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## THE COMPREHENSION OF CONCEPTUAL ANAPHORA IN DISCOURSE

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### Abstract

A primary constraint on using a pronominal anaphor is that it must agree with its antecedent in number. However, there are situations in which pronouns act as conceptual anaphors. For example, in the discourse, "I think I'll order a frozen margarita. I just love them.", the pronoun "them" does not refer to a single margarita, but perhaps all the margaritas the speaker has ever tasted. When anaphors operate in this way, they are often mismatched with their literal antecedent in number. Three situations when conceptual anaphora occurs are identified: when referring to the members of a Collective Set (as opposed to the set per se), a Multiply occurring Item or Event (versus a Unique Item/Event), or a Generic Type (versus a Specific Token). Two experiments are reported. The first demonstrated that subjects consider a mismatched, plural pronoun more natural than a matched, singular pronoun when it follows a Collective Set, Multiple Item/Event, or Generic Type noun. Conversely, subjects consider a matched, singular pronoun more natural when it follows an Individual Member of a set, Unique Item/Event, or Specific Token noun. The second experiment demonstrated that subjects comprehend a mismatched, plural pronoun faster than a matched, singular pronoun when it follows a Collective Set, Multiple Item/Event, or Generic Type noun, but they comprehend a matched, singular pronoun faster when it follows an Individual Member, Unique Item/Event, or Specific Token noun. This suggests that when comprehenders encounter conceptual--though mismatched anaphors--they do not have to reinstate the multiple entities into their mental representations.

A convenient feature of language is that it provides mechanisms for referring back to people or things previously mentioned. One such mechanism is anaphora. Over the past few years, many cognitive psychologists have been interested in understanding how comprehenders resolve discourse anaphora.<sup>1</sup> That is, how do comprehenders access from their mental representations the correct referent for an anaphoric expression? This question is also of interest to Artificial Intelligence specialists, particularly those working on Natural Language Processing (NLP) systems.

Anaphora resolution in many NLP systems is accomplished via certain heuristics, presumably the same heuristics employed by human comprehenders. Tyler and Marslen-Wilson (1981) have identified four possible constraints that guide this heuristic process. They are (a) Lexical Constraints, cued by lexical markings such as number, gender, and case, (b) Syntactic Constraints, (c) Thematic Constraints, cued by discourse markings such as topic, focus, or foregrounding, and (d) Pragmatic Constraints, provided by the comprehender's knowledge and inferential reasoning about the real world.

Heuristics which follow lexical constraints--number, gender, and case--are most easily incorporated into NLP systems. They are also the heuristics which human comprehenders acquire earliest (Palermo & Molfese, 1972) and which novice writers are most successful at applying (Bartlett, 1984).

This paper focuses on a particular use of pronominal anaphora, a use that one might assume would cause difficulty for comprehenders. At least, it is known that this type of anaphoric expression creates problems for virtually all extant

NLP systems (cf. Webber, 1984). The reason is that this type of construction clearly violates one of the most elementary, lexical constraints. An example, given by Sidner (1984), is the following:

- (1a) My neighbor rides a monster Harley 1200.
- (1b) They are really huge but gas-efficient bikes.

In this discourse, there is a blatant mismatch between the number of the pronoun and its supposed antecedent. The anaphor in (1b) clearly requires a plural antecedent; yet there are only singular nouns available in (1a). However, such mismatches occur rather frequently. Consider the following utterances overheard in a bar:

- (2a) I think I'll order a frozen margarita.
- (2b) I just love them.

Or the following comments overhead on a university campus:

- (3a) My roommate was so excited. She actually made an A.
- (3b) She doesn't make them very often.

Or the following exchange between the author (A) and a friend (F):

- (4a) F: I can't believe you have a Fiat.
- (4b) A: Why is that?
- (4c) F: They're so temperamental.

Or the following statements the author made a few days after the exchange in (4a-c).

- (5a) I need to call the garage [where her car was being serviced].
- (5b) They said they'd have it ready by five o'clock, but I'm sure they won't.

In each of these instances, the mismatch occurs because the pronominal anaphor is not intended to map literally onto a preceding noun; rather these anaphors are intended to refer in a more conceptual manner. The speaker in (2) was not proclaiming her affection for one specific frozen margarita; rather she appeared to be proclaiming affection for all frozen margaritas in the universe (or at least those the speaker had tasted). Similarly, the author's friend in (4) was not diagnosing the personality of the specific token of Fiats that the author owns, but the generic type of automobile. And when the author stated that she needed to call the garage, she was not literally referring to a physical structure or place of business, but the mechanics who work there.

Such cases of conceptual anaphora can be simply classified--albeit roughly--as occurring in at least three situations. In example (5), the literal antecedent is a collective noun, a noun that refers to a collection or set of individuals. The mismatched plural pronoun is intended to refer to the individual members of the collection rather than the set per se. Conceptual anaphors are used frequently to refer to the individual members of what are traditionally considered Collective Sets (e.g., team, group, musical band) as in the examples below:

- (6a) The substitute teacher begged the class to stop misbehaving.

(6b) But they didn't pay any attention to her.

Conceptual anaphors are also used to refer to the members of less traditional Collective Sets, for example:

(7a) After college, my sister went to work for IBM.

(7b) They made her a very good offer.

(8a) You wouldn't believe how bad it is to work for the city of Eugene.

(8b) They can never tell you whether your job will be covered in the next month's budget.

(9a) I need to call Sears.

(9b) They made a mistake on my last credit card bill.

A second situation when conceptual anaphora is used is when referring to things one is likely to have multiples of, or events one is likely to experience repeatedly, for example:

(10a) I need a plate.

(10b) Where do you keep them?

(11a) Yesterday was my birthday.

(11b) I used to really dread them, but yesterday I didn't care.

(12a) I just spilled something. Would you go get me a paper towel?

(12b) They're in the kitchen.

In the above examples, the literal antecedent is a sole item or event; however, because most households possess more than one plate (and presumably keep those plates together), most people have more than one birthday, and paper towels are usually dispensed in a roll of many, the intended reference is to these Multiple Items or Events. Thus, a conceptual anaphor, resulting in a mismatched pronoun, is used.

A third situation arises when conceptual anaphors are used to refer to Generic Types as in the following:

(13a) My mother's always bugging me to wear a dress.

(13b) She thinks I look good in them, but I don't.

(14a) Carla is downstairs watching a soap opera.

(14b) If she had her way, she'd watch them all afternoon.

(15a) I enjoy having a pet.

(15b) They are such good companions.

In this situation, the mismatched plural pronoun is intended to refer to a concept in general. For instance, it is soap operas in general, rather than the specific one Carla is currently watching, that the speaker in (16) believes Carla could watch all afternoon.<sup>2</sup>

The present classification scheme is not presented as a formal distinction. It is possible that the boundaries between these three situations are actually fuzzier or that stricter boundaries are needed. However, what is common among

these sentence pairs is that the pronoun in the second sentence refers to something more than what is explicitly mentioned in the first sentence. In other words, these pronouns are operating as conceptual (or implicit) anaphors as opposed to literal (or explicit) anaphors.

On the other hand, there are situations when a literal mapping between an antecedent and its anaphor is intended. For example, this occurs when an Individual Member of a collective set is singled out. In this situation, a matched, singular pronoun is used, as in the examples below:

(6c) The substitute teacher begged the student to stop misbehaving.

(6d) But he didn't pay any attention to her.

(7c) After college, my sister went to work for the vice president of IBM.

(7d) He made her a very good offer.

(8c) You wouldn't believe how bad it is to work for the mayor of Eugene.

(8d) He can never tell you whether your job will be covered in the next month's budget.

Similarly, there are situations in which a literal mapping between an anaphor and its antecedent is intended because the item or event being referred to is Unique (i.e., one is likely to have only one of such an item, or experience such an event only once). In this situation, a matched, singular pronoun is used. Compare, for example, the following three sentence pairs with (10a&b), (11a&b), and (12a&b), respectively:

(10c) I need an iron.

(10d) Where do you keep it?

(11c) Yesterday was my fortieth birthday.

(11d) I used to really dread it, but yesterday I didn't care.

(12c) I just spilled something. Would you go get me a mop?

(12d) It's in the kitchen.

Finally, there are situations when a literal mapping between an antecedent and its anaphor is intended because the preceding, coreferential noun has been identified so distinctly that it represents a Specific Token of a class of items, for example:

(13c) My mother's always bugging me to wear a dress that she bought me last year for Christmas.

(13d) She thinks I look good in it but I don't.

(14c) Carla is downstairs watching a soap opera that stars Michael Lewis.

(14d) If she had her way, she'd watch it all afternoon.

(15c) I enjoy having a pet canary named "Chatty".

(15d) She is such a good companion.

The present research was undertaken to answer two major questions about the comprehension of conceptual anaphora. The first question was this: How natural do comprehenders find references to conceptual antecedents via mismatched pronouns? That is, are comprehenders disturbed by these mismatches? Or do they

find them comprehensible because the antecedent noun represents a Collective Set, Multiple Item/Event, or Generic Type? If so, then presumably comprehenders would find mismatched pronouns less natural when the antecedent noun represents an Individual Member, Unique Item/Event, or a Specific Type. To empirically investigate this question, an experimental approach was taken in which the same sentence was presented in one of four different conditions.

### Method

Sixteen sets of four sentence pairs were constructed for each of the three discourse situations when conceptual vs literal anaphora is used (i.e., reference to Collective Sets vs Individual Members, Multiple Events/Items vs Unique Events/Items, and Generic Types vs Specific Tokens). Two of the four sentence pairs were formed by preceding a sentence containing either a Plural or a Singular pronoun by a sentence with a Collective Set, Multiple Event/Item, or Generic Type noun. The other two sentence pairs were formed by preceding either a Plural or a Singular pronoun by a sentence containing an Individual Member of a Collective Set, a Unique Event/Item, or a Specific Token noun. An example set of four sentence pairs of each situation is shown in Table 1.

Table 1

---

The substitute teacher begged the class to stop misbehaving.	Collective Noun
But they didn't pay any attention to her.	Plural Pronoun
The substitute teacher begged the class to stop misbehaving.	Collective Noun
But it didn't pay any attention to her.	Singular Pronoun
The substitute teacher begged the student to stop misbehaving.	Individual Noun
But they didn't pay any attention to her.	Plural Pronoun
The substitute teacher begged the student to stop misbehaving.	Individual Noun
But he didn't pay any attention to her.	Singular Pronoun
I need a plate.	Multiple Noun
Where do you keep them?	Plural Pronoun
I need a plate.	Multiple Noun
Where do you keep it?	Singular Pronoun
I need a iron.	Unique Noun
Where do you keep them?	Plural Pronoun
I need an iron.	Unique Noun
Where do you keep it?	Singular Pronoun
My mother's always bugging me to wear a dress.	Generic Type
She thinks I look good in them but I don't.	Plural Pronoun

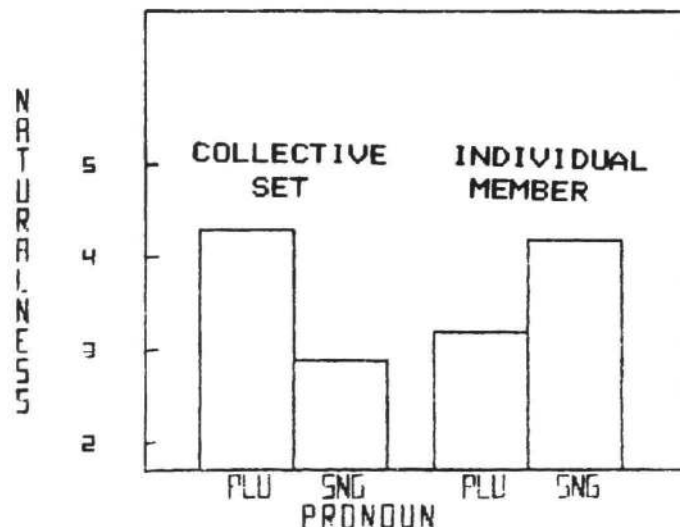
My mother's always bugging me to wear a dress. She thinks I look good in it but I don't.	Generic Type Singular Pronoun
My mother's always bugging me to wear a dress that she bought me last year for Christmas. She thinks I look good in them but I don't.	Specific Token Plural Pronoun
My mother's always bugging me to wear a dress that she bought me last year for Christmas. She thinks I look good in it but I don't.	Specific Token Singular Pronoun

These sentences were presented to 65 college-aged subjects. To minimize the subjects' exposure to similar sentences, each subject was presented with only two members of each set of four sentence pairs: one of the 2 sentence pairs with a Collective Set, Generic Type, or Multiple Noun and one of the 2 sentence pairs with an Individual Member, Specific Token, or Unique Noun. Thus, each subject was presented with 96 of the 192 sentence pairs. The subjects' task was to read each sentence pair and to rate "how natural" the second sentence seemed in reference to the first. The meaning of "natural," the subjects were told, was "how likely it is that you might hear such a sentence or produce such a sentence." To indicate their ratings, subjects used a 5-point scale where 5 meant "Very natural" and 1 meant "Not very natural."

**Results**

**Collective Sets vs Individual Members.** The mean ratings for the sentences following sentences with Collective Set vs Individual Member nouns are shown in Figure 1. The two bars on the left represent the mean ratings of the sentences when they contained either Plural or Singular pronouns, respectively, and they followed sentences with Collective Set nouns. The two bars on the right represent the mean ratings of the sentences when they contained either Plural or Singular pronouns, respectively, and they followed sentences with Individual Member nouns. An analysis of variance (ANOVA) revealed neither a main effect of pronoun number (Plural vs Singular) nor one of preceding noun (Collective vs Individual) [both  $p$ s > .4]. There was, however, a significant interaction between these two variables [ $\min F(1,24) = 52.77$ ].<sup>3</sup>

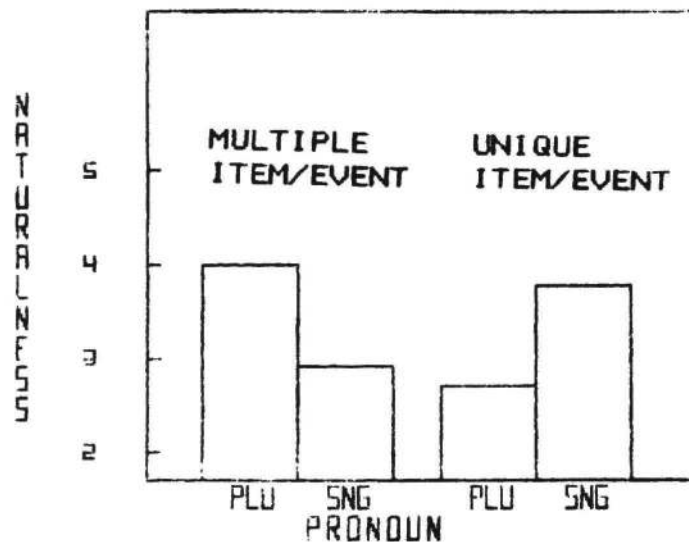
Figure 1



Additional planned comparisons revealed the following: When the sentences followed sentences with Collective nouns, they were rated significantly more natural when they contained Plural than Singular pronouns [ $\min F'(1,22) = 37.46$ ]. In contrast, when the sentences followed sentences with Individual nouns, they were rated significantly more natural when they contained Singular than Plural pronouns [ $\min F'(1,26) = 21.63$ ]. In addition, when the sentences contained Plural pronouns, they were rated considerably more natural when they followed sentences with Collective than Individual nouns [ $\min F'(1,24) = 28.55$ ]. In contrast, when the sentences contained Singular pronouns, they were rated considerably more natural when they followed sentences with Individual than Collective nouns [ $\min F'(1,21) = 27.20$ ].

**Multiple Items/Events vs Unique Items/Events.** The mean ratings for the sentences containing Plural vs Singular pronouns following sentences with Multiple vs Unique nouns are shown in Figure 2. The two bars on the left represent the mean ratings of the sentences when they contained either Plural or Singular pronouns, respectively, and they followed sentences with Multiple Items/Events nouns. The two bars on the right represent the mean ratings of the sentences when they contained either Plural or Singular pronouns, respectively, and they followed sentences with Unique Items/Events nouns. An ANOVA again revealed no main effect of pronoun number [ $\min F' < 1.0$ ], although there was a marginally significant effect of preceding noun: Sentences following Multiple nouns were rated slightly more natural ( $M = 3.45$ ) than sentences following Unique nouns ( $M = 3.23$ ) [ $\min F'(1,24) = 3.97$ ;  $p < .07$ ]. More interestingly, there was a significant interaction between these two variables [ $\min F'(1,23) = 44.51$ ].

Figure 2



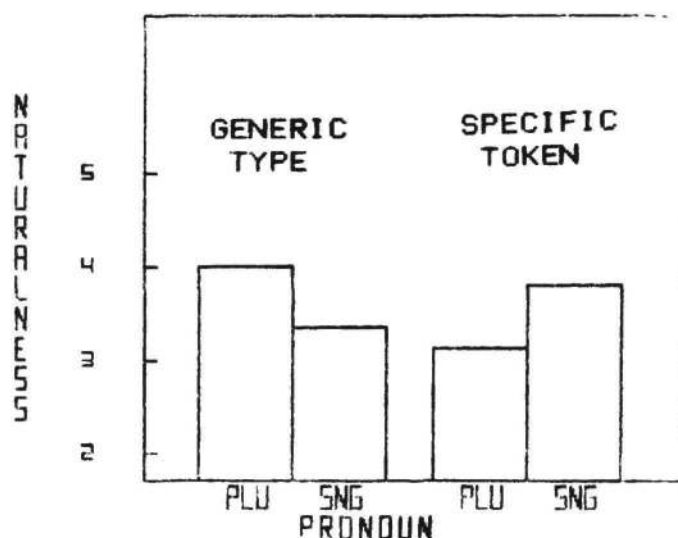
Again, planned comparisons revealed the following pattern: When the sentences followed sentences with the Multiple nouns, they were rated significantly more natural when they contained Plural pronouns [ $\min F'(1,20) = 24.33$ ]. In contrast, when the sentences followed Unique nouns, they were rated significantly more natural when they contained Singular pronouns [ $\min F'(1,36) = 48.50$ ]. In addition, when the sentences contained Plural pronouns, they were rated more natural when they followed sentences with Multiple nouns [ $\min F'(1,32) = 60.16$ ]. In contrast, when the sentences contained Singular pronouns, they were



rated considerably more natural when they followed Unique nouns [ $\min F'(1,20) = 15.23$ ].

**Generic Types vs Specific Tokens.** The mean ratings for the sentences containing Plural vs Singular pronouns following sentences with Generic Type vs Specific Token nouns are shown in Figure 3. An ANOVA again revealed no main effect of pronoun number (Plural vs Singular) or preceding noun (Generic Type vs Specific Token) [both  $p_s > .4$ ], only a significant intereaction between these two variables [ $\min F'(1,20) = 16.80$ ].

Figure 3



Additional planned comparisons revealed a familiar pattern: When the sentences followed sentences with Generic Type nouns, they were rated significantly more natural when they contained Plural pronouns [ $\min F'(1,20) = 9.318$ ]. In contrast, when the sentences followed sentences with Specific Token nouns, they were rated significantly more natural when they contained Singular pronouns [ $\min F'(1,24) = 13.87$ ]. In addition, when the sentences contained Plural pronouns, they were rated considerably more natural when they followed Generic Type nouns [ $\min F'(1,19) = 13.07$ ]. In contrast, when the sentences contained Singular pronouns, they were rated considerably more natural when they followed Specific Type nouns [ $\min F'(1,19) = 5.410$ ].

In summary, these results suggest strongly that comprehenders find references to conceptual antecedents via mismatched pronouns very natural. In fact, they find the use of a mismatched pronoun more natural than a matched pronoun. Yet it is because the preceding noun represents a Collective Set, Multiple Item/Event, or Generic Type that subjects find these mismatches acceptable. That is, they find mismatched pronouns considerably less natural when the preceding noun represents an Individual Member, Unique Item/Event, or a Specific Type.

The second question motivating this research was how difficult is it to map conceptual vs literal anaphors onto their intended antecedents? One prediction is that it is always difficult to map a plural pronoun onto a singular noun because on encountering a singular noun, only a single entity is established in the comprehender's mental representation of the discourse (e.g., the "discourse model" of Webber 1984, "discourse file" of Givon, 1979, or "mental model" of

Johnson-Laird, 1983). According to this prediction, when one subsequently encounters a mismatched pronoun, additional entities have to be reinstated. An opposite prediction is that it is only difficult to map a mismatched pronoun when it is used as a literal anaphor (i.e., it refers to an Individual Member, Unique Item/Event, or a Specific Token noun). But when a mismatched pronoun is used as a conceptual anaphor (i.e., it refers to a Collective Set, Multiple Item/Event, or Generic Type noun), it is no more difficult to map than mapping a matched pronoun to a literal anaphor. This would be the case if on encountering Collective Set, Multiple Item/Event or Generic Type nouns, comprehenders automatically incorporate multiple entities into their mental representations, though when encountering Individual Member, Unique Item/Event, or Specific Token nouns, only a single entity is instantiated.

An experimental paradigm frequently used to investigate anaphoric mapping is to measure the amount of time required for a comprehender to read a sentence containing the anaphoric reference (Clark & Sengul, 1979; Garrod & Sanford, 1977; Garrod & Sanford, 1983; Garnham, 1980, Garnham, 1984; Haviland & Clark, 1974; Malt, 1985; Sanford & Garrod, 1981; Yekovitch & Walker, 1978; Yekovitch, Walker, & Blackman 1979). Presumably, the more time required to read the sentence, the more difficult the mapping process. If on encountering a plural pronoun that refers to a Collective Set, Multiple Item/Event, or Generic type, comprehenders have to reinstate these multiple entities, then their reading time for these sentences should be longer than when a singular pronoun is used. On the other hand, if comprehenders automatically incorporate multiple entities into their mental representations, then their reading times should be shorter when a plural as opposed to singular pronoun is used. And the opposite would be true of situations employing literal anaphora (i.e., references to an Individual Member, Unique Item/Event, or Specific Token).

### Method

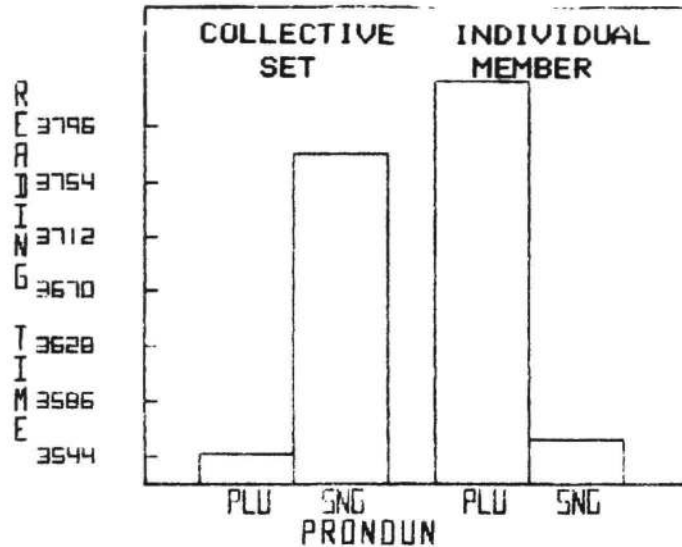
The same materials were used as in the first experiment. Each of 72 subjects was tested individually. The subject was seated in front of a video display monitor. For each pair of sentences, the first sentence appeared toward the top of the video display screen and remained there for a period of time proportionate to the number of characters it contained. After this first sentence disappeared, the second sentence appeared toward the bottom of the screen. This second sentence remained visible until the subject pressed a key to indicate that he/she was finished reading the sentence. Immediately after the second sentence of the pair disappeared, the word "Paraphrase" appeared on the screen. At this point the subject "retold [aloud] the sentence in his/her own words." The paraphrase task was included to ensure that subjects would read the sentence pairs for comprehension, rather than simply pressing the key as rapidly as possible. Each subject's paraphrases were recorded on audio tape.

### Results

**Collective Sets vs Individual Members.** The mean reading times for the sentences containing Plural vs Singular pronouns following sentences with Collective vs Individual nouns are shown in Figure 4. Note that the interpretation of the direction of the reading time figures should be opposite that of the naturalness rating figures: A shorter bar on the graph represents a faster reading time, which is interpreted as greater ease in comprehending the sentence.<sup>4</sup> An ANOVA revealed no main effect of pronoun number (Plural vs

Singular) or of preceding noun (Collective vs Individual) [both  $\min F'$ 's < 1.0], only a significant interaction between the two [ $\min F'(1,33) = 8.76$ ].

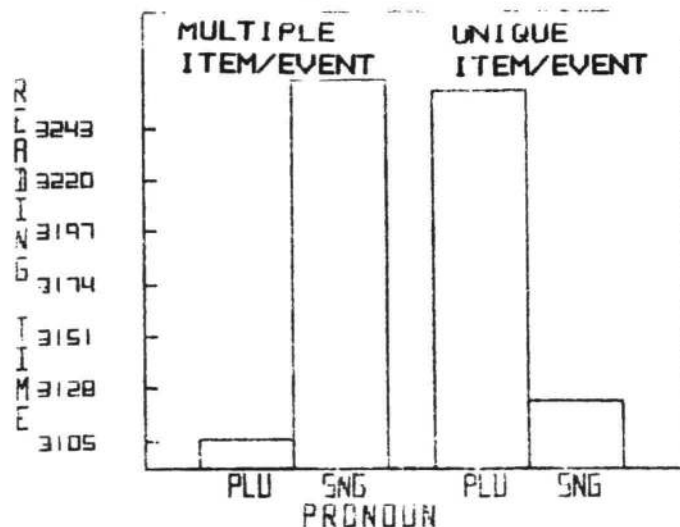
Figure 4



Additional planned comparisons revealed the following: When the sentences followed sentences with Collective nouns, they were read faster when they contained Plural pronouns [ $\min F'(1,28) = 4.008$ ]. In contrast, when the sentences followed sentences with Individual nouns, they were read significantly faster when they contained Singular pronouns [ $\min F'(1,33) = 4.277$ ]. In addition, when the sentences contained Plural pronouns, they were read considerably faster when they followed Collective nouns [ $\min F'(1,29) = 4.961$ ]. In contrast, when the sentences contained Singular pronouns, they were read faster when they followed Individual nouns [ $F_1(1,68) = 10.38$ ;  $F_2(1,15) = 5.99$ ;  $\min F'(1,33) = 3.637$ ,  $p < .07$ ].

**Multiple vs Unique Items/Events.** The mean reading times for the sentences containing Plural vs Singular pronouns following sentences with Multiple vs Unique nouns are shown in Figure 5. An ANOVA again revealed no main effect of pronoun number (Plural vs Singular) or preceding noun (Multiple vs Unique) [both  $\min F'$ 's < 1.0], only a significant interaction between the two [ $\min F'(1,59) = 7.203$ ].

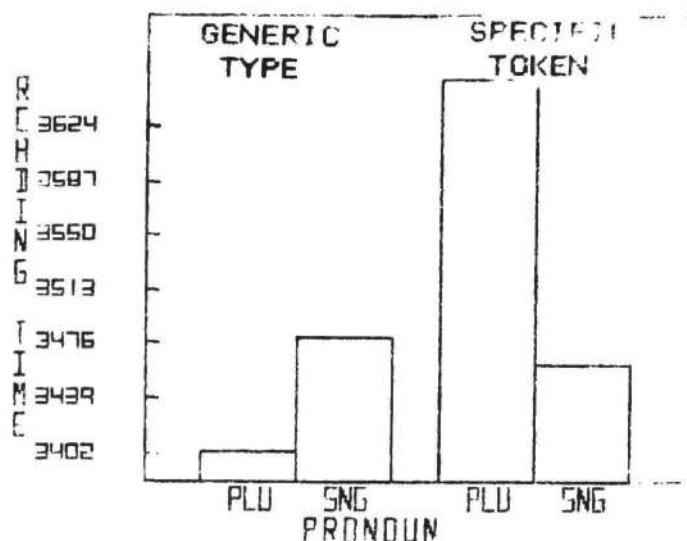
Figure 5



Again, planned comparisons revealed the following pattern: When the sentences followed sentences with the Multiple nouns, they were read significantly faster when they contained Plural pronouns [ $F_1(1,68) = 5.903$ ;  $F_2(1,15) = 6.578$ ]. In contrast, when the sentences followed Unique nouns, they were read significantly faster when they contained Singular pronouns [ $F_1(1,68) = 4.559$ ;  $F_2(1,15) = 7.689$ ]. In addition, when the sentences contained Plural pronouns, they were read faster when they followed sentences with Multiple nouns [ $F_1(1,68) = 5.114$ ;  $F_2(1,15) = 7.272$ ]. In contrast, when the sentences contained Singular pronouns, they were read considerably faster when they followed Unique nouns [ $F_1(1,68) = 6.098$ ;  $F_2(1,15) = 4.106$ ].

**Generic Types vs Specific Tokens.** The mean reading times for the sentences containing Plural vs Singular pronouns following sentences with Generic Type vs Specific Token nouns are shown in Figure 6. Again the main effects of pronoun number (Plural vs Singular) and preceding noun (Generic Type vs Specific Token) [both  $p_s > .40$ ] were not significant, but the interaction between the two was [ $\text{min}F'(1,35) = 4.223$ ].

Figure 6



Additional planned comparisons revealed that the interaction differed from the pattern observed in the reading time data for the other two conceptual-vs-literal anaphora situations, as well as the naturalness ratings for this situation: When the sentences followed sentences with Generic Type nouns, they were read just as fast when they contained Plural as Singular pronouns; that is, there was no significant difference between their mean reading times [ $\text{min}F' < 1.0$ ]. In contrast, when the sentences followed sentences with Specific Token nouns, they were read significantly faster when they contained Singular pronouns [ $F_1(1,68) = 8.776$ ;  $F_2(1,15) = 5.864$ ]. In addition, when the sentences contained Plural pronouns, they were read significantly faster when they followed Generic Type nouns [ $\text{min}F'(1,26) = 4.819$ ]. However, when the sentences contained Singular pronouns, they were read just as fast when they followed Specific Token as Generic Type nouns [ $\text{min}F' < 1.0$ ]. In other words, subjects comprehended the Generic Type-Singular sentences at the same rate as they comprehended the Generic Type-Plural or the Specific Token-Singular sentences.

It is curious why subjects had little difficulty when the singular pronouns referred to Generic Type nouns. Because this was the only effect in the reading time data that failed to mirror what was observed in the naturalness ratings, it was examined further. An additional source of data which could illuminate how subjects interpreted these Generic Type-Singular pronoun sentences was their paraphrases. These paraphrases indicated that for several of the sentences in this condition, instead of interpreting the singular pronoun as an awkward coreferent subjects interpreted it as a dummy subject. Their resulting paraphrases were formed via extraposition of a participial clause and It-Insertion. For example, a majority of the subjects paraphrased the following Generic Type-Singular pronoun sentence pair

(16a) My neighbor rides a moped.

(16b) I think it's dangerous.

as

(16c) I think it's dangerous to ride mopeds.

This was in contrast to the same sentence pair presented with a plural pronoun

(16d) My neighbor rides a moped.

(16e) I think they're dangerous.

for which the modal paraphrase was

(16f) Mopeds are dangerous.

It was also in contrast to the same sentence pair presented with a singular pronoun, and preceded by the Specific Token noun

(16g) My neighbor rides a moped that doesn't even have a light.

(16h) I think it's dangerous.

for which the modal paraphrase was

(16i) My neighbor's moped is dangerous because it doesn't have a light.

Thus, subjects had little difficulty mapping a singular pronoun onto a Generic Type because they simply did not attempt to. Rather, they handled this awkward coreference by interpreting it as a different construction.

In summary, it does not appear that on encountering a conceptual anaphor comprehenders have to reinstate multiple entities into their mental representation. However, it is possible that such mismatched pronouns do cause momentary processing difficulties but these momentary difficulties are quickly resolved when integrating the two sentences. Perhaps the reading time paradigm used in this experiment only demonstrates integration processes, and other on-line measures (e.g., Gernsbacher, 1986) would better demonstrate immediate mapping processes and any incurred mapping difficulties.

### Conclusions

These data suggest that not only are conceptual anaphors considered natural but they are relatively easily comprehended. Although currently problematic for most NLP systems, the use of conceptual anaphora for human comprehenders is a convenience. Unlike other types of anaphors, they provide more than verbal

shorthand. That is, they operate beyond simply saving a speaker's breath or a writer's pens: They allow extension. Although the function of coreference has been suggested throughout this paper, these anaphors more closely resemble the function of cospecification suggested by Sidner (1984). (Indeed, there are some who might suggest that these situations are not cases of anaphora at all; yet, I am in agreement with Stenning (1978), that these situations are a bonafide use of anaphora.)

This research provides only a demonstration, not an explication. Several questions remain about the use of conceptual anaphora. For example, what are the boundary conditions for interpreting nouns as Multiple Item or Events? What features of the following sentence

(17a) I just washed a plate.

identifies uniqueness so that (17b) is an appropriate sequiter?

(17b) Where should I put it?

How does the knowledge that the speaker is in a store convert the following reference to a Unique Item/Event into a reference to a Multiple Item/Event?

(18a) I need an iron.

(18b) Where aisle are they on?

These and other questions deserve further investigation.

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#### Footnotes

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1. See, for example, Anderson, Garrod, & Sanford (1983); Caramazza, Grober, Garvey, & Yates (1977); Clark & Sengul (1978); Corbett (1984); Corbett & Chang (1983); Dell, McKoon, & Ratcliff (1983); van Dijk & Kintsch (1983, Ch. 5); Erhlich (1980); Garrod & Sanford (1977, 1983); Garnham (1981, 1984); Hirst & Brill (1980); Malt (1985); McKoon & Ratcliff (1980); Sanford & Garrod (1981); Yekovich, & Walker (1978); Yekovich, Walker, & Blackman (1979).

2. It has been suggested that the Generic Type vs Specific Token distinction is similar to the traditional distinction between "nonspecific" and "specific" nouns (Chafe, personal communication). Yet the more traditional distinction is too broad (see Prince, 1981, for a similar view). In particular, the traditional distinction fails to capture the present distinction between nouns representing Generic Types and Multiple Events/Items.

3. Two parallel sets of analyses were conducted on each effect; in one set of analyses, "subjects" were considered a random factor, and in the other, "items" were considered a random factor. The results reported are based on the minF' statistics (Clark, 1973) when significant at the .05 level or lower. When the



minF' statistic is only marginally significant ( $.05 > p < .08$ ), the separate "subjects"  $F_1$  statistic and "items"  $F_2$  statistic are reported.

4. The figures for the reading time data have been scaled individually for each conceptual-vs-literal anaphora situation. The reason for this is that the average number of characters in the sentences differed across the three situations. The sentences following sentences with Collective Set vs Individual Member nouns were an average 44.31 characters long; those following Multiple vs Unique Items/Events nouns were an average 45.09 characters, whereas those following Generic Type vs Specific Token nouns were 35.81 characters. Because number of characters is one of the factors affecting reading time (Haberlandt & Grasser, 1985), the reading time for the sentences following Generic Type vs Specific Token nouns were, on the average, faster than those following the other two situations. Of course, the sentences for the four conditions within each of the three situations did not differ in number of characters because the same sentences were cycled through each of the four conditions.