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Priming of Structural and Conceptual Verb Phrase Anaphors

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This article examines the processing of several classes of verb phrase anaphora, including: verb phrases with explicit pronominal forms, which we will refer to as "do it" anaphora, illustrated in (1); verb phrase ellipsis (VPE), as in (2); and unexpressed or implicit complements to verbs which appear to have anaphoric properties, known as null complement anaphora (NCA), such as the unexpressed infinitive in (3).

1. He refused to do it.
2. He refused to.
3. He refused.

Anaphora is a one of the primary means that languages employ to establish relationships between elements of sentences and discourse. The study of anaphora has led to a greater understanding of many aspects of language understanding and language structure. From a psycholinguistic perspective, considerable progress has been made in determining both how and when anaphoric constructions are identified and how and when antecedents are assigned (see Garnham 1986 for a comprehensive review). Some progress has also been made in determining the nature of the representations involved in associating an anaphor with its antecedent.

One of the most revealing sources of evidence about the representational issue comes from studies making use of *priming* methodologies. It has been established that noun phrase anaphors, including both pronouns and definite lexical NP's, facilitate recognition of their antecedents, relative to some non-anaphoric control condition. For example, if subjects were to read sentences such as (4) and (5), and then decide whether or not the word "woman" was in the sentence they read, they would recognize "woman" faster after reading (4), which ends with a pronoun with "the woman" as its antecedent than after sentence (5), which does not make any anaphoric reference back to "the woman" (Chang 1980; Corbett & Chang 1983; Dell, McKoon & Ratcliff 1983; MacDonald & McWhinney 1990).

4. The woman in the straw hat saw the old man who sat next to her.
5. The woman in the straw hat saw the old man sitting on the bench.

Previous work on the processing of anaphors has focused primarily on pronouns and other types of NP anaphora. VP anaphora, which is perhaps as pervasive in natural language, has been largely ignored. Thus, one goal of this work was to establish whether VP anaphors facilitate the recognition of their antecedents in the same way that NP anaphors do. Motivation for studying VP anaphora comes from its potential as a testing ground for a set of issues which has sparked considerable interest in the linguistic community. The priming which has been observed for overt NP anaphors has also been observed for constructions which are hypothesized to contain an empty syntactic category, such as *wh*-trace, NP-trace, or PRO. Since empty categories are assumed to have anaphoric properties, this has been taken by some as evidence for the psychological reality of these empty categories (Bever & McElree 1988; Fodor 1989; MacDonald 1989; McElree and Bever 1989; Samar and Berent 1991). These priming studies are of interest because they may provide external evidence for some abstract syntactic representations. Additionally, as theories of grammar differ in the types of empty categories they posit, such data may provide a basis for discriminating among competing theories (Fodor 1989).

However, interpreting the results of these studies as supporting the psychological reality of empty categories is controversial. There is a question as to whether priming is specifically sensitive to underlying syntactic structure (and thus is diagnostic of the presence of phonologically null syntactic representations), or whether the obtained priming effects are due instead to differences between anaphoric and non-anaphoric sentences in underlying conceptual representations (such as a mental model--a non-syntactic representation of the propositional content of a discourse as well as information which is inferred or part of our general knowledge, as in Johnson-Laird 1980; Johnson-Laird & Garnham 1980). Since priming studies have concentrated on NP anaphora in which these representational aspects are confounded, it has been difficult to resolve this issue. The study of VP anaphora, on the other hand, may be more discriminating because some VP anaphors are differentially sensitive to the representational aspects of their antecedents.

All lexical NP anaphors are instances of what some linguists have termed "deep" or "conceptual" anaphora (Hankamer and Sag 1976; Sag and Hankamer 1984). That is, they do not require an antecedent to be linguistically expressed. Because deep anaphors can be pragmatically controlled, they are argued to be interpreted with respect to a conceptual level of representation. Some VP anaphors, on the other hand, are what linguists have termed "surface" or "structural" anaphors. They not only require their antecedents to be linguistically expressed, they impose certain syntactic conditions on them as well. In particular, antecedents of surface anaphors must be, roughly speaking, structurally parallel to the anaphoric element in the sense that the antecedent could be copied into the position of the anaphor (with appropriate morphological modifications for agreement). This point is illustrated in examples (7) and (8). In (7), the antecedent "write this poem" is structurally parallel to both the deep "do it" anaphor of (7a) and the surface anaphor formed by VP ellipsis of (7b). Both anaphors are resolved felicitously. In (8) however, the antecedent is not a constituent that could be copied into the position of the anaphor. The lack of structural parallelism has no effect on the resolution of the deep anaphor (8a), but yields an infelicitous result with the surface anaphor in (8b).

Syntactic Coherence of Antecedent

- | | |
|---|---|
| (7) Did Ann write this poem? a. No, Sue did it. b. No, Sue did. | (8) Was this poem written by Ann? a. No, Sue did it. b. *No, Sue did. |
|---|---|

It has been demonstrated that the distinction between anaphors that find their antecedents at a structural level of representation and those that find their antecedents at a conceptual level of representation is relevant not only to off-line judgments of grammaticality, but also to the on-line processing of VP anaphora (Mauner forthcoming; Tanenhaus & Carlson 1990). The deep-surface distinction may be useful in determining whether priming is specifically sensitive to syntactic representations, as suggested by empty category priming studies. If priming is specifically related to the association of a syntactic antecedent to an anaphoric element (perhaps via copying or coindexation), we might expect to find priming only for structural anaphora and not conceptual anaphora. If, on the other hand, priming is sensitive to the properties of conceptual representations, we might expect both types of anaphora to lead to priming.

There is, however, a second way in which priming might be sensitive to the properties of structural representations. Most researchers argue that it is the syntactic properties of the anaphor itself that are relevant for priming (Bever & McElree 1988; Fodor 1989; MacDonald 1989; McElree and Bever 1989; Samar & Berent 1991). Thus, it may be the case that priming reflects higher activation of only a conceptual representation of the antecedent but nevertheless, must be mediated by the presence of an anaphoric element in the syntax. This would be sufficient to argue for the reality of empty categories. However, little evidence has been advanced to support this claim.

One particular type of conceptual anaphor seems particularly well-suited for investigating this issue, namely null complement anaphora (NCA) (Hankamer & Sag 1976, Grimshaw 1979). Null complement anaphors are deep anaphors that are arguably not mediated by the presence of an anaphoric element in the syntax. Rather, they are based on an inference due to the semantic argument structure of the verb, as illustrated in example (9).

9. John was told to take out the trash.
He refused.

If priming requires the mediation of an anaphor in the syntax, we would expect that priming would not be observed for NCA. If, on the other hand, priming can result simply from the conceptual representation of a discourse, then we might expect to find priming for NCA as well as other types of VP anaphora.

For these reasons, we set out to investigate not only whether VP anaphors prime their antecedents in general, but whether the representational differences associated with the various types of VP anaphora will lead to differences in priming.

Experiment 1

In our first experiment, we compared recognition times for probes in three different conditions: one involving a structural VP anaphor, one involving a conceptual VP anaphor, and one involving no VP anaphora.

Subjects were presented with a series of two-sentence passages which they read at their own pace from a computer screen. Initially, the screen displayed a series of blanks (10):

10. -----

Subjects pressed a button which caused the first sentence to be revealed (11):

11. Mary asked John to take out the trash.

When they had finished reading the first sentence, they pressed the button again. The first sentence was replaced by dashes while the second sentence was revealed (12):

12. -----
Because he was tired, he forgot to. ----

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When subjects pressed the button again, the second sentence was replaced by dashes and a probe word appeared (13):

13. -----
----- TAKE

Subjects pressed a "yes" or "no" button as quickly as possible, depending on whether or not they recognized the probe word as having been in the preceding passage. The final component of each trial was a comprehension question to which subjects again responded "yes" or "no".

In critical trials, there were three different versions of each two-sentence passage, corresponding to the three conditions to be tested. The first sentence was the same in each version, and always contained a VP whose head verb was the word which would be used as a probe. The second sentence either contained a VP anaphor that referred back to the VP headed by the probe word, or was a natural continuation of the discourse but contained no VP anaphor. VP anaphors were either surface anaphors formed by VP ellipsis, or some form of conceptual anaphor. A variety of conceptual anaphors were used, including "do it" and Null Complement anaphora, but otherwise the conceptual and structural anaphora versions of the passages were minimally distinct, differing only in the anaphors themselves. The non-anaphoric sentence formed the control condition against which the amount of priming obtained would be measured. A sample set of materials illustrating the three conditions is given in (14). The antecedent/probe verb is presented here in upper case letters for the convenience of the reader.

14. Sample materials for experiment 1

Sentence 1:

I don't know who should SWEEP the crumbs off the floor.

Sentence 2:

Conceptual:

However, I bet Carol will volunteer to do it, reluctantly.

Structural:

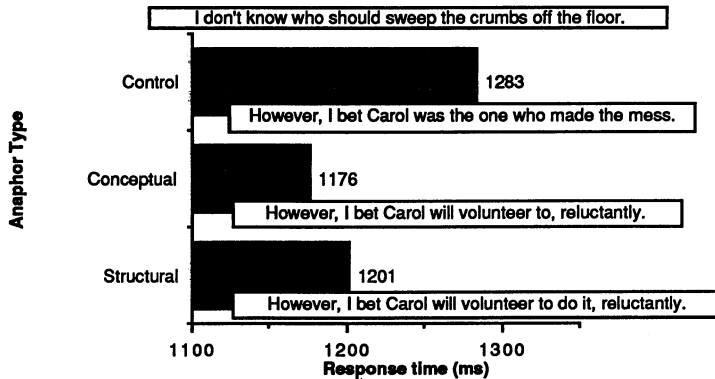
However, I bet Carol will volunteer to, reluctantly.

Control:

However, I bet Carol was the one who made the mess.

We predicted that if VP anaphors prime their antecedents, then recognition times to probes in the anaphoric conditions should be faster than in the non-anaphoric condition. This is, in fact, what we found. Recognition times for probes following conceptual and structural anaphors, and non-anaphoric control sentences are shown in Figure 1.

Figure 1



Mean recognition times to probes in the conceptual and structural conditions were statistically indistinguishable from each other (1176ms and 1201ms respectively), but significantly faster than recognition times for probes following non-anaphoric sentences (1283ms).¹ This result indicates that both conceptual and structural VP anaphors prime or facilitate recognition of their antecedents. Moreover, the fact that priming was obtained for both conceptual and structural anaphors suggests that priming is not sensitive to assignment of a structural antecedent.

The sentences in our conceptual anaphora condition included both explicit anaphoric elements such as "do it" and null complement anaphors, which have no overt anaphoric element in the syntax and arguably no empty category either. This allows us to test another aspect of priming. If priming requires the presence of an anaphoric element in the syntax, then priming should be observed only with those anaphors that have such an anaphoric element. Thus, we predict that priming should be obtained for "do it" anaphora and VPE, but not for NCA.

To evaluate this possibility, we compared probe recognition times to "do it" anaphors and null complement anaphors to recognition times obtained for control sentences. The results suggested that both types of conceptual anaphors primed their antecedents. Recognition times to "do it" anaphora (1119 ms) were 135 ms faster than their associated controls, and recognition times to null complement anaphora (1273 ms) were 65 ms faster than their associated controls.² The difference between the two types was not significant. Due to the small number of items involved however, these effects are statistically unreliable.

Because of the theoretical significance of Null Complement Anaphora, we performed a second experiment, again comparing priming to structural anaphora with priming to conceptual anaphora. As before, VP ellipsis was used for the structural anaphor condition, but in this second experiment, Null Complement Anaphora was the only type of conceptual anaphor employed. This second experiment was also designed to rule out an alternative explanation of the priming results obtained in Experiment 1. While the results of Experiment 1 are consistent with VP anaphors priming their antecedents, it is also possible that these differences between anaphoric and non-anaphoric conditions were due to increases in probe recognition times following non-anaphoric sentences rather than decreases in probe recognition times following anaphoric sentences. It is possible that non-anaphoric sentences introduced topic shifts that made the entire first sentence less salient or accessible for priming. Thus, the results of Experiment 1 do not indicate whether it was specifically the antecedent VP or the first sentence as a whole which was primed, relative to the non-anaphoric condition, by the VP anaphors. (See Dell, McKoon, & Ratcliff 1983 for more discussion of this latter possibility.)

To control for this possibility, we decided to establish priming of an antecedent by comparing the recognition times of a probe taken from the antecedent to a probe taken from some other part of the same sentence. If VP anaphors prime their antecedents, then an antecedent probe should be easier to recognize than a non-antecedent probe from the same clause. In contrast, if the priming observed in Experiment 1 reflected a greater shift of topic in the non-anaphoric condition and a consequent decrease in the saliency of the first sentence of the passage, then there should be no difference between two otherwise comparable words taken from the first sentence.

Our second experiment was thus designed to examine two questions: Would the antecedent of a VP anaphor be primed with respect to some other word in the same sentence and would priming be obtained for null complement anaphors as well as structural anaphors, as suggested by the tentative evidence from the first experiment?

Experiment 2

In Experiment 2, subjects again read two-sentence passages and responded to a probe word presented after they had completed reading the second sentence. As illustrated in example (14), the first sentence of a critical trial always contained at least two VPs. The second sentence contained either a structural or a conceptual VP anaphor that always referred back to the second of the two VPs of the first sentence. The two versions of the second sentence differed only in whether they contained a structural anaphor (VPE) or a conceptual anaphor (NCA). After reading the second sentence, subjects were presented with one of two verbs from the first sentence, one of which was the head of the antecedent of the VP anaphor in the second sentence. (15) gives a sample set of materials.

15. Sample materials from experiment 2

Sentence 1:

The teachers' union decided to DEMAND that the school board DEVELOP a better retirement plan.

Sentence 2:

Structural:

The school board agreed to, to avoid a strike.

Conceptual:

The school board agreed, to avoid a strike.

Probes:

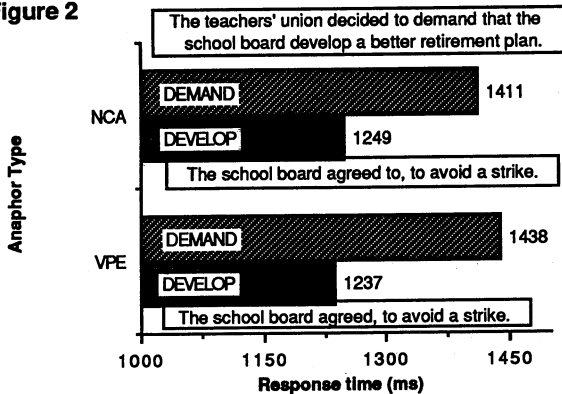
Antecedent: DEVELOP

Non-antecedent: DEMAND

Thus, there were four conditions in this experiment such that each anaphor version (VPE and NCA) was tested twice, once with an antecedent probe and once with a non-antecedent probe.

We predicted that, if VP anaphors prime their antecedents, then responses to antecedent probes should be faster than responses to probes that did not refer back to the anaphor's antecedent. As the graph of probe recognition times illustrated in Figure 2 indicate, subjects were indeed faster to recognize antecedent verb probes than non-antecedent probes.

Figure 2



Two results of interest emerged from these data. The first is that antecedent probes, for both the VPE and the NCA conditions, were responded to significantly

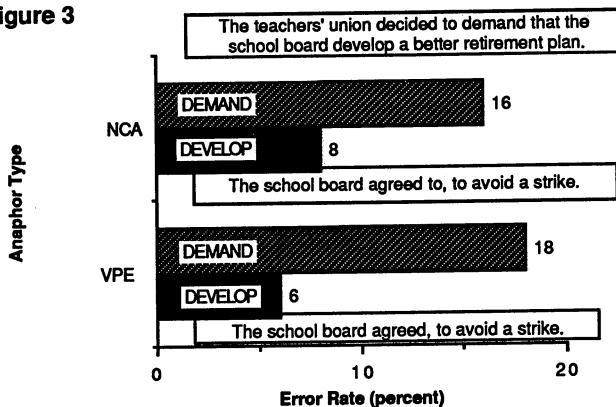
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faster than the non-antecedent probes, indicating that the anaphors are specifically priming their antecedents. The second is that no interaction between probe choice and type of anaphor was found, indicating that the patterns for VPE and NCA are essentially the same, with no significant differences between the two anaphoric constructions.

Error rates for the probe recognition were also revealing. Because subjects were instructed to respond as quickly as possible, they were under some time pressure to make their decisions. Consequently, they sometimes incorrectly indicated that the probe word was not in the passage -- that is, while in all critical trials, the correct response was always "yes" as the probe had been in the preceding passage, subjects occasionally responded "no". (The experiment included a set of "filler" or distractor items, some of which involved a probe word which was not in the passage. Overall, "no" was the correct response 50 percent of the time.) If an anaphor facilitates the recognition of its antecedent, then we would expect fewer false rejections of congruent or antecedent probes than incongruent or non-antecedent probes. That this is in fact what was found can be seen in Figure 3.

Figure 3



Antecedent probes elicited significantly fewer false rejections than nonantecedent probes, in both ellipsis and NCA conditions. Thus, error data were consonant with probe recognition findings.³

The results of Experiment 2 replicate the finding of Experiment 1 that VP anaphors prime their antecedents using a different paradigm. This convergence of evidence demonstrates that the priming found in Experiment 1 was not due to decreased salience of the entire first sentence in the non-anaphoric version of the

passages, but rather, to the direct influence of the VP anaphora in raising the salience of its antecedent. It also demonstrates the robustness of the VP priming effect across different tasks and stimulus items. Furthermore, this priming was observed for Null Complement Anaphora as well as verb phrase ellipsis, indicating that the Structural Priming Hypothesis must be rejected.

Discussion

The results of Experiments 1 and 2 clearly demonstrate that VP anaphors facilitate the recognition of their antecedents. This result indicates that a probe recognition task can be useful in investigating VP as well as NP anaphora. Furthermore, we find priming to both conceptual and structural anaphora. The fact that we find priming with null complement anaphora, given its apparent lack of a syntactic anaphoric category, suggests that priming is not due, at least exclusively, to the assignment of referential indices to portions of structure, but rather to a more conceptual stage of interpretation at which the inference(s) necessary to connect an antecedent to the event described in the second sentence has to have been made.

This point has implications for the use of priming to study of empty categories. The lack of selective sensitivity to structural representations indicates that we should be cautious in our interpretations of claims of evidence for the presence of empty categories based on the results of priming. At the moment, this is merely a caution. Our measure of priming, coming after subjects have completed the reading and interpretation of a full sentence, may be too far removed in time from the initial stages of processing to be sensitive to purely structural factors. Moreover, the probe recognition task that was used to establish priming, is a measure which is known to be sensitive to a wide range of factors. We might point out, in passing, that much of the other research on anaphoric priming, including research on empty categories, has employed this same combination of late probing and the probe recognition task. However, Janet Fodor (1989) has recently argued that another task, namely cross-modal lexical decision, when examined immediately in the context of an anaphor, is a better diagnostic of syntactic factors.

Another issue which requires further attention has to do with the status of NCA. Following Hankamer and Sag (1976), Napoli (1983) and others, we have assumed that NCA involves neither an anaphoric element in the syntax nor a structural antecedent. The claim that it is interpreted with respect to a conceptual, rather than linguistic, representation is supported by the fact that it may be interpreted as taking a pragmatically or contextually determined antecedent, and the fact that it is insensitive to the syntactic form of a putative linguistic antecedent -- see Grimshaw (1979) for discussion of this, as well as the comments surrounding the examples in (7) and (8) above. However, it is possible that the interpretation of NCA involves a structural heuristic when the opportunity presents itself: perhaps a syntactic constituent is copied into place in an NCA construction when the form and category of the constituent is appropriate.⁴ Because we wanted to directly compare the results of NCA with VPE, which generally does require a syntactically congruent antecedent, all of our materials had this characteristic, and thus it is possible that our

results for the NCA conditions reflect the heuristic use of such a process. Our previous research (Maurer forthcoming, Tannenhaus and Carlson 1990) indicates that this is not the case, but it remains to be demonstrated that priming will be observed for NCA when no structural antecedent is available. The mismatches in syntactic category between antecedents and null complements discussed by Grimshaw would be a good starting point.

In summary, we have demonstrated that the well-established phenomenon of priming by NP anaphora holds for VP anaphora as well. We have shown that it holds for a variety of different types of VP anaphora, including Verb Phrase Ellipsis, conceptual anaphora involving an explicit anaphoric category, and a case of conceptual anaphora which, at least *prima facie*, does not involve an anaphoric category in the syntax, overt or otherwise. These results open up new avenues of research into the processing of anaphora and the comprehension of discourse. While it is important to explore the issues raised in this discussion more carefully in the future, our results are nonetheless a step towards clarifying these issues, and we think that VP anaphora will be particularly useful in these investigations.

Endnotes

1. All differences reported as significant refer to analyses by subjects and were reliable at a probability level of $p < .05$ or lower.
2. Direct comparison of the response times for the anaphoric conditions is not possible because different items were used for the null complement anaphors and the "do it" anaphors.
3. Error data were not provided for Experiment 1 because there were no significant differences between the conditions there. We suspect that this difference between the two experiments reflects the fact that the first experiment was easier: subjects were able to perform essentially perfectly on all conditions. Support for this comes from the difference in degree of priming: in Experiment 1 the magnitude of the priming was on the order of 100ms, while in experiment 2 it was close to 200ms.
4. Thanks to Norbert Hornstein and Shalom Lappin for bringing this to our attention during the question period after the presentation of this paper.

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References

- Bever, Thomas G. and Brian McElree. 1988. Empty Categories Access Their Antecedents during Comprehension. *LI* 19.1:35-43.
- Chang, Frederick R. 1980. Active memory processes in visual sentence comprehension: Clause effects and pronominal references. *Memory and Cognition* 8:58-64.
- Corbett, Albert T. and Frederick R. Chang. 1983. Pronoun disambiguation: Accessing potential antecedents. *Memory and Cognition* 11:283-294.
- Dell, Gary S., Gail McKoon, and Roger Ratcliff. 1983. The Activation of Antecedent Information during the Processing of Anaphoric Reference in Reading. *Journal of Verbal Learning and Verbal Behavior* 22:121-132.
- Fodor, Janet D. 1989. Empty Categories in Sentence Processing. Special Issue: Parsing and interpretation. *Language and Cognitive Processes* 4.3-4:155-209.
- Garnham, Alan. 1986. Understanding anaphora. In A.W. Ellis (ed.) *Progress in the Psychology of Language*, vol. 3. London: Erlbaum.
- Grimshaw, Jane. 1979. Complement Selection and the Lexicon. *LI* 10.2: 279-326.
- Hankamer, Jorge and Ivan Sag. 1976. Deep and Surface Anaphora. *LI* 7.3: 391-428.
- Napoli, Donna Jo. 1983. Missing Complement Sentences in English: A Base Analysis of Null Complement Anaphora. *Linguistic Analysis* 12.1:1-28.
- Johnson-Laird, Philip. 1980. *Mental Models*. Harvard University Press, Cambridge, Massachusetts.
- Johnson-Laird, Philip and Alan Garnham. 1980. Descriptions and Discourse Models. *Linguistics and Philosophy* 3:371-394.
- MacDonald, Maryellen and Brian MacWhinney. 1990. Measuring inhibition and facilitation from pronouns. *Journal of Memory and Language* 29.4:469-492.
- MacDonald, Maryellen. 1989. Priming effects from gaps to antecedents. *Language and Cognitive Processes* 4.1:35-56.
- McElree, Brian and Thomas G. Bever. 1989. The Psychological Reality of Linguistically Defined Gaps. *Journal of Psycholinguistic Research* 18.1:21-35.

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Maurer, Gail. forthcoming. Syntactic Context and the interpretation of VP anaphors. *Proceedings of the 22nd annual meeting of the New England Linguistics Society.*

Sag, Ivan and Jorge Hankamer. 1984. Toward a Theory of Anaphoric Processing. *Linguistics and Philosophy* 7:325-345.

Samar, Vincent J. and Gerald P. Berent. 1991. *Be* Is a Raising Verb: Psycholinguistic Evidence. *Journal of Psycholinguistic Research* 20.5:419-443.

Tanenhaus, Michael K. and Greg N. Carlson. 1990. Comprehension of deep and surface verbphrase anaphors. *Language and Cognitive Processes* 5.4:257-280.