1197 | (3.8) | 25 | 1184 | (2.3) |
| Pronoun | 1050 | (0.1) | 1161 | (3.7) | 111 | 1106 | (1.9) |

The main effect of anaphor in both auditory and visual text presentations is that the control condition elicited the slowest responses and the pronoun anaphor condition elicited the fastest responses (see Table 1). For each text presentation condition, the Newman-Keuls statistic showed significant differences at or beyond the 0.05 level between the control condition and the two anaphor conditions; there was a significant difference between the two types of anaphors, with the pronoun condition showing faster times than the noun-anaphor condition.

While the main effect for adjective tells us that abstract adjectives elicit slower times than concrete adjectives, we do not see an interaction between type of anaphor and adjectives. We were interested in the contrast between the abstract and concrete adjectives in the anaphor conditions to assess the extent to which anaphoric processing might enhance sensitivity to conceptual information about the probe. It is clear that there is a greater difference between the abstract and concrete adjectives in the pronoun condition relative to the noun-anaphor condition (see Table 1). The control condition which shows an intermediate concrete/abstract difference can be understood as the baseline effect of concreteness when there is no anaphor at all. The absence of a significant interaction between adjective and anaphor type may be the result of the moderating effect of adjective type in the control condition relative to the more pronounced differences between the two anaphor conditions.

Therefore, a sub-ANOVA was performed comparing only the anaphor conditions against type of adjective. These results show that the effect of anaphor remained [min $F'(1,60) = 7.6$, $P < 0.01$], and an effect for the adjectives was significant by subjects [$F1(1,60) = 7.6$, $P < 0.01$] and nearly so by items [$F2(1,16) = 4.09$, $P = 0.06$]. An interaction between the pronoun and noun-anaphor and type of adjective probe was significant by subjects [$F1(1,45) = 7.74$, $P = 0.008$] and by items [$F2(1,16) = 5.94$, $P = 0.03$].

### *Discussion*

The most general finding is that there is a response facilitation to adjective probes following both pronouns and noun-anaphors; this indicates that information about the antecedent is available shortly after the presentation of each kind of anaphor. More importantly, subjects recognised adjective probes faster following the pronoun than following the noun-anaphor, which indicates that pronouns access antecedent information more rapidly than noun-anaphors. The same results were obtained for both a reading and listening situation, indicating that response facilitation to antecedent information in anaphoric processing does not differ between an auditory or visual format. Overall, the results contradict the theory that rapid anaphor

resolution depends primarily on the accumulation of additive features of the anaphor; however, they confirm the hypothesis that anaphoric relations are processed more rapidly with pronouns than with noun-anaphors, at least in the context of short discourses.

Our analyses showed that concrete probes were more rapidly responded to than abstract probes in every condition. This confirmed a general finding in the literature that concrete information is more readily understood than abstract information. It is clear that factors other than anaphoric processing contribute to the abstract/concrete difference, because the control condition is also associated with an abstract/concrete effect. Recognition tasks, for example, produce differential responses to concrete and abstract material. This effect may be stronger than that produced by the anaphor processing activities, as we do not see significant differences between the control and either of the two anaphor conditions.

However, when a direct comparison of the relationship of adjectives to the two anaphors is made, we obtain a significant interaction. Looking at the relative sizes of the differences, we see that the size of the difference in the pronoun condition is larger than in the control condition, whereas the effect for the noun-anaphor falls below the control.

In conclusion, there are two contrasts that can be drawn in our comparison of pronoun and noun-anaphors. First, subjects recognised the adjective probes faster after the pronoun, indicating that pronouns access antecedent information more rapidly than do noun-anaphors. Secondly, when the concrete/abstract differences are directly compared for type of anaphor, pronouns show a stronger abstract/concrete differential than do noun-anaphors. To the extent that the differential sensitivity to the concrete/abstract information reflects sensitivity to the conceptual aspects of the probe, we hypothesised that the superior facilitation following the pronoun might be associated with immediate accessibility to the conceptual aspects of the antecedent.

It is intriguing that the noun-anaphor primes the antecedent and yet does not elicit the abstract/concrete difference. An obvious hypothesis is that noun-anaphors prime information about the antecedent that is not conceptual in nature. Studies of comprehension of sentences and words have indicated that linguistic information is analysed first at a surface level and then at a conceptual level (e.g. Bever, Garrett, & Hurtig, 1973; Craik & Tulving, 1975). We hypothesised that in the case of the noun-anaphor, the interpretation of the antecedent follows a level-specific analysis. That is, the noun-anaphor may access a "surface" level representation of the antecedent information in which sensitivity to the surface characteristics of the antecedent initially predominates over the information at a conceptual level.

In conclusion, the above results suggest that pronouns access their

antecedents more rapidly than noun-anaphors, at least in short texts. We suggest that the greater response facilitation for the pronoun may be the result of a direct access of the conceptual aspects of the antecedent representation. This hypothesis is suggested by the observation of the greater sensitivity to the concreteness of the adjective probe following the pronoun than the noun-anaphor. This suggestion needs further investigation because the concreteness effect is only weakly associated with anaphoric processing. In the following experiments, we directly tested the hypotheses that noun-anaphor resolution involves a preliminary analysis of the antecedent at a surface level of representation, whereas pronouns access the conceptual representation of the antecedent directly. In particular, we asked subjects to make judgements about surface and conceptual characteristics of the probe words to determine the relative sensitivity to surface and conceptual information following each type of anaphor.

## THE RELATIVE AVAILABILITY OF SURFACE AND CONCEPTUAL ANTECEDENT INFORMATION FOLLOWING ANAPHORS

Several studies have shown that judgements about a property of a word are facilitated by processing at a level of analysis associated with that property (Fisher & Craik, 1977; Moeser, 1983; Morris, Bransford, & Franks, 1977). For example, the recall of a word cued by semantic category information is more likely when that word has been processed to a semantic level (Fisher & Craik, 1977). Similarly, rhyme-based word recognition is better when the task is preceded by a context in which subjects are listening for rhymes (Morris et al., 1977).

In the following experiments, subjects were required to make one of two kinds of judgement about the adjective probe. These decisions required the subject to process information about the adjective at either a surface or conceptual level of analysis. One set of subjects made a word–nonword decision about a sequence of letters. This task requires processing at a relatively superficial level, as it only requires the identification of the input as a word, without requiring evaluation of its meaning (see Schuberth & Eimas, 1977; Snodgrass & Jarvella, 1972). The other set of subjects was required to make a category decision—namely, whether the word was abstract or concrete.

These experimental tasks were intended to contrast the relative strength following each kind of anaphor of the surface and conceptual information about the antecedent. Our experimental rationale is derived from the observations, described above, that the availability of a particular level of representation facilitates performance on a task which requires processing at that level. Given the hypothesis that noun-anaphors involve surface-

level processing initially, we predicted that in the lexical decision task, responses to probes following noun-anaphors should show greater facilitation than following pronouns. On the hypothesis that pronouns involve conceptual processing of the antecedent directly, we predicted that in the category naming task, the facilitation effect should reverse, i.e. responses following pronouns should show greater facilitation than those followng noun-anaphors.

## Experiments 2 and 3: Category and Lexical Decision Tasks

In the following two experiments, we conducted a direct investigation of the nature of the initial processing activities for each kind of anaphor. In the lexical decision study, each adjective probe occurred in two forms: in one condition as a word, in another condition as a nonsense string. For example, the probe "gangly" had as its corresponding almost-word "kangly". In all cases, the first letter or syllable of the probe word was replaced with another letter or syllable which transformed it into a nonsense string that shared the final orthographic and phonetic characteristics of the real word. If the noun-anaphor provides sensitivity to the surface aspects of the antecedent, we would expect an inhibition for responses when the almost-word string is easily confused with the real-word string. Accordingly, we predicted that correct "no" responses to nonsense strings would be inhibited following noun-anaphors but not following pronouns.

Because Experiment 1 showed that no differences obtained between auditory and visual presentation of the discourses, both these experiments were carried out in a visual format, the more typical presentation for a lexical decision task.

### *Method*

*Subjects.* A total of 18 subjects from the Columbia University Summer School undergraduate subject pool participated in the category decision experiment (Experiment 2), and 36 subjects participated in the lexical decision experiment (Experiment 3).

*Materials and Design.* The discourses for both experiments were the same as in Experiment 1. In the category decision experiment, the test probes were also identical to those in the previous study. (Recall that these items had been evaluated in a pretest as clearly categorisable as either "abstract" or "concrete".) The anaphor and filler sentence design for Experiment 3 was the same as in the previous study.

The lexical decision study had two probe type conditions: in one, all the critical text probes were the antecedent adjective; in the other, the test probes were almost-word nonsense strings which corresponded to the actual adjective. In each condition the filler discourses and probes complemented the test discourses so that, over all trials, 50% of the probes were nonsense strings and 50% were word strings. Each probe-type condition followed the design established in the previous study. Nested within each probe-type condition, were three testing conditions, one for each type of anaphor for a given discourse and its associated probe (see Appendix for nonsense probe word stimuli).

*Procedure.* For the category decision experiment, subjects were instructed to decide whether the word following the discourse could best be categorised as "concrete" or "abstract". The meaning of these categories was explained via examples of words from all tested syntactic categories, which were described as either "concrete" or "abstract". The subjects were told that the test words may or may not appear in the previous discourse. Subjects recorded their answers by pressing keys which were marked "A" for abstract and "B" for concrete.

For the lexical decision experiment, subjects were told to decide whether the letter string following the discourse was a real word or not. Examples of nonsense strings were given. Subjects recorded their answers by pressing keys which were marked "Y" for a word judgement and "N" for a nonsense word judgement.

## Results

Incorrect responses (category decision task, 1.8%; lexical decision task, word probe 1.5%, nonsense string, 1.4%) were eliminated from the statistical analysis. Response times that were greater than 2.5 standard deviations for an individual subject were replaced by the mean value plus 2.5 standard deviations.

*Category vs Lexical Decision Task Analysis.* The mean response time and associated error percentages for the category decision task and the lexical decision task (real word probes only) are presented in Table 2. Overall, responses for category decisions are much longer than for lexical decisions. More importantly, the tasks show contrasting relative differences between types of anaphors. Whereas category decision responses are faster following the pronoun than the noun-anaphor, lexical decision responses are faster following the noun-anaphor than the pronoun. The interaction of task and anaphor is significant, as the ANOVA described below indicates (see Fig. 1).

TABLE 2
Lexical and Category Tasks: Mean Decision Times and Associated Error Percentages by Anaphor Conditions

| | *Task* | | | |
|---|---|---|---|---|
| | *Lexical Decision* | | *Category Decision* | |
| *Anaphor* | *M* | *(E)* | *M* | *(E)* |
| Control | 889 | (1.2) | 1534 | (1.2) |
| Noun-anaphor | 829 | (1.9) | 1415 | (1.6) |
| Pronoun | 854 | (1.4) | 1272 | (2.6) |

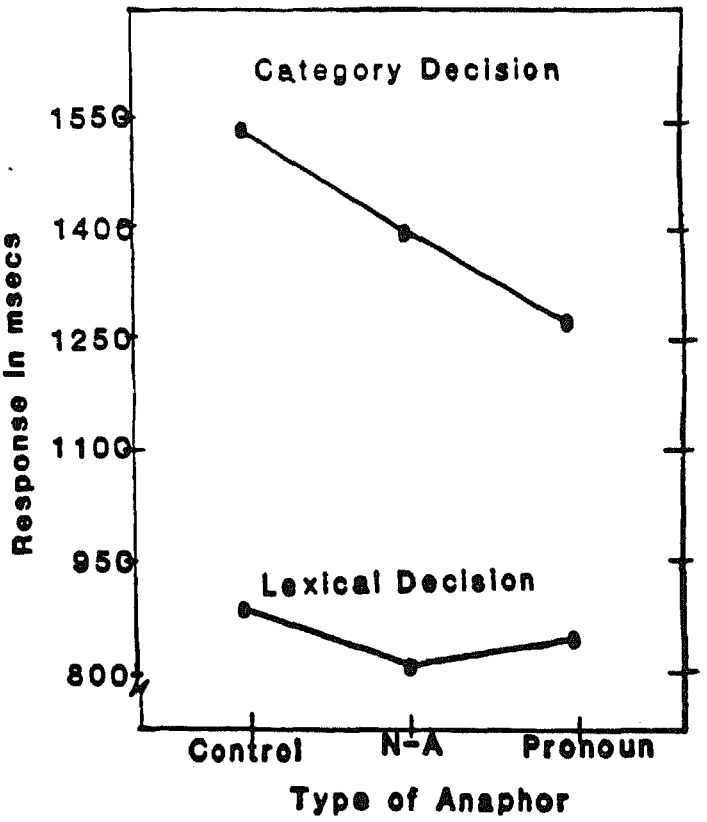


FIG. 1 Mean response times to probe word following the pronoun, noun-anaphor, and control conditions as obtained with the category and lexical decision tasks.

An analysis of variance across type of task [category decision and lexical decision (real word probes only)] and type of anaphor showed a main effect of task [min $F'(1,69) = 54.93$, $P < 0.01$] and a main effect of anaphor [min $F'(2,113) = 4.43$, $P < 0.05$]. Of greatest interest, is the interaction between type of task and type of anaphor—min $F'(2,120) = 3.10$, $P < 0.05$.

*Category Decision Task Analyses.* An ANOVA for each task experiment was performed separately. Table 3 presents the results of the category decision experiment by type of anaphor and type of adjective. As in the recognition task experiments, response facilitation following the anaphor is greater for the pronoun condition than the noun-anaphor condition. There is a strong abstract/concrete difference for the control and pronoun condition but not for the noun-anaphor. An ANOVA by subjects for the category decision experiment alone showed a main effect for type of anaphor [min $F'(2,30) = 3.62$, $P < 0.05$], and a main effect for type of adjective by subjects [$F1(1,23) = 7.64$, $P = 0.01$] and by items [$F2(1,17) = 5.06$, $P = 0.04$]. There was no interaction.

Because there is an adjective effect for the control as well as the pronoun condition, it is clear that the anaphor processes have a minor contribution to the abstract/concrete effect in this study. We noted that the abstract/concrete effect in the category decision task for the control and pronoun conditions was much larger than in the recognition task, suggesting that the major contributor in the abstract/concrete effect might be the task itself. The category task specifically requires processing a conceptual level of presentation, whereas in a recognition task sensitivity to both surface and conceptual features of linguistic information has been shown to help in the task completion (Anderson & Paulson, 1977; Kirsner, 1973). We reasoned that the extent to which the abstract/concrete differences reflect sensitivity

TABLE 3
Category Decision Task: Mean Decision Times and Associated Error Percentages by Anaphor Condition and Type of Adjective Probe

| | *Adjective* | | | | | *Combined Mean* | |
|---|---|---|---|---|---|---|---|
| | *Concrete* | | *Abstract* | | | | |
| *Anaphor* | *M* | *(E)* | *M* | *(E)* | *A–C* | *M* | *(E)* |
| Control | 1454 | (0.5) | 1614 | (1.8) | 160 | 1534 | (1.2) |
| Noun-anaphor | 1395 | (2.3) | 1435 | (0.9) | 40 | 1415 | (1.6) |
| Pronoun | 1183 | (3.2) | 1361 | (2.3) | 178 | 1272 | (2.6) |

to conceptual information, the effect should be seen more strongly in the category task than in the recognition task. An ANOVA comparing type of task (recognition task *vs* category task) and type of adjective showed such an interaction effect, supporting this interpretation—min $F'(1,50) = 7.56$, $P < 0.01$.

Nevertheless, the effects of the category task seem to have a differential effect for the anaphor conditions. Whereas it is true that in the category task, every anaphor condition shows an increased abstract/concrete difference compared to the recognition task, the effect appears much smaller for the noun-anaphor than for the control and pronoun conditions. A Task × Adjective × Anaphor ANOVA shows a three-way interaction effect by subjects [$F1(2,63) = 5.92$, $P = 0.004$] and marginally so by items [$F2(2,50) = 2.52$, $P = 0.09$]. One possible explanation for this interaction is that anaphoric resolution following a noun-anaphor may suppress sensitivity to conceptual aspects of the antecedent probe, whereas the processing activities in the control and pronoun conditions are not antagonistic to the category task demands of analysis of the conceptual information of the probe word.

*Lexical Decision Task Analyses.* An ANOVA for the lexical decision task for real word probes showed a main effect of type of anaphor [$F1(2,46) = 3.81$, $P = 0.03$; $F2(2,34) = 3.4$, $P = 0.05$] and no effect for type of adjective. A Newman–Keuls test shows that response times are facilitated in both anaphor conditions compared to the control condition ($P < 0.05$) and that lexical decision responses are more strongly facilitated following noun-anaphors than pronouns ($P < 0.05$; see Table 4).

Responses for each type of anaphor were quite similar regardless of whether the adjective probe was abstract or concrete. The absence of an

TABLE 4
Lexical Decision Task: Comparison of Mean Decision Times for Word Probes and Nonsense String Probes (Breakdown for Concrete/Abstract Times in Parentheses)

| | *Anaphor Condition* | | |
|---|---|---|---|
| *Probe* | *Control (M)* | *Noun-anaphor (M)* | *Pronoun (M)* |
| Word string (c/a) | 889 (891/886) | 829 (828/830) | 854 (843/864) |
| Nonsense string (c/a) | 939 (945/933) | 1035 (1033/1035) | 937 (942/932) |

adjective effect, in contrast with that found in the category decision data, is consistent with the view that the lexical decision concerns predominantly nonconceptual aspects of the word.

Correct "no" lexical decision to almost-words following the noun-anaphor were slower than those following the control, suggesting an inhibitory effect. This inhibition effect did not occur following the pronoun; rather, the response times following the pronoun were quite similar to the control (see Table 4). The ANOVA for the lexical decision task for the almost-words showed a min $F'(2,60) = 3.25$, $P < 0.05$. A Newman–Keuls test showed a significant difference at the 0.05 level between the control and the noun-anaphor condition but not between the control and the pronoun conditions. Again, the response times for abstract and concrete adjectives were not significantly different in any anaphor condition.

Figure 2 shows the means for correct "yes" responses to real word probes compared to correct "no" responses to nonsense strings for each

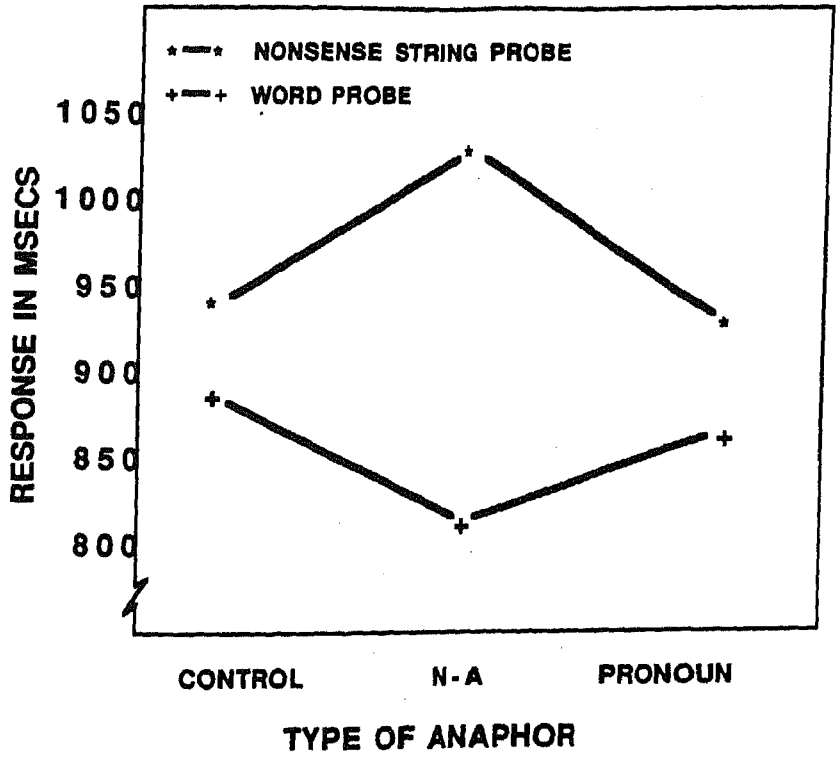


FIG. 2 Mean response times for each type of anaphor condition when the probe was either a word probe or nonsense string probe.

anaphor condition. These means indicate that noun anaphors show the strongest facilitation effect in "yes" responses to the real-word probes and a strong inhibition for "no" responses to almost-word probes. An ANOVA assessing the relationship between type of anaphor and type of letter string probe shows an interaction with min $F'(2,132) = 3.58$, $P = 0.05$. These findings show that while noun-anaphors show differential response times depending on whether the string is a word probe or not, both the control and pronoun conditions produce much less response sensitivity to the letter string.

### *Discussion*

The findings support the hypothesis that the anaphors access different levels of representation. Responses to category decisions were faster followng pronouns, whereas lexical decisions to real words were faster following noun-anaphors than pronouns. This pattern gives direct support to the hypothesis that pronouns access a conceptual representation, whereas noun-anaphors initially prime a surface representation. This differentiation between the anaphors is further supported by the strong inhibition effect following the noun-anaphor in the reaction to almost-words similar to the antecedent adjective (and the complete lack of any such effect following the pronoun). We interpret this inhibition as due to the strong priming of the orthographic/phonetic form of the adjective by the noun-anaphor. The subject sees a nonword that is orthographically similar to the "primed" antecedent that he/she is impelled at first to accept the nonword as a word. The two effects—the facilitation of lexical decisions for real word probes and the inhibitory effect for decisions on nonsense strings—work together to support the claim that surface information about the antecedent is available following the noun-anaphor.

The concreteness effect for both the control and pronoun condition suggests that the anaphor processes make only a minor contribution to the abstract/concrete effect. Rather, the requirement in the category task that subjects process the word at a conceptual level seems to explain the abstract/concrete effects across both the control and pronoun anaphor conditions. This interpretation was supported by an analysis in which the category decision task showed significantly stronger differential effects for the adjective probes than did the word recognition task. There is also some evidence that the impact of the task on the concreteness effect varied with the type of anaphor. While the abstract/concrete difference is significantly larger in the category task than in the word recognition task, the effect is much smaller in the noun-anaphor condition than in the control and pronoun conditions. This suggests that the noun-anaphor may suppress sensitivity to conceptual aspects of the antecedent probe, whereas the

processing activities in the control and pronoun conditions are not antagonistic to the category task demands of analysis of the conceptual information of the probe word.

The abstract/concrete effects are consistent with our hypotheses about differential priming effects following pronouns and noun-anaphors. However, the multiple sources of the adjective effect make for a complicated interpretation and so are presented only as secondary support for our hypotheses concerning anaphor resolution. In contrast, the interaction effect obtained when we compared the category task to the lexical decision task shows clear evidence that pronoun anaphor resolution primes a conceptual representation of the antecedent, whereas the noun-anaphor primes a surface representation.

Our final interest concerned assessing whether noun-anaphor resolution includes an eventual sensitivity to the conceptual aspects of the antecedent representation. In the following study, we presented the probe at a delayed interval in order to assess the potential increase in sensitivity to the conceptual aspects of the representation following the noun-anaphor.

## Experiment 4

The results from the preceding experiments show that a noun-anaphor initially primes its antecedent at a surface level of representation. We hypothesise that understanding discourses in which either anaphor is presented ultimately involves sensitivity to the conceptual representation of the antecedent. In the following experiment, we tested the hypothesis that the noun-anaphor eventually provides access to the conceptual representation.

Using the paradigm of Experiment 1, we tapped the time course of anaphor resolution by presenting the probe after a brief interval. While responses to a probe presented immediately after the noun-anaphor show no sensitivity to the adjective concreteness, the prediction is that a probe presented after a short delay would, like the pronoun, reveal a sensitivity to conceptually relevant differences in the adjective probes. For example, in the auditory presentation of Experiment 1, responses following the pronoun were 74 msec faster following concrete adjectives, whereas the abstract/concrete effect on the noun-anaphors was only 23 msec, a difference smaller than the control.

In the following study, we would expect the word recognition task to again produce some baseline differences (as measured by the control condition) showing shorter response times to concrete adjective probes. We expect that in comparing Experiments 1 and 2, however, the concreteness effect for the control condition should stay about the same, and the

noun-anaphor, in contrast, should show a significant increase in the size of the abstract/concrete response times.

### *Method*

A total of 24 subjects, 12 male and 12 female college students, received course credit or were paid to participate in this experiment. All were right-handed native English speakers. The experimental design, materials, procedure, and instructions were identical to those in Experiment 1. The only change was the presentation of the probe word at a 250-msec delay. We selected this interval of delay based on the findings of Dell, McKoon, and Ratcliff (1983), who showed that anaphoric nouns prime their antecedent 250 msec after the anaphor was read.

### *Results and Discussion*

Incorrect responses (1.0%) were eliminated from statistical analysis. Response times that were greater than 2.5 standard deviations for an individual subject were replaced by their mean value plus 2.5 standard deviations.

All the responses to the probe words were longer in the 250-msec delay than in the no-delay condition but had a similar pattern of results. In particular, the noun-anaphor and pronoun conditions showed facilitated response to the probe. In contrast to the first experiment, however, the responses to the noun-anaphor showed a strong abstract/concrete effect (141 msec) compared to its relative size in the earlier study (23 msec).

A three-way ANOVA (Probe Time × Anaphor × Adjective) showed that delayed presentation of the probe did not significantly affect response times to either the anaphors or the adjectives alone. However, a three-way interaction of probe time, type of anaphor, and adjective was obtained—min $F'(2,77) = 3.30$, $P < 0.05$. This interaction is the result of the increased difference in the abstract/concrete responses for the noun-anaphors given a delayed probe and the absence of a significant change for the control and pronoun conditions. As we have taken the abstract/concrete difference as an indication of sensitivity to conceptual information, this finding indicates that at the 250-msec delay, the conceptual representation of the antecedent has been accessed by the noun-anaphor.

An ANOVA for the delayed probe study alone showed a main effect of adjective—min $F'(1,26) = 5.23$, $P = 0.05$. The effect of type of anaphor, however, is weaker than that of Experiment 1—$F1(2,42) = 6.02$, $P = 0.02$; $F2(2,34) = 2.26$, $P = 0.12$. No significant interaction was obtained. A Newman-Keuls analysis shows that while the differences between the control condition and the two anaphor conditions are significant ($P <$

TABLE 5
Delayed Probe Study: Mean Reaction Times and Associated Error Percentages by Anaphor Condition and Type of Adjective Probe

| | *Adjective* | | | | | | |
|---|---|---|---|---|---|---|---|
| | *Concrete* | | *Abstract* | | | *Combined Mean* | |
| *Anaphor* | *M* | *(E)* | *M* | *(E)* | *A–C* | *M* | *(E)* |
| Control | 1211 | (0.3) | 1242 | (1.4) | 31 | 1227 | (0.9) |
| Noun-anaphor | 1100 | (0.0) | 1241 | (2.1) | 141 | 1171 | (1.1) |
| Pronoun | 1113 | (0.3) | 1158 | (1.4) | 45 | 1136 | (0.9) |

0.05), the difference between the pronoun and noun-anaphor is not. The absence of a significant difference between the two kinds of anaphors may be the result of the increased priming effect for the noun-anaphor, as it represents processing of the anaphor beyond a surface to a conceptual level of representation.

## CONCLUSION

This research confirms the original hypothesis that pronouns can provide for more rapid interpretation of an antecedent than noun-anaphors during the resolution of anaphoric relationships in discourse. At least, in short discourses, information about the antecedent is available more rapidly following a pronoun. This advantage has been shown to derive from differences in the processing level at which the interpretation of antecedent information occurs.

Alternative and simpler interpretations of these data could attribute the longer response times following the noun-anaphors (the predicted result in three out of four experiments) to the lower frequency or the longer length of the noun-anaphors compared to pronouns. However, positive lexical decisions were *faster* following the noun-anaphor than the pronoun, a finding which contradicts predictions based on frequency or length. Furthermore, negative lexical decisions to almost-words were slower following the noun-anaphor than the control conditions without any anaphor at all; this, too, would not follow from the relative frequency or length of the noun-anaphors. Finally, the systematic trends in the abstract/concrete differences observed for each anaphor type across differing presentation times (delay and no-delay studies) and in the category naming task cannot be derived from frequency and length factors.

The recognition studies and the word judgement studies taken together are convergent methodologies which demonstrate that the differences between pronoun and noun-anaphor resolution depend on the fact that

they prime different levels of representation. Immediate sensitivity to conceptual aspects of antecedent information following a pronoun was indicated by the strong response facilitation in a category decision task and given indirect support by the abstract/concrete adjective effect when the probe was presented immediately after the anaphor. Immediate sensitivity to surface aspects of the antecedent following noun-anaphors was indicated by the facilitation effect in the positive lexical decision task for the antecedent-related probe words, as well as by the inhibition effect for nonsense letter strings that were close to the antecedent adjective. The relative insensitivity of the responses immediately following the noun-anaphor to conceptual aspects of the antecedent was also indicated by the relative absence of an abstract/concrete difference compared with the pronoun. Overall, the results suggest that antecedent information is represented in at least two levels and that there is differential processing of this information determined by the kind of anaphor that triggers the search for the antecedent.

Several questions remain about the mechanisms that guide the selection and activation of the antecedent representation. Clearly, comprehension of an anaphor requires that it ultimately access a conceptual representation of its antecedent: our results in the experiment with the delayed probe presentation confirm this for noun-anaphors, and there are several ways this has been assessed for pronouns. Our findings leave open the possibility that the initial accessing mechanism for the noun-anaphor is an interlexical association, i.e. the noun in the noun-anaphor may initially prime the adjective by pure associative strength. Such an associational mechanism may be one of several components which contribute to anaphoric resolution for repeated noun-anaphors. Facilitation for the antecedent-related information following the pronoun (in the recognition and category studies) is striking because there is no obvious associational relationship between the pronoun and the antecedent, and major questions remain as to how that relationship is forged.

We have shown that an anaphoric relationship signalled by a repeated noun does not necessarily have an advantage over one signalled by a pronoun, despite the fact that it may act as a prime for the surface as well as the conceptual aspects of an antecedent representation. Nevertheless, the relative informational richness of the noun-anaphor may be useful under some discourse conditions. Repeated noun-anaphors prime the lexical as well as the conceptual information associated with the referent, creating an additional processing load. This additional processing could be a disadvantage when the referent is the focus of the discourse and hence continually repeated. However, when the referent has not been recently mentioned, the additional "surface" information, while producing a greater processing load, provides an additional level of information which

"primes" the old representation of the antecedent and makes it more readily available.

There is, indeed, some evidence that repeated noun-anaphors facilitate response to their antecedents under certain discourse circumstances. Purkiss (1978), for example, has shown that repeated noun-anaphors are more rapidly interpreted than unambiguous pronouns when the antecedent is not the focus of the discourse and has been presented at least three sentences earlier. Our initial recognition study along with Purkiss' results indicate a complementary pattern anaphor resolution—faster anaphor resolution obtains following pronouns in short discourse but faster resolution for noun-anaphors occurs when antecedents are at greater distances across the discourse or are not the focus of the discourse. These findings suggest that the interpretative processes associated with particular anaphors will affect ease of comprehension depending on their position in the context of the discourse as a whole.

Marslen-Wilson et al. (1981) present distributional data for the use of pronoun and noun-anaphors in a discourse context which are consistent with the reaction time findings. In assessing the use of anaphors in speech production, it was found that pronouns clustered within discourse units (e.g. paragraphs, "subdialogues"), whereas noun-anaphors were found distributed at greater distances across the discourse. Hence, patterns of speech production mirror the patterns of relative ease of comprehension of anaphors for listeners or readers.

Garrod and Sanford (1982, 1985) have suggested that the presence of pronouns and repeated nouns in a discourse signal different kinds of information about the status of the referent in the discourse. As mentioned earlier, they suggest that pronouns operate to maintain a referent which is presently in focus or foregrounded. They have further suggested that noun-anaphors, in contrast, are used to reintroduce referents from whch attention has recently been diverted. Marslen-Wilson et al.'s (1981) distributional data and our processing data are consistent with the notion of differential roles of anaphors in a discourse.

Our studies have investigated some of the comprehension processes that are involved in the resolution of anaphoric relationships for specific kinds of anaphors. As such, they contribute to the larger project of explaining the ways in which information across a discourse is understood and integrated. We have suggested ways in which the underlying processing mechanisms specific to the type of anaphor are consistent with the observed distributions. This adds explanatory support to discourse theories which suggest that specific anaphors serve different functions in discourse.

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## APPENDIX

Stimuli and Probe Words used for Experiments 1–4

*Concrete Probes:*

1. The slim boxer/ trained well/ for the controversial fight.
   Boxing aficionados/ were willing/ to pay/ top dollars/ to see him.
   / to see the boxer.
   Boxing aficionados/ were making/ larger bets/ than ever before.
   *Probe word:* SLIM
   (Expt 3) FLIM

2. The gangly busboy/ spilled soup/ on the famous actress.
   The waiter/ ran/ to help him.
   / to help the busboy.
   *Probe word:* GANGLY
   KANGLY

3. The fat executive/ slept/ with the stupid secretary.
   The office staff/ despised/ him.
   / the executive.
   The office staff /was/ thoroughly scandalized.
   *Probe word:* FAT
   LAT

4. The tanned patron/ left/ a quarter tip.
   The waiter/ stared angrily/ at him.
   / at the patron.
   The waiter/ muttered angrily/ to himself.
   *Probe word:* TANNED
   DANNED

5. The skinny bellboy/ did a softshoe routine/ in the lobby.
   The hotel guests/ were amazed/ by him.
   / by the bellboy.
   The hotel guests/ could not believe/ their eyes.
   *Probe word:* SKINNY
   SPINNY

6. The stocky gigolo/ visited/ the baroness/ every week.
   A detective/ had been hired/ to spy/ on him.
   / on the gigolo.
   A detective/ had secured/ incriminating evidence.
   *Probe word:* STOCKY
   GROCKY

7. The short bandit/ jumped/ into the getaway car.
   The witness/ gave a description/ of him.
   / of the bandit.
   The witness/ remained calm/ during the questioning.
   *Probe word:* SHORT
   THORT

8. The squat mystic/ expounded/ on a religious doctrine.
   The devotees/ believed wholeheartedly/ in him.
   / in the mystic.
   The devotees/ listened/ with wholehearted fervor.
   *Probe word:* SQUAT
   KUAT

9. The masked robber/ took/ the saleswoman/ hostage.
   The house detective/ tried/ to talk/ to him.
   / to the robber.
   The house detective/ entered/ the rear door.
   *Probe word:* MASKED
   NASKED

*Abstract Probes*

10. The proud king/ handed down/ the crown/ to the somber princess.
    It was an occasion/ of great satisfaction/ for him.
    It was an occasion/ celebrated/ throughout the land.
    *Probe word:* PROUD
    BROUD

11. The stern judge/ sentenced/ the matronly woman.
    The astonished crowd/ turned/ to look at him.
    / to look at the judge.
    *Probe word:* STERN
    GLERN

12. The glib salesman/ demonstrated/ the digital stereo.
    The customer/ paid/ no attention/ to him.
    / to the salesman.
    *Probe word:* GLIB
    KLIB

13. The slick conman/ convinced/ the naive woman/ to give up her money.
The bank/ was not able/ to stop him.
/ to stop the conman.
The bank/ was informed/ by the police.
*Probe word:* SLICK
GLICK

14. The shy clown/ had added/ a wooden puppet/ to the act.
All the neighborhood children/ wanted/ to play/ with him.
/ with the clown.
All the neighborhood children/ were jumping/ with excitement.
*Probe word:* SHY
THY

15. The sharp engineer/ described/ his new design.
The executives/ had been told/ to evaluate him.
/ to evaluate the engineer.
The executive/ had been told/ to take/ careful notes.
*Probe word:* SHARP
THARP

16. The eager scientist/ presented/ a startling new theory.
Only VIPs/ were allowed/ to question him.
/ to question the scientist.
Only VIPs/ were allowed/ to ask questions.
*Probe word:* EAGER
NEAGER

17. The polite M.C./ made/ a long introduction.
Everyone/ was bored/ by him.
/ by the M.C.
Everyone/ shifted about/ restlessly.
*Probe word:* POLITE
GOLITE

18. The humble ballerina/ received/ flowers / from the conductor.
The musicians/ in the orchestra / smiled/ at her.
/ at the ballerina.
The musicians/ in the orchestra/ got ready/ to leave.
*Probe word:* HUMBLE
BUMBLE