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Syntactic Context and the Interpretation of VP Anaphors<sup>1</sup>

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Hankamer and Sag (1976) have proposed that all anaphoric devices can be divided into two classes—roughly, those which find their antecedents at a linguistic level of representation, called surface anaphors, and those which find their antecedents at a conceptual level of representation, called deep anaphors. This classification unifies two observations about the interpretation of anaphors; namely, (1) that not all anaphors require the presence of a linguistic antecedent and (2) that only anaphors that require a linguistic antecedent place constraints on the syntactic form of that antecedent.

This first observation, that deep, but not surface anaphors, can be resolved with a non-linguistic antecedent, is illustrated in examples (2) and (3) in which the surface anaphor is represented with an ellided verb phrase (VPE), and the deep anaphor is represented with a "do it" anaphor.

- (2) Imagine the following scenario: John, the proverbial protagonist of most linguistic stimuli, lives with two housemates, Mary and Bill. It's morning. John comes to the table carrying an empty box of Sugar Bombs cereal, and notices that his housemates have full bowls of cereal. John tries to shake some cereal into his bowl but the box is empty. So, John asks:

"Alright, who ate the last of my Sugar Bombs?"

Bill responds:

"Mary did it." (deep anaphor)

and Mary responds:

"Bill did." (surface anaphor)

Note that when an antecedent is linguistically present, both the surface and deep anaphor responses to John's question are felicitous. Now let's make a slight alteration in the scenario (3).

- (3) After realizing that there are no more Sugar Bombs, John is so overcome with anger that he is unable to speak. He is, however, able to glare accusingly at both of his housemates. Buckling under the pressure of John's gaze, Bill blurts out:

\*"Mary did." (surface anaphor)

and Mary gushes:

"Bill did it." (deep anaphor)

In this scenario, when there is no linguistic antecedent, only Mary's deep anaphor response is felicitous.

The next example (4) illustrates the observation that only surface anaphors, which as we have just seen require a linguistically present antecedent, place constraints on the syntactic form of their antecedent. Antecedents of surface anaphors must be syntactically coherent. Roughly speaking, the notion of syntactic coherence can be cashed out as a constraint on the form of an antecedent such that the antecedent must be able to felicitously replace the anaphor without any major alterations in its surface form. This requirement is often referred to as syntactic parallelism. For example, for verb phrase anaphora, a verb phrase antecedent would be non-parallel with respect to its anaphor if it contained passive morphology while the elements comprising the anaphor did not.

(4) ANTECEDENT CONTEXT SENTENCES

Someone has to transcribe this tape. (parallel)

This tape has to be transcribed. (non-parallel)

ANAPHOR TARGET SENTENCES

I am sure John won't want to. (surface anaphor)

I am sure John won't want to do it. (deep anaphor)

Note that when the antecedent is syntactically parallel, both deep and surface anaphors are felicitous. However, when the antecedent is syntactically non-parallel, only the deep anaphor is felicitous.

The presence of a syntactic parallelism constraint for surface anaphors suggests that, contrary to standard language processing assumptions, surface syntactic representations when formed, must be maintained, at least briefly, in memory. The fact that syntactic parallelism requirements hold only for surface anaphors, coupled with the observation that deep anaphors require no linguistic antecedent at all, suggests that deep and surface anaphors access distinctly different types of representations when they are resolved. Sag and Hankamer (1984) incorporate this representational distinction into a processing model in which surface anaphors find their antecedents at a linguistic level of representation while deep anaphors find their

## INTERPRETATION OF VP ANAPHORS

antecedents within a discourse model or conceptual representation. This processing model predicts that during comprehension, surface anaphors should be sensitive to aspects of surface structure in a way that deep anaphors are not.

Despite the rather clearcut linguistic intuitions that have given rise to the deep-surface distinction, experimental evidence for the processing prediction, that the syntactic form of an antecedent should affect the interpretation of surface anaphors only, has been mostly negative. Tanenhaus and Carlson (1990) and Murphy (1985; 1990) found that, contrary to this prediction, both deep and surface anaphors take longer to comprehend when they are preceded by a syntactically non-parallel antecedent (although Tanenhaus and Carlson's judgment data supported the prediction.) Given the sharpness of the contrast illustrated in (4), these data are both puzzling and unexpected.

A possible explanation for these surprising data comes from an examination of the way in which syntactic parallelism was manipulated in previous experiments. In effect, these manipulations confounded syntactic parallelism with pragmatic factors. For instance, in Tanenhaus and Carlson (1990), approximately half of the non-parallel antecedents were passives with agent by-phrases while the remaining sentences were agentless passives. Passives with by-phrases are, for a variety of reasons, pragmatically less felicitous than their agentless correlates (Quirk et al, 1985). If longer comprehension times for deep anaphors in previous experiments were due to pragmatic factors, then the removal of pragmatic confounds should result in a pattern of response times that show that surface anaphors are sensitive to the surface form of their antecedents in a way that deep anaphors are not. Specifically, there should be greater response times to surface anaphors when preceded by non-parallel antecedents, than when preceded by parallel antecedents. In contrast, response times to deep anaphors should not differ as a function of the syntactic form of their antecedents. In Experiment 1, these predictions were tested using active declarative sentences as parallel antecedents with their passive correlates forming the non-parallel antecedents. The 28 experimental items in each list were intermixed with 56 filler sentence pairs, 25% of which were constructed so that the target sentence would not make sense given the context sentence. A sample set of experimental materials are given in (5).

## (5) ANTECEDENT CONTEXT SENTENCES

Someone needs to feed the kitten. (parallel)  
The kitten needs to be fed. (non-parallel)

## ANAPHOR TARGET SENTENCES

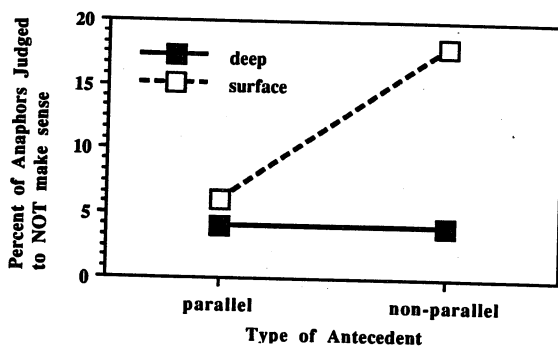
Joey forgot to again. (surface)  
Joey forgot to do it again. (deep)

Subjects performed a speeded make-sense judgment task in which they pressed a button after reading a context sentence which contained either a syntactically parallel or non-parallel antecedent. This button press caused the context sentence to disappear and revealed a target sentence containing either a surface or a deep anaphor. Subjects were instructed to press a "Yes" button if they thought that the target sentence made sense given the context sentence, and a "No" button if they thought it did not.

In a make-sense judgment task, two types of data are collected; the subjects' "yes" or "no" judgment data, and latencies or how long it took to make the "yes" judgments. Separate analyses of variance were conducted on the proportion of sentences judged to not make sense (judgment data), and on the response latencies for sentences judged to be sensible (latency data).

The percentage of target sentences judged to not make sense are presented in the following graph (Figure 1). The crucial interaction between Anaphor Type and Parallelism of Antecedent was significant. As can be seen, deep anaphors with parallel and non-parallel antecedents and surface anaphors with parallel antecedents were judged equally sensible. In contrast, surface anaphors preceded by a non-parallel antecedent were judged to make sense less frequently than either deep anaphors preceded by a non-parallel antecedent or surface anaphors preceded by a parallel antecedent.

Figure 1. Percentage of deep and surface anaphors judged to not make sense as a function of syntactic parallelism of antecedent.

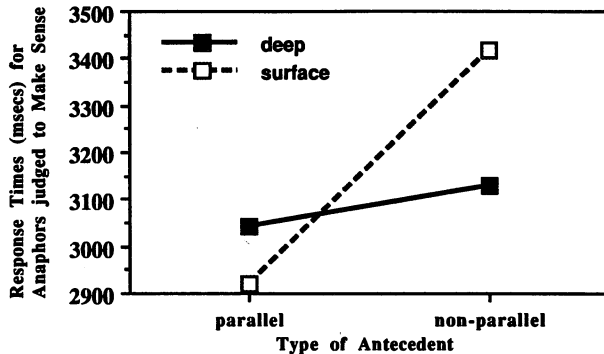


Analyzing latencies for sentences judged to make sense allows us to determine whether there are any processing differences for deep and surface anaphors that are not reflected in the judgment data. To see why this might be the case, it is useful to think about the sentences subjects are asked to judge as varying along some sort of felicity dimension, represented as a monotonically decreasing function. In a make-sense judgment task, each subject sets his or her own criterial point or threshold somewhere along this curve. Any sentence falling beyond this point will be judged to not make sense. However, unless a subject sets a very loose criterion for felicity, there will inevitably be some sentences that are less than perfectly felicitous, but are nevertheless not so bad as to elicit a "no" judgment. Generally, the closer a stimulus is to a criterial point, the more difficult decisions about that stimulus become. This difficulty is reflected in increases in response times. Thus, we expect to find increased response times for those items that are close to threshold but do not elicit a "no" judgment.

## INTERPRETATION OF VP ANAPHORS

Mean judgment latencies for target sentences judged to make sense are presented in the next graph (Figure 2). Crucially, the interaction between Anaphor Type and Parallelism of Antecedent is again significant. The pattern of significance for pairwise comparisons is the same as for the judgment data.

Figure 2. Response Latencies (msecs) of deep and surface anaphors judged to make sense as a function of syntactic parallelism of antecedent.

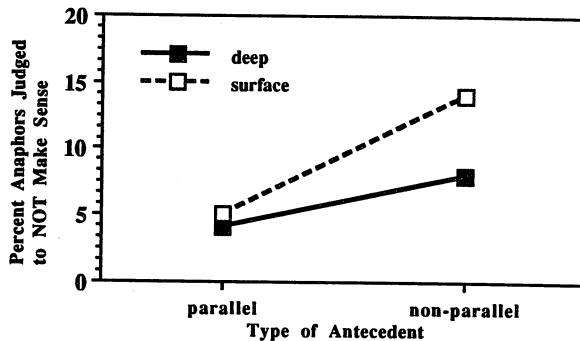


The results from Experiment 1 indicate that only surface anaphors are affected by the linguistic form of their antecedents. This result lends clear support to the processing hypothesis advanced by Hankamer and Sag (1984). Surface anaphors were judged to make sense more often when their antecedents were syntactically parallel than when they were syntactically non-parallel. In contrast, the antecedent's syntactic form had no effect on how deep anaphors were judged. And, in contrast to the latency results obtained by both Tanenhaus and Carlson (1990) and Murphy (1985; 1990), the pattern of judgment latencies in this experiment also show a clear interaction between anaphors type and parallelism of antecedent and thus support the distinction between deep and surface anaphors.

A second experiment was performed to confirm that the effects of syntactic parallelism obtained in previous experiments were due solely to pragmatic factors. In order to replicate the results from these studies, the hypothesized source of the pragmatic confound from those studies was reintroduced into the stimuli. The materials in Experiment 2 were similar to those in Experiment 1 with one exception ---in Experiment 2, the non-parallel antecedent context sentences all ended with a by-phrase, specifically "by someone". The "by someone" phrase was used because its interpretation closely matches the interpretation of the agentless passives in Experiment 1. The procedure in Experiment 2 was otherwise identical to that of Experiment 1.

The percentage of sentences judged to not make sense are shown in the next Figure (3). The only effect to reach significance was the main effect of Parallelism of Antecedent. The graph shows that both surface and deep anaphors were judged to make sense more often when preceded by a parallel antecedent than when preceded by a non-parallel antecedent. The difference between surface anaphors as a function of Parallelism was significant. The difference between deep anaphors as a function of Parallelism approached significance in the subjects analysis only. These results are similar to, although somewhat weaker than, those obtained by Tanenhaus and Carlson (1990). One reason why surface anaphors may have elicited fewer "no" judgments in this study than in Tanenhaus and Carlson's study, is that Tanenhaus and Carlson's surface anaphors included some sluicing cases and some items in which there were morphological differences between the verb form in the non-parallel antecedent and what the verb form would have to be in the target sentences. I will have more to say about this later in this paper.

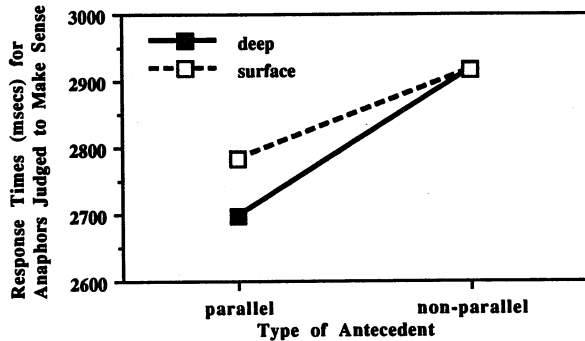
Figure 3. Percentage of deep and surface anaphors judged to not make sense as a function of syntactic parallelism of antecedent.



The next figure (4) shows the mean judgment latencies for target sentences. There was a main effect of Parallelism of Antecedent that was reliable only in the subjects analysis. Planned comparisons revealed that deep anaphors were judged to make sense more quickly when preceded by a parallel antecedent than a non-parallel antecedent in the analysis by subjects only. No other effects approached significance.

## INTERPRETATION OF VP ANAPHORS

Figure 4. Response Latencies (msecs) of deep and surface anaphors judged to make sense as a function of syntactic parallelism of antecedent.



The results of Experiment 2 are quite similar to those of Tanenhaus and Carlson (1990) and Murphy (1985) with respect to response latencies. It is interesting to note that, in contrast to Tanenhaus and Carlson (1990) in which a clear interaction between Type of Anaphor and Parallelism of Antecedent was obtained, no such interaction was found in this experiment. Tanenhaus and Carlson's (1990) results were, in fact, intermediate with respect to the results obtained in Experiment 1 and Experiment 2. Presumably, this is because only half of their non-parallel antecedents contained by-phrases which elevated the response times of deep anaphors in non-parallel contexts.

The results of Experiment 2 strongly suggest that the parallelism effect in reading times and judgment latencies for deep anaphors found in previous experiments was due, in large measure, to the presence of by-phrases in non-parallel antecedents. While there is no definitive answer to the question of why by-phrases induce the effects seen in Experiment 2 and in previous studies<sup>2</sup>, the resolution of this question is not germane to deep-surface anaphor processing distinction. What is relevant is that, when by-phrases are removed, we see syntactic parallelism effects in judgments and response latencies for surface anaphors only. Thus, the results reported here are taken as unambiguous support for both the representational hypothesis that surface anaphors find their antecedents at a linguistic level of representation while antecedents of deep anaphors are found at a non-linguistic, conceptual level of representation, as well as the processing model posited by Sag and Hankamer (1984).

Beyond the immediate result that the psycholinguistic evidence is now reconciled with linguistic intuitions, these results have wider implications. For the two decades, most psychologists have maintained that, while syntactic information might be used to develop a parse from which an interpretation is constructed,



interpretation itself proceeds without recourse to an abstract level of representation resembling structures proposed by linguists. To get an intuitive sense for this view, consider the following sentences (6) which, while there are some differences in emphasis, express essentially the same content.

- (6) a. John visited Mary in Los Angeles for two weeks.  
 b. Mary was visited by John in Los Angeles for two weeks.  
 c. In Los Angeles, John visited Mary for two weeks.  
 d. For two weeks, John visited Mary in Los Angeles.

A long-accepted finding has been that when people encode language, they encode only the gist of any linguistic input and that verbatim memory for what is heard or read is ephemeral (Sachs, 1967). This finding forms the basis for the widely-held view that structural information, if used at all, plays only an incidental role in language comprehension. It is maintained in memory just long enough for a conceptual representation to be built up and then it is discarded. This view has received empirical support from studies in which subjects report having seen certain target sentences when what they really saw were synonymous sentences, or several sentences from which the target sentences could have been inferred (Bransford and Franks, 1971). Up until now, researchers in language comprehension have been unable to find any evidence that suggests that structural information affects comprehension in any way beyond the construction of a parse.<sup>3</sup> The results of the two experiments in this paper are counter-evidence to both the claim that structural information is maintained only long enough to develop a conceptual representation, and to the claim that interpretation proceeds without recourse to syntactic representations. The interpretation of surface anaphors is dependent on the syntactic representation of their antecedents which must be maintained across sentential boundaries. Thus, for at least one class of discourse anaphor, it can be demonstrated that syntactic processes operate across discourse segments.

These results should also be considered in terms of the role language processing research can play in elucidating the nature of linguistic representations. Within language processing research, there have been few paradigms for investigating linguistic representations as distinct from conceptual representations. The differential sensitivity of deep and surface surface anaphors to syntactic representations may be used as a tool for determining which aspects of syntactic representation are involved in producing syntactic coherence effects. Some grammatical frameworks posit that syntactic phenomena are specific to discrete levels of syntactic representation. Sag and Hankamer (1984) have argued that the level at which syntactic coherence effects are mediated is not one of surface syntax, but rather a level in which representations are encoded in some structured logical language---a level of logical form. Given the strong linguistic evidence for this claim (see Sag and Hankamer, 1984 for arguments), the presence or absence of syntactic coherence effects may serve as a tool for testing representational claims. For instance, we would not expect syntactic coherence effects to obtain for relatively "surfacey" alterations in the verb morphology illustrated in (7), or for more abstract changes like variable binding (8), because at the level of logical form, the antecedents in (7) and (8) are syntactically coherent.

## INTERPRETATION OF VP ANAPHORS

299

## (7) ANTECEDENT CONTEXT SENTENCES

- a. I already fed the cat.
- b. I didn't feed the cat.

## TARGET SURFACE ANAPHOR SENTENCES

- a. I didn't know John was supposed to.
- b. I thought John was supposed to.

## TARGET DEEP ANAPHOR SENTENCES

- a. I didn't know John was supposed to do it.
- b. I thought John was supposed to do it.

## (8) My daughter has already learned to tie her shoes,

- a. but my son hasn't learned to, yet. (surface)
- b. but my son hasn't learned to do it, yet. (deep)

Finally, these data are relevant to the issue of how, when, and to what degree linguistic and conceptual representations are coordinated to form coherent interpretations. The data pattern obtained in both experiments suggests that such coordination must take place. After all, a strong form of the representational hypothesis predicts that a surface anaphor with a syntactically incoherent antecedent would be uninterpretable---a prediction not supported by the data. On average, surface anaphors with non-parallel antecedents were judged to make sense over 80% of the time. These results may, however, be misleading. The relative ease with which surface anaphors with non-parallel antecedents were interpreted may have been due to the fact that many of verbs used in the target sentences allowed for Null Complement anaphors (NCA), a form of deep anaphor illustrated in (9a).

- (9) a. Joey forgot again. (deep-NCA)
- b. Joey forgot to, again. (surface preceded by NCA)
- c. Joey forgot to do it, again. (deep)

Thus, if interpretation failed at a linguistic level of representation, it would still have been possible to construct an interpretation from the conceptual representation formed from the preceding null complement anaphor. Two experiments have been designed to test this hypothesis. The first experiment uses a form of surface anaphor, called sluicing (Ross, 1967), that is not preceded by a deep anaphor, as illustrated in (10). If the relative acceptability of surface anaphors in the first two experiments was due to a mediating deep anaphor, then surface anaphors preceded by non-parallel antecedents in this experiment should elicit much lower sensicality judgments and greater response times than their deep anaphor correlates<sup>4</sup>.

## (10) ANTECEDENT CONTEXT SENTENCES

- Someone ransacked my apartment last weekend. (parallel)
- My apartment was ransacked last weekend. (non-parallel)

## TARGET ANAPHOR SENTENCES

- The police still don't know who. (surface)
- The police still don't know who did it. (deep)

A more direct test of the deep anaphor mediation hypothesis is also in progress. By comparing the judgments elicited by surface anaphors constructed from verbs that can also function as null complement anaphors (NCA) with verbs that cannot when the parallelism of the antecedent is manipulated, as illustrated in (11), we should be able to determine whether a deep anaphor that precedes a surface anaphor can mediate interpretation and ameliorate syntactic coherence effects.

(11) ANTECEDENT CONTEXT SENTENCES

Tom really needed someone to type these reports. (parallel)  
 Tom really needed these reports to be typed. (non-parallel)

ANAPHOR TARGET SENTENCES

It was fortunate that John volunteered to. (NCA/Surface)  
 It was fortunate that John wanted to. (non-NCA/Surface)

While the results of the sluicing and NCA verb experiments will not provide us with any definitive answers about how linguistically structured representations are coordinated with conceptual level representations, they will constrain the sorts of models that can be posited to explain the role linguistically structured information plays in the interpretative process.

ENDNOTES

1. The work reported on in this paper was done in collaboration with Michael K. Tanenhaus and Greg N. Carlson, both from the University of Rochester and has been supported by NIH grant HD27206, awarded to Michael Tanenhaus and Greg Carlson. A preliminary version of this report was presented as a poster at the 1991 C.U.N.Y. Sentence Processing Conference, held at the University of Rochester, Rochester, NY.

2. With respect to why the presence of agent by-phrases might lead to this result, several hypotheses are possible. Agent by-phrases in passives often shift the focus away from the event and onto the agent. Thus, the processing of a subsequent verb phrase anaphor would be slowed because the focus had been shifted away from the event. Passives sentences are also quite rare. They comprise only 8% of the constructions found in written corpora. Out of this, only 20% contain by-phrases (Quirk, Greenbaum, Leach & Svartvik, 1985). Thus, one possible explanation for the increased latencies incurred by the presence of passive by-phrases could be their low frequency of occurrence. There is an additional factor. Quirk et al also point out that agent by-phrases are omitted when the agent is irrelevant, redundant, unknown, or non-specific and that their inclusion often leads to infelicitousness as illustrated in the following example (i).

- (i) a. John fought Bob last night.  
 #Bob was beaten by John.  
 Bob was beaten.
- b. Mom is really angry about the trash.  
 #It was supposed to have been taken out yesterday by Ann.  
 It was supposed to have been taken out yesterday.

## INTERPRETATION OF VP ANAPHORS

301

3. Frazier, Taft, Roeper, Clifton and Erlich (1984) have obtained results in which reading times for second clauses in coordinated sentences are faster when preceded by a first clause that is structurally parallel. While such effects are referred to in the literature as parallelism effects, they are repetition effects that affect parsing decisions. As such, they are qualitatively different from syntactic coherence effects that affect interpretive decisions.

4. Incidentally, one might wonder why these sluicing examples elicit stronger infelicity judgments. It is because "who" fails to find a linguistically present antecedent, a violation of the first requirement for surface anaphors. This also suggests that "who", unlike personal pronouns, might be a surface anaphor.

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