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Sentence Priminq Effects on the Processinq of Ambiguous Words.

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Sentence Priming Effects on the Processing of Ambiguous Words

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Abstract

Sentence context effects for ambiguous words were investigated in a repetition format. Subjects read sentences which presented homographs in either a dominant or subordinate context and were asked to decide if these sentences made sense. On a later trial, the homograph appeared in another sentence either in the same or different context. The sentences were separated by 0, 1, or 6 intervening sentences. Control sentences were also constructed in which the homograph was replaced with a word which made sense within the context of the sentence. The results showed that subjects were able to read a sentence faster when it was preceded by a sentence in the same context, and these reading times were faster than those for unrelated control sentences. This effect was seen for both subordinate and dominant sentences. We interpreted these results as providing evidence for facilitation. When the two sentences differed in context the results revealed sentence reading times that were slower than unrelated control sentences, therefore, providing evidence for inhibition.

Sentence Priming Effects on the Processing of Ambiguous Words

The way a person reads and processes words is a frequent topic for study among cognitive psychologists. In recent years some investigators have chosen to study one specific area of lexical processing, namely, the effects of context on word recognition. In studying contextual effects, investigators have found that if two words (a prime and a target) are related, then a response to the second word (the target) will be made more quickly than if the two words are unrelated. For example, Meyer and Schvaneveldt (1971) found that lexical decisions (deciding whether letter strings are words) were made more quickly for related stimuli than if the two words were unrelated. They found this effect using such prime-target pairs as "bread-butter" and "nurse-doctor" as related stimuli. They created unrelated pairs such as "bread-doctor" and "nurse-butter" and found reaction times associated with these pairs comparatively slower.

This priming effect can also be seen when sentences are used as primes. It has been shown that words are recognized more quickly if they are presented within a related context than if they are presented in isolation or in an unrelated context. Statements such as "The farmer drove the tractor" and "The woman smoked the tractor" both contain the word

tractor. However, the first sentence increases a subject's ability to recognize the word "tractor" within the given context, while the second one does not (Stanovich & West, 1979), thus illustrating the effect of an entire sentence on word recognition.

The fact that a word or sentence can decrease the response time to a related word is known as priming or facilitation, and this priming effect is due to what is known as spreading activation (Meyer & Schvaneveldt, 1971). When a word is encountered, its representation is activated in a person's long-term memory. This activation then "spreads" to other related concepts and words, and they too are activated, thus facilitating their later recognition. An illustration of spreading activation can be seen in Meyer and Schvaneveldt's study. If one reads the word "bread," this becomes activated in memory and in turn activates words such as "butter", thus decreasing the reaction time to recognize "butter" when it is presented for a response.

The pervasiveness of these facilitation effects has led researchers to explore more specific areas of word recognition, particularly the effects of context on the processing of ambiguous words. Ambiguous words, or homographs as they are sometimes called, are defined as

those words which have more than one dictionary entry with a common spelling. An example would be the word "diamond" which has two possible meanings: It could mean either a precious gem or a field for a baseball game (Nelson, McEvoy, Walling, & Wheeler, 1980). Research which investigates the effects of context on the processing of ambiguous words is of interest because homographs provide a special case among words due to their multiple meanings. If priming effects could be demonstrated in the case of homographs, then one could learn more about the mechanisms by which the contextual effects operate. Specifically, ambiguous words are ideally suited to studying the selectivity of context among different domains of meaning.

In order to study the contextual effects on the processing of ambiguous words, researchers typically present a homograph within a sentence context and test the effects of that context on the recognition of a target. Sentences are usually biased toward either the dominant (more common) meaning or the subordinate (less common) meaning and serve as primes. For example, a dominant sentence for the word "diamond" would read, "Everyone admired the woman's diamond necklace". A subordinate sentence might read, "The field was in the shape of a diamond". The targets are words which

relate to the separate meanings of the ambiguous word within the sentence. In the case of the word "diamond" a dominant associate would be "gem" and a subordinate would be "baseball". The subject is presented with the sentence, either visually or auditorily, and then responds to the target by naming it or performing a lexical decision. The recognition time for these targets compared to unrelated sentence-target stimuli is used as an index of the activation of the various meanings, as a function of the nature of the preceding context. In addition, the amount of time that elapses between the presentation of the context and the target allows the experimenter to measure the timecourse of meaning activation in memory.

Models of lexical ambiguity

Current literature has outlined three basic models concerning the processing of ambiguous words (Simpson, 1984). The first of these is known as the "context dependent" model. It has also been referred to as a "selective-access" model (Glucksberg, Kreuz, & Rho, 1986). According to this model, the context in which an ambiguous word is presented determines the meaning to be retrieved. In other words, when a homograph is encountered only the contextually appropriate meaning is accessed. Therefore,

there is actually no need to resolve which meaning is the appropriate one to retrieve because that has already been decided by the present context. Consequently, the homograph is not treated as an ambiguous word per se, rather it is processed as a word with one meaning and accessed directly with no resolution involved. Support for this model has been found in those experiments showing that only the contextually appropriate meaning is facilitated relative to unrelated stimuli. For example, if the subject saw "Everyone admired the woman's diamond necklace" as a prime, then responding to the word "gem" would be faster than responding to the word "baseball."

Intuitively, the above model makes sense. It would seem that word recognition should be an efficient procedure which would use any cues available to aid it, and not consider each and every possible alternative when the desired meaning is provided. Indeed, some researchers have found evidence for this model (Glucksberg, et al.; 1986; Schvaneveldt, Meyer, & Becker, 1979; Simpson, 1981; Simpson & Kellas, 1989; Tabossi, Colombo, & Job, 1987). However, despite its appeal, this model has received a fair amount of criticism, thus leading researchers to support additional models.

The second model of processing has been called "ordered-access" (Simpson, 1984). Proponents of this model state that when an ambiguous word is encountered, the various meanings are retrieved in an order consistent with their frequency. The first meaning retrieved is identified as the one which occurs most frequently in English usage. This meaning is then compared to the context in which the word appears. If indeed this is the appropriate meaning, then the process ends here. However, if the meaning is not the correct one, then the process continues by retrieving the next most frequent meaning, and so on. This process continues until the appropriate meaning is matched with the intended context. This model holds that the actual retrieval process is free of context, and that context only plays a role after a meaning is accessed. For this model, context serves as a reference by which to check whether a meaning should be maintained. Researchers such as Hogaboam and Perfetti (1975), and Neill, Hilliard, and Cooper (1988) have found evidence for this model. To continue the example above, this model would predict that given either of the "diamond" sentences, "gem" should lead to faster responses than "baseball," as the former denotes the more common meaning of "diamond."

Still others have failed to find support for either of the above two models and have proposed the final model outlined here: the "exhaustive-access model" (Onifer & Swinney, 1981). This model states that when a reader encounters an ambiguous word, all of the meanings for that word are immediately activated regardless of the context. Then, after all the meanings are activated they are checked with the present context to determine the appropriate meaning and the unwanted meaning is discarded. Consequently, only that meaning which corresponds to the proper context is brought to consciousness. This model proposes that the inappropriate meanings then decay or are actively suppressed. The notion of active suppression of the inappropriate meaning, while popular (Seidenberg, Tanenhaus, Leiman, & Bienkowski, 1982; Swinney, 1979; Tanenhaus, Leiman, & Seidenberg, 1979) has never been tested directly. However, of the three models presented, the exhaustive-access model has received the greatest amount of support (e.g. Kintsch, & Mross, 1985; Onifer & Swinney, 1981; Seidenberg, et al. 1982; Swinney, 1979; Tanenhaus, et al., 1979). These researchers have shown that both meanings for a homograph ("diamond") are activated immediately following the presentation of the word regardless of the context in

which it was presented. For example, there would be no difference in reaction time between the response to "gem" or "baseball" following the presentation of either sentence. This pattern of results differs from the ordered-access model's expected results in that all meanings are available immediately, not just the most frequent one. Both models argue, however, that context influences a post-access decision stage, and not the initial meaning activation.

Although the models outlined above present clear and separate predictions regarding the processing of ambiguous words, testing these predictions is not as straightforward. Unfortunately, different methods have provided different results when investigating the same model. Even results initially interpreted as evidence for one model have been reevaluated and could be considered evidence for another. An illustration of this can be seen in the study done by Simpson (1981). His work was originally interpreted as a case for the context-dependent or selective-access model. His results showed that sentences with a strong bias toward one meaning served as primes for a word related to that meaning only, and facilitation was not found for the other (inappropriate) meaning. From these results Simpson concluded that the context in which a homograph is presented

restricts processing to only that meaning which corresponds to the context.

These results were among the few which supported the context-dependent model. However, criticisms of the methodology have changed the possible interpretation of these data. For example, Onifer and Swinney (1981) were critical of an experimental technique employed by Simpson. In this experiment, there was a delay between the end of the sentence presented to the subjects and the onset of the target word (approximately 120 ms). Consequently, Onifer and Swinney felt that this delay allowed for the activation of all meanings and then the discarding of the inappropriate one(s). This, of course, changes the interpretation of the Simpson (1981) study. Rather than support of a context-dependent model, the conclusions now point to support of the exhaustive-access model. However, in order for this criticism to be valid, the 120 ms interval must be investigated to decide if this is sufficient time in which to allow this post access selection process to occur.

Thus, in response to this criticism, Simpson repeated his experiment controlling for the discrepancy in time lapse (Simpson & Kellas, 1989). In this experiment, the subjects were again presented sentences ending in homographs. The

sentences were of three types: related to the dominant meaning, related to the subordinate, or unbiased (biasing neither meaning). For example, Simpson and Kellas (1989) used three sentences for the word "coach". The dominant sentence read "We won and gave a prize to our coach", the subordinate sentence was "The princess rode home in her new coach", and the unbiased sentence was "We liked the looks of the new coach". These sentences were followed by a target word which was either related to the dominant meaning of the homograph, related to the subordinate meaning, or was unrelated to the homograph. For the above sentences, the target words could be "team" which would be a dominant associate, or "horse", a subordinate associate, or an unrelated word, such as "crazy". In addition, the time between the end of the sentence and the presentation of these target words (Interstimulus Interval, or ISI) was manipulated, in that the word followed immediately (0 ms) after the sentence was read, 300 ms later, or 700 ms later. The results showed that for the dominantly biased sentences, only the meaning consistent with that priming context was retrieved. Similarly, only subordinate targets were facilitated following the subordinately biased sentences. In both cases, therefore, there was facilitation for the

contextually appropriate meaning only. For the unbiased sentences, the pattern of results showed that at 0 ISI, only the dominant meaning was accessed. Then, at 300 ms, both meanings were available, and finally, at 700 ms, only the dominant was available.

The results obtained from the biased sentences respond to the criticism of Onifer and Swinney (1981) in that at 0 ISI, only the appropriate meaning was accessed. Presenting the target immediately following the sentence eliminates the possibility that all meanings were accessed and the appropriate one retained. By removing the time delay, Simpson and Kellas have made the context-dependent model more plausible.

The pattern of results with neutral sentence context is similar to results found by Simpson and Burgess (1985) for homographs in isolation. They used homographs in prime-target pairs, and subjects were asked to make lexical decisions to the targets. The ambiguous word was the prime, and the targets were related to either the dominant or subordinate meaning, or unrelated to the homograph. They found that in these instances (in the absence of context), the dominant meaning for an ambiguous word is available almost immediately and the less frequent definition develops

over time. Since Simpson and Kellas (1989) found this same pattern of results using unbiased sentences, it would seem to indicate that in the absence of context both meanings of an ambiguous word are accessed, but the dominant one is accessed first and the subordinate meaning will eventually be accessed.

As was shown, Simpson and Kellas (1989) found evidence for the context-dependent model using sentences as primes. However, this is not always the case. Other research in lexical ambiguity has found different results when sentences are used as primes, and these results tend to support the exhaustive-access model. One reason for this difference may be due to the nature of the sentences employed in each experiment. An example of these sentences can be seen in an experiment by Tanenhaus et al. (1979). Tanenhaus and his associates used such primes as "I bought the watch", or "I will watch." While one would not dispute that the timepiece meaning for watch is the only appropriate one for the first sentence, and the definition which means the act of looking is the only fitting one for the second, these are not strongly biasing sentences. Thus, while the investigators can argue that the two distinct meanings of the word "watch" are implicit here, the contextual constraint of the

sentences is questionable. This is due to the fact that any number of words could replace the word "watch" in the previous sentences. Thus, the degree of bias is not the same as other more constraining sentences used in other research. Since these sentences are often typical of those used in the studies supporting the exhaustive-access model, the question arises as to their degree of contextual bias and the influence this may have on their results. If these contexts are not as relatively constraining as sentences used in other investigations, then one cannot draw the same conclusions as in those conditions which present highly constraining contexts.

Repetition context

Up to this point, the research presented seems to indicate that context does play some type of role in the processing of ambiguous words. However, the tests which are used to investigate the effects of context do not test the realistic encounters one may have with an ambiguous word. That is to say that in an experiment, the subject sees the homographs within a given context only once and does not encounter that word again for the duration of the experiment. However, in everyday transactions this is not the case, as a person may have several interactions with the

same word. Unfortunately, since the present methodologies do not allow the possibility of testing the unused meaning, current research tells us relatively little about the fate of the unselected meanings. In addition, the experimental designs used to test these contextual effects do not allow the researcher to test whether or not the context on one presentation of an ambiguous word has an effect on another presentation of that same word, including the possibility that inappropriate meanings are suppressed. Therefore, another type of experimental design has been implemented in lexical ambiguity. It is a repetition format which involves presenting homographs more than once during an experiment across various lags (i.e. intervening trials).

Using this repetition format, investigators have explored the effects of inhibition or suppression. However, to date, more of the evidence has concerned the suppression of perceptual information, and few researchers have actually studied the effect of suppression on a linguistic level. Tipper (1985) explored inhibition by using a Stroop-like task whereby subjects were asked to ignore an object which was superimposed on another object which the subject was asked to name. He found that on subsequent trials when the previously ignored object became the one to be named,

subjects' reaction times were significantly slowed relative to a control condition. This slowing of reaction times was seen for both exact repetition of the object as well as with categorically related objects, thus indicating that perhaps this suppression of information does reach a categorical level of representation.

Neill (1989) also used an experimental technique similar to Tipper (1985) and found supporting results for this research. Neill has proposed that paying attention to a particular stimulus involves the active inhibition of certain distracting information. Consequently, in perceptual research, he found that actual facilitation of a given stimulus may be the indirect result of active suppression of irrelevant information. This suppression then allows the selected object or piece of information to be brought into conscious awareness.

The work of both Neill (1989) and Tipper (1985) found suppression to be occurring in attention allocation for perceptual processing. Conclusions from their research can be used to infer similar occurrences for linguistic processing as well. While the study of suppression has not been as extensive on the linguistic level as it has on the perceptual level, studies have been conducted which provide

indirect evidence for the suppression of linguistic information. In their work on aging, Hasher and Zacks (1988) investigated the possible effects of inhibition in discourse and comprehension. They found that an inhibitory mechanism is indeed at work in language processing. They propose that suppression is a type of editing device which allows the processing of information to be more efficient by not allowing irrelevant details or distracting information to enter the person's comprehension. This is similar to Neill's (1989) idea of facilitation being a product of suppressing irrelevant information.

In addition to the work by Hasher and Zacks (1988), Simpson and Kellas (1989) also found evidence of linguistic suppression in their study of homographs. In their study which used a repetition design, Simpson and Kellas presented subjects homograph-target word pairs. The targets on each trial were associates of either the dominant or subordinate definition of the ambiguous prime. These first presentations of a prime and target were designed to create a context for the later presentation of that same homograph. They investigated the time it took a subject to name the target on the second presentation of a homograph, as a function of the meaning presented initially. For

example, the subject would see the word "bar" followed by "tavern", which is a dominant associate for that word. Then at some later point in the experiment, the subject would see "bar" followed by "stool," which is also related to the more frequent (dominant) meaning. Another possibility is that the subject might see "bar" followed by "metal" on the second presentation, which is an associate for the subordinate definition. Hence, with the first example, they were able to test the possible priming effects of the first presentation, and the second example would allow them to see a possible suppressive effect when the opposite meaning was given in the two presentations. This was investigated when the dominant as well as the subordinate was presented first. Simpson and Kellas investigated this effect across four lags (0, 1, 6, and 12 intervening word pairs).

The results of this study found that when a subject views and responds to one definition of an ambiguous word on the first presentation (e.g. a subordinate associate of the homograph), it takes longer to respond to the target word related to the other meaning of the homograph (e.g. a dominant associate). These results also showed the responses to target words were slower than to control words. The fact that these responses were slower than to totally

unrelated material provides evidence that indeed some sort of process is actively inhibiting the second meaning because it requires more time to access it. Simpson and Kellas (1989) called this phenomenon meaning suppression. These results were seen across all lags, indicating the large extent of this effect. In addition, this inhibition was seen regardless of whether the subject saw a dominant associate or a subordinate associate on the first presentation. Therefore, when a prime-target pair represents one meaning of a homograph, as in "bar-tavern," associates related to the other meaning ("bar-metal") are suppressed. The fact that suppression was found for the dominant associate following presentation of the subordinate is important. Previous research by proponents of the ordered-access as well as exhaustive-access models have found that the dominant meaning usually has an advantage over the subordinate meaning. This advantage for the dominant associate has even been demonstrated when the context biases the reader toward the subordinate (Tabossi, et al. (1987). Therefore, these results by Simpson and Kellas (1989) contribute a great deal to describing the extent to which context may have an effect on processing ambiguous words. The research described here investigated

these repetition effects when homographs are presented in sentences.

Only one study in the past has examined repetition effects in a sentence format. Ashcraft (1976) investigated a subject's reaction time to judging the truthfulness of property statements such as "Sparrow has beak" and "Sparrow has feathers". Subjects were quicker to respond to a property statement if they had previously seen a related statement in the experiment, as in the above examples. He also found decreasing effects of the first presentation with an increasing number of intervening trials. In other words, the effect was strongest at short lags. Ashcraft's study demonstrated that the processing of one sentence can have an effect on later sentences. The present study investigated the processing of one homograph meaning on subsequent sentence processing.

Objectives of the present research

The present study proposed to investigate the effects of repeating sentences which contained homographs, and expanded on the repetition design of Simpson and Kellas (1989). This study involved presenting two sentences to a subject for each ambiguous word. On the first presentation he or she saw a sentence which biased the ambiguous word

toward one of its meanings. For example, a subject might have seen "He cut his foot on the broken glass" which is biased toward the dominant (leg) meaning for the word "foot". Then, the subject would see "foot" again, but this time it would either be in its dominant context but a different sentence (e.g. "He burned his foot when he walked on the hot coals") or in a subordinate context ("The grass grew over a foot while we were on vacation"). Subjects also saw subordinate sentences first, in which case a different subordinate sentence read "We extended the ladder another foot to reach the roof". The subject was asked to read these sentences and decide if they made sense, and these sentence judgement times were recorded for all first and second presentations for each ambiguous word. The second presentations were further subdivided depending on whether the subject saw a sentence related to the same meaning as on the first presentation, or one related to the other meaning for the given ambiguous word. Anomalous sentences were also included for the task of deciding whether the sentences made sense.

According to the context-dependent model, it was proposed that if the context of the second presentation of a homograph was the same as the first, then the time it took

to read the second sentence would decrease due to a priming effect. This priming effect is due to the fact that the meaning represented by the first presentation was initially activated when it was read, thus providing an advantage for the second time it was encountered within the same context, which was in line with the results of Ashcraft (1976). If the two presentations differed in context, then reading time to the second presentation may be increased due to the suppression of the inappropriate meaning. Furthermore, suppression would be expected to hold for dominant-to-subordinate as well as subordinate-to-dominant presentations, based on the results of Simpson and Kellas (1989). This effect would be indicated by sentence reading times on the second presentation that are slower than reading sentences that are unrelated to any presented earlier.

Therefore, for the research presented here two hypotheses were examined. The first of these investigated the effects of facilitation. That is, when the homograph is presented within the same context in both sentences, it was predicted that the reading time for the second sentence would be faster than a control sentence containing a totally unrelated word in place of the homograph.

The second hypothesis investigated the effects of inhibition. In those cases when the first and second presentations of the homograph were different, specifically, the first sentence was dominantly biased and the second was biased toward the subordinate or the first sentence was subordinately biased and the second was biased toward the dominant, suppression was expected. That is, it was hypothesized that in these cases, the reading time of the second sentence would be slower than a control sentence which contained a totally unrelated word in the place of the homograph.

METHOD

Subjects

Forty-eight undergraduate psychology students served as subjects for this experiment. They received class credit for their participation. All had normal or corrected-to-normal vision.

Stimuli

Seventy-two homographs were chosen from homograph association norms (Nelson, McEvoy, Walling, & Wheeler, 1980). They were presented to the subjects within the context of a sentence. Four sentences were written for each homograph (See Appendix C). Two of the sentences used the

ambiguous word according to its dominant meaning, and two were biased toward the subordinate. The dominant meanings were defined as those which, according to the norms, had the more frequent responses when presented to subjects. In other words, when a subject is asked for free associations to a given homograph, the meaning which corresponds to the response which occurs most frequently is labeled as the dominant. The subordinate meanings were defined as those which had the less frequent responses in this same procedure. For this experiment, words were selected which had a large discrepancy between dominant and subordinate responses. Of the 46 subjects whose responses were used for the Nelson et al., (1980) norms, the criterion was that at least 34 (75%) gave responses for the dominant meaning. This was to insure that sentences labeled dominant or subordinate would indeed be interpreted this way by the subjects. For example, the dominant meaning of the word "bar" is the drinking establishment, and its subordinate meaning is a metal rod (Nelson, et al., 1980). Therefore, sentences associated with the dominant meaning were, "They went to the bar to have a drink", and "The coworkers gathered at the bar after work." Subordinate sentences would be, "The track star jumped over the bar to win first

place", and "The metal bar was too heavy to lift." The placement of the ambiguous word varied between the sentences to eliminate the possibility of subjects systematically recognizing the words at a given location and making a decision based on that word rather than reading the entire sentence. This is illustrated in the above example in that the word "bar" appears at various locations throughout the four sentences.

Another group of stimuli which were presented to the subjects were 72 control sentences (See Appendix C). These were created by using the same sentence structures used for the 72 original sentences. However, instead of the ambiguous word, another word (nonambiguous) was used in its place. An example of this can be shown for the above sentences for the word "bar". The sentences read, "They went to the hotel to have a drink", and "The coworkers gathered at the gym after work." Subordinate control sentences read, "The track star jumped over the hurdle to win first place", and "The metal box was too heavy to lift." As is illustrated in these sentences, the word was chosen so that it made sense within the context of the given sentences.

Additionally, 72 different homographs were chosen and

used in sentences. However, these sentences were semantically anomalous (See Appendix D). An example of this type of sentence is "The deck fit perfectly on the kitchen table," or "She bought her dog a deck at the grocery store." As in this sample, each homograph was used in two different nonsense sentences, making a total of 144 anomalous sentences. Their presence was necessary in order to make meaningful the task of deciding whether or not the sentences made sense.

Design

This study was designed to test whether one presentation of an ambiguous word within the context of a sentence would affect the processing of that same word on a subsequent presentation. It involved the use of a 2 X 2 X 2 X 3 mixed factorial design. The between-subjects factor was the nature of the sentence seen on the second presentation (dominant or subordinate). The within-subjects factors were the nature of the sentence seen on the first presentation (dominant or subordinate), the relatedness of the two sentences (related or control) and lag (0, 1, and 6 intervening trials) between presentation of sentences.

To investigate all possible priming or suppressive effects of the sentences, each sentence had to be paired

with every other sentence for that particular homograph and must be associated with each lag. This allowed each homograph to be represented within each cell created by the proposed design. Therefore, 48 stimulus lists were constructed, 24 each for the subjects receiving dominant and subordinate sentences on the second presentation. This number of lists also allowed the stimuli to be counterbalanced. For example, as in the above illustration, two dominant sentences for a given word were written and included on two separate lists. Thus, if one subject saw "They went to the bar to have a drink" on the first presentation and "The coworkers gathered at the bar after work" on the second presentation, then another subject would see these two sentences in the reverse order. The same was true for the two subordinate sentences as well as subordinate-dominant pairs. The anomalous sentences were also presented within the same lags as the semantically correct sentences, and were the same for all 48 lists.

Procedure

The subjects were seated approximately 60 cm in front of an Apple IIe computer screen. They were told that their task was to read sentences and decide whether or not they made sense according to real-world knowledge. They were

also instructed to do this as quickly as possible without making errors.

The time required to read the sentence and make a decision was recorded by the computer. A timer on the computer was activated as soon as the target sentence was presented and was programmed to stop when the subject responded. The computer also recorded whether the subject's response was correct or incorrect. Responses were made on the keyboard. Subjects were instructed to keep their right and left index fingers on the "K" and "D" keys, respectively, and press the "D" key if the sentence was semantically correct and the "K" if it was not.

To begin the experiment, the subject was instructed to press the space bar on the keyboard of the computer. A rectangular block, one character space wide, then appeared on the screen and the sentence followed 500 ms later. After the subject responded, the sentence left the screen and another followed, again after a 500 ms interval. This continued until the subject had read 72 sentences and was then given a break. The sentences were presented in three blocks, and the subject saw all 288 sentences. The subjects were also shown 12 practice sentences in this same manner at the beginning of the experiment.

Results

A preliminary analysis showed no significant main or interactive effects involving lag. This same pattern of results was also seen in the previous repetition study by Simpson and Kellas (1989). Therefore, the decision was made to collapse across lag for all further analyses. A complete listing of these results can be found in Appendix A. The mean sentence reading times and standard deviations are listed in Table 1. The associated error proportions and standard deviations are listed in Table 2. Mean sentence reading times for the second sentences were submitted to a 2 (Nature of the sentence on the second presentation, Dominant-Subordinate) X 2 (Nature of the sentence on the first presentation, Dominant-Subordinate) X 2 (Relatedness of the two sentences, Related-Control) mixed factorial analysis of variance. The between-subjects variable was the nature of the sentence on the second presentation, and the remaining two variables were within subjects. The same analysis was performed on the subjects' error proportions. For this study, an error was defined as a subject's incorrect response when deciding whether or not a sentence made sense. In other words, if a subject responded that a sentence did not make sense when indeed it did, then this

Table 1

Mean sentence reading times (in milliseconds) and standard deviations as a function of the sentence seen on the first presentation.

		Relatedness of Sentences			
		Related		Control	
Sentence on Presentation 2	Sentence on Presentation 1	SRT	SD	SRT	SD
DOM	DOM	2256	564	2371	524
	SUB	2454	522	2339	466
SUB	SUB	2500	608	2560	504
	DOM	2812	601	2690	628

Note: SRT = Mean Sentence Reading Time For Second Sentence
SD = Standard Deviation
DOM = Dominantly biased sentence
SUB = Subordinately biased sentence

Table 2

Error proportions and standard deviations for the sentence seen on the second presentation as a function of the sentence seen on the first presentation.

		Relatedness of Sentences			
		Related		Control	
Sentence on Presentation 2	Sentence on Presentation 1	EP	SD	EP	SD
DOM	DOM	.03	.05	.02	.03
	SUB	.05	.06	.04	.05
SUB	SUB	.07	.07	.05	.08
	DOM	.10	.08	.09	.10

Note: EP = Error Proportions

SD = Standard Deviation

DOM = Dominantly biased sentence

SUB = Subordinately biased sentence

response was recorded as an error. However, the focus of the results and discussion will be on the reading times, and discussion of error rates will be included only when these effects may add to or qualify conclusions drawn from the reading time data.

In the reading time analysis, there were no significant main effects. However, the interaction between the nature of the second sentence and the nature of the first was significant, $F(1, 46) = 18.17$, $MSe = 1.11$. In addition, there was a significant 3-way interaction involving the nature of the sentence on the second presentation, the nature of the first sentence, and relatedness, F (1, 46) = 5.84, $MSe = .51$. This interaction was examined by performing separate analyses on each of the two levels of the between-subjects variable, that is, the nature of the sentence seen on the second presentation, either dominant or subordinate, and these results are listed in Appendix B.

In analyzing the effects for those subjects who read dominant sentences on presentation number two, the interaction of relatedness and the nature of the first sentence was significant, F (1, 23) = 5.16, $MSe = .32$. This interaction may be traced to the finding that the subjects who saw dominant sentences on the first presentation had

faster reading times for related sentences than for their control sentences. Conversely, the reading times were slower for related than for control sentences when a subordinate sentence had been presented initially. Neither of these contrasts was significant, however (See Table 1). To ensure that this interaction was not due to a violation of the assumption of homogeneity of variance, Hartley's (1950) test was applied. The results from this F-max test indicate that the assumption of homogeneity of variance was not violated. Hence, this failure of simple main effects to achieve statistical significance could be due to small sample size. Therefore, increasing the power by increasing the sample size would be in order.

The other level of this analysis was for the group of subjects who were presented subordinate sentences on the second presentation. The result of this analysis showed a significant main effect of the first presentation, $\underline{F}$ = (1, 23) = 14.81, $\underline{MSe}$ = 1.17, thus indicating that these subjects had faster reading times when they saw subordinately biased sentences first as opposed to dominant sentences, but this effect did not interact with relatedness.

For the error proportion analysis, there was a main effect for the nature of the sentence subjects were shown as

the second sentence, F (1, 46) = 12.56, MSe = .09. This outcome indicates that subjects who saw subordinate sentences on the second presentation had significantly more errors than those who were shown dominant sentences.

The error proportions also showed a significant interaction for the nature of the first and second presentations, F (1, 46) = 13.11, MSe = .036. Further breakdown of the results of error proportions for the group which saw dominant sentences on the second presentation showed a simple main effect for the type of sentence on the initial presentation, F (1, 23) = 4.40, MSe = .008. For those individuals reading dominant sentences on the second presentation, significantly more errors were made when the prior sentence was subordinate as opposed to dominant. This same pattern of results was seen for subordinate on the second reading, F (1, 23) = 8.75, MSe = .029. Subjects made more errors when the first sentence was dominant rather than subordinate. In short, the results from the error rates mirrored those found for sentence reading times in that those conditions which showed slower processing times also showed more errors.

Discussion

The present research proposed to investigate the

effects of context on the processing of ambiguous words. This experiment was an extension of the work by Simpson and Kellas (1989), which studied homographs in a repeated format, but used word pairs instead of sentences. The research presented here found that, indeed, the presentation of an ambiguous word within the context of a sentence appears to affect the subsequent processing of that word when it is encountered again. This effect of processing is seen in both subordinate and dominant contexts. In other words, the subjects who saw dominant related sentences on the second presentation were able to process these sentences 198 milliseconds faster if they had also seen a dominant sentence earlier, rather than a subordinate sentence. Conversely, the subjects who saw subordinate related sentences on the second presentation responded to these sentences 312 milliseconds faster if preceded by another subordinate sentence rather than a dominant sentence.

This finding of faster reading times of the second sentence when the first and second sentences were both biased toward the same definition of the homograph supports and expands upon those results reported by Simpson and Kellas (1989). Simpson and Kellas found these same effects in their experiment when they used word pairs as primes and

targets. The present research supports these results in that it found priming and facilitation in the context of sentences rather than the use of word pairs.

Another interesting result from this experiment is focused on the subordinately biased sentences. This experiment found that the reading times for subordinate sentences were faster when preceded by other subordinate sentences rather than dominant. This outcome provides additional support to the work by Simpson and Kellas (1989), who also found a similar result with word pairs. Previous research in this area has found evidence for the dominant meaning having an advantage over the subordinate even when the context biases the reader toward the subordinate meaning (Tabossi et al., (1987). However, other research is emerging which does not show this advantage. Simpson and Kellas (1989) found that following the presentation of a subordinately biased sentence containing a homograph, subordinate associates were responded to faster than dominant associates. Hence, the results of the present experiment also contribute to the possibility that the subordinate meaning does have an advantage when it is specifically primed by context, thus, supporting the context-dependent model of processing.

Another hypothesis of the current research was to investigate the possible effects of suppression or inhibition for the unselected meaning of a homograph. For the present study, the evidence of inhibition is not as straightforward as the results presented by Simpson and Kellas (1989). This is due to the fact that, while reading times for sentences which were preceded by a sentence using the homograph in a different context (i.e., going from dominant on one trial to subordinate on the next, and from subordinate to dominant) were in fact slower than their control sentences, they were not significantly slower. Although the trend is evident, the results can not be supported statistically. However, further study in this area is warranted due to the past evidence as well as the suggestive effects seen in the current experiment.

Few studies have examined the effects of one sentence processing episode on subsequent comprehension. One exception (Ashcraft, 1976) examined a subject's response to deciding the truthfulness of certain property statements, such as "Maple is wood", or "Robin has feathers." He found that subjects were able to verify these statements more rapidly if they had seen a related statement on a previous trial, and he found that although this effect decreased

across lag it did not disappear. The present research therefore supports Ashcraft's conclusions that the presentation of one sentence does have a direct effect on a subsequent presentation of a related sentence. Ashcraft found that priming by a sentence spreads primarily to highly related concepts or properties. In terms of the present research involving homographs, this was also the case. Dominant sentences served to prime (decrease the reading time of) subsequent dominant sentences and the same was true for subordinate sentences.

The current research investigated homographs within the context of a sentence. The conclusions from this study are that homographs biased within a sentence do have an effect on subsequent presentations. In addition, the study proposed to investigate possible suppression and facilitation effects for these sentences as well, However, conclusive evidence was not found due to the relative weakness of these effects. While the data show that suppression and facilitation are indeed occurring, this was not substantiated statistically. Therefore, further study of this type is recommended. Increasing the power of the present study by testing more subjects may indeed show stronger evidence of suppression and facilitation. Also,

another suggestion for subsequent research would be to address the effect of lag. Lag was not found to play a part of the end result of the research. In previous research with sentences (Ashcraft, 1976), the effect of a prior presentation decreased with increasing lag, but that was not the case in the present research. Therefore, exploring longer lags (12) would be a possibility.

The study of homographs provides a valuable contribution to the study of language as a whole. Lexical ambiguity is not simply an example of an isolated phenomenon which occurs in language (Simpson, 1984). Rather, homographs represent an extreme example of words which have multiple meanings. All words can have at least slightly different interpretations depending on the context in which they are presented. Therefore, the present study contributes to this body of literature in showing that context does play a role in processing. It also provides evidence of the nature of the role of context in language processing, namely the inhibition of irrelevant information as well as facilitation of related information.

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Appendix A

ANOVA Summary Table (Main Effects)

Source	SS	DF	MS	F	P
Presentation 2	3.916	1	3.916	3.850	.053
Error	46.795	46	1.017		
Presentation 1	.230	1	.230	3.229	.055
Pres1 X Pres2	1.107	1	1.107	18.167	<.001
Error	2.803	46	.061		
Relatedness	.011	1	.011	.177	
Pres2 X Related	.011	1	.011	.176	
Error	2.967	46	.064		
Pres1 X Related	.006	1	.006	.076	
Pres2 X Pres1 X Rel	.511	1	.511	5.837	.018
Error	4.025	46	.087		

Appendix B

ANOVA Summary Table (Simple Main Effects For Dominant on Presentation 2)

Source	SS	DF	MS	F	P
Presentation 1	.164	1	.164	3.840	.059
Error	.980	23	.043		
Relatedness	.000	1	.000	.000	
Error	1.326	23	.058		
Pres1 X Relate	.317	1	.317	5.161	.031
Error	1.413	23	.061		

ANOVA Summary Table (Simple Main Effects For Subordinate on Presentation 2)

Source	SS	DF	MS	F	P
Presentation 1	1.174	1	1.174	14.812	.01
Error	1.823	23	.079		
Relatedness	.023	1	.023	.319	
Error	1.641	23	.071		
Pres1 X Relate	.200	1	.200	1.764	.194
Error	2.612	23	.114		

Appendix C:

STIMULUS ITEMS

The stimuli listed below are in alphabetical order. The sentences numbered 1 and 2 indicate dominantly biased sentences, and those sentences numbered 3 and 4 indicate subordinately biased sentences. The underlined word in each sentence denotes the homograph. The word following each sentence in parentheses indicates the word which was substituted to construct control sentences in the experiment.

Arms
1. The man enlarged his arms by working out. (muscles)
2. Lifting weights increased the size of his arms. (legs)
3. The arms agreement was signed by both countries. (peace)
4. The two leaders met to discuss the arms reduction. (weapons)

Ball
1. The children played with the ball on the playground. (toys)
2. The ball was measured by the referee. (field)
3. Attending the ball was an annual event. (party)
4. The ball was a perfect place to wear her new gown. (nightclub)

Band
1. The marching band played during halftime. (troop)
2. My father enjoyed the music of the band. (group)
3. Jane loved the emerald band her husband gave her. (necklace)
4. The gold band was displayed in the jewelry store window. (bracelet)

Bank
1. I took my money to the bank. (store)
2. They built a new bank downtown. (office)
3. The bank along the river was beautiful. (tree)
4. The sandy bank was a perfect place for the picnic. (beach)

Bar
1. They went to the bar to have a drink. (hotel)
2. The coworkers gathered at the bar after work. (gym)
3. The track star jumped over the bar to win first place. (hurdle)
4. The metal bar was too heavy to lift. (box)

Bark
1. The dog's bark frightened the children. (howling)
2. The animal's bark warned the guard. (growl)
3. The bark on that tree was very unusual. (leaf)
4. The rough bark tore my jacket. (branch)

Bat
1. Johnny used his new bat to hit a homerun. (stick)
2. He received a baseball bat for his birthday. (glove)
3. The bat frightened us when it flew out of the cave. (bird)
4. Johnny shot the hairy bat with his gun. (monster)

Beam
1. I saw the animal in my headlight beam. (glare)
2. The beam was bright so we shielded our eyes. (sun)
3. The beam on the ceiling was made of wood. (clock)
4. They installed a steel beam to support the building. (pole)

Bill
1. We didn't have enough money to pay the bill. (plumber)
2. The cleaning bill was quite high. (fee)
3. The bird used his bill to pick up the twig. (beak)
4. The bird's bill was quite colorful. (feather)

Bit
1. The trainer bought a new bit and bridle. (rope)
2. The horse did not like having a bit in his mouth. (rein)
3. The neighbor asked to borrow a bit of sugar. (cup)
4. She ate just a little bit at the banquet. (food)

Bow
1. He shot the deer using a bow and arrow. (gun)
2. The archer aimed his bow at the target. (arrow)
3. The little girl wore a pretty bow in her hair. (ribbon)
4. He wore a bow tie with his jacket. (new)

Bug
1. He squashed the bug with his foot. (worm)
2. The bug was caught in the spider's web. (fly)
3. His annoying laughter began to bug me. (bother)
4. His little brother's questions really bug him. (amuse)

Calf
1. The hungry calf ate the corn from a bucket. (horse)
2. The farmer's calf won first prize at the fair. (pig)
3. The runner's calf hurt after he ran the race. (knee)
4. He exercised his calf muscle to avoid further injury. (leg)

Cape
1. She wore a cape over her old dress. (coat)
2. He designed a new cape for the fashion show. (dress)
3. The sailors thought the cape was beautiful. (island)
4. They encountered storms as they neared the cape. (ocean)

Case
1. She put her jewelry into a gold case. (box)
2. The broken case did not contain any valuables. (box)
3. The attorney found the case very challenging. (client)
4. He argued the case from the bench. (appeal)

Cell
1. The door to the cell was locked. (house)
2. The bars around the cell were very strong. (window)
3. He looked at the cell under the microscope. (slide)
4. The cell was examined by the doctor. (patient)

Charm
1. He was attracted by her charm and wit. (laughter)
2. That woman could charm her way out of anything. (talk)
3. He gave his girlfriend a charm bracelet. (new)
4. She wore a beautiful charm on her necklace.

Charge
1. They did not charge me for the extra piece of pie. (ask)
2. A small charge was added for the service. (fee)
3. The general instructed the soldiers to charge. (retreat)
4. The platoon's charge up the hill was successful.

Check
1. She used a check to pay for the merchandise. (dollar)
2. My grandmother enclosed a check in my birthday card. (note)
3. The teacher put a check by the incorrect answer. (mark)
4. The student was upset by the check on his paper. (comments)

Chest
1. He went to the doctor because he was having chest pains. (leg)
2. His chest was sunburned so he wore his shirt. (back)
3. Her cedar chest was filled with memories. (closet)
4. The divers found a treasure chest. (box)

Club
1. Our club decided to have a fundraiser. (class)
2. We all met at the club for lunch. (restaurant)
3. The heavy club cracked his skull. (brick)
4. That club is a dangerous weapon. (knife)

Coach
1. The players gave their coach an award. (mascot)
2. The coach was pleased with the team's performance. (player)
3. The silver coach took the princess to her castle. (limousine)
4. Riding in a coach is a pleasant way to travel. (train)

Dash
1. He ran the 100-yard dash in record time. (hurdles)
2. We made a mad dash through the rain. (run)
3. The recipe called for a dash of salt. (teaspoon)
4. He added a dash of pepper to the chili. (lot)

Date
1. Please check the date on the calendar. (month)
2. We chose a date for the next meeting. (place)
3. He found a date high in the tree. (apple)
4. She thought the date had a peculiar taste. (food)

Deed
1. The lawyer arranged for the deed to be changed. (contract)
2. The deed to the house was in the safe. (blueprint)
3. The child's friendly deed was appreciated. (attitude)
4. He performed his good deed for the day. (act)

Diamond
1. Everyone admired the woman's diamond bracelet. (silver)
2. She kept her diamond brooch in the safe. (new)
3. The field was in the shape of a diamond. (rectangle)
4. They marked off the diamond for the baseball game. (playground)

Draft
1. I signed up for the draft while I was downtown. (job)
2. They were protesting the draft in front of the courthouse. (decision)
3. She protected her hair from the draft with a scarf. (rain)
4. A cold draft was coming in from under the door. (wind)

Drill
1. The dentist used his drill on my tooth. (instruments)
2. He used an electric drill to make the table. (saw)
3. The drill sergeant was intimidating. (army)
4. The children filed outside for the drill. (game)

Fair
1. He is a fair person so I trust his judgement. (nice)
2. We made a decision which would be fair to both people. (agreeable)
3. She burns easily in the sun because her skin is fair. (delicate)
4. Part of her beauty was due to her fair complexion. (soft)

Fall
1. Fall is my favorite time of the year. (summer)
2. He will start college in the fall. (summer)
3. I walked carefully so I would not fall. (trip)
4. She was scared she might fall on the ice. (slip)

Fan
1. They installed a ceiling fan in the den. (light)
2. They used an electric fan to cool the room (air-conditioner)
3. My brother is a baseball fan. (player).
4. The fan club organized a meeting with the actress. (acting)

Figure
1. His figure improved when he lost weight. (personality)
2. They all admired the model's figure. (outfit)
3. They could not figure out the answer. (find)
4. We used a calculator to figure the sum. (add)

File
1. I began a special file for the new information. (list)
2. The secretary put the file in the wrong place. (papers)
3. The carpenter used a file to smooth the rough edges. (saw)
4. A file was used to put the finishing touches on the table. (paintbrush)

Fine
1. The doctor said I would be fine in a few days. (up)
2. She is feeling fine after the accident. (shaky)
3. The carpenter used a fine grain of sandpaper. (new)
4. The fine grains of sand fell through the hourglass. (little)

Foot
1. He cut his foot on the broken glass. (finger)
2. He burned his foot when he walked on hot coals. (toe)
3. The grass grew over a foot while we were gone. (inch)
4. We extended the ladder another foot. (level)

Grave
1. She took flowers to her husband's grave. (office)
2. The grave was marked by a tombstone. (sight)
3. The grave nature of the problem got our attention. (serious)
4. Her grave expression told us something was wrong. (sad)

Habit
1. His smoking habit began to annoy his coworkers. (cigars)
2. She tried to break the habit but was unsuccessful. (seal)
3. The nun wore her habit to church. (cross)
4. Wearing a habit was required for all the women. (skirt)

Hand
1. His hand hurt from writing all day. (arm)
2. She cut her hand while washing dishes. (finger)
3. The cowboy thought he had a winning hand. (horse)
4. She was dealt a good hand during the poker game. (card)

Hard
1. The metal became hard after it was cooled. (rough)
2. We sat on the hard bench to wait for the bus. (new)
3. The questions were so hard most of the class failed. (difficult)
4. Even though I studied that test was hard. (unfair)

Horn
1. He blew the horn loudly. (bugle)
2. The horn sounded announcing his arrival. (bell)
3. The animal's horn was broken. (leg)
4. The bull's horn hit the matador. (hoof)

Iron
1. Bars of iron were used to make the cage. (lead)
2. The box was made of very thick iron. (wood)
3. My mother used her iron to press the clothes. (steamer)
4. He did not have an iron so his clothes were wrinkled. (dryer)

Jam
1. She gave homemade jam as Christmas gifts. (bread)
2. He spread jam and peanut butter on his bread. (honey)
3. The traffic jam postponed our arrival. (accident)
4. We had to jam our clothes into a suitcase. (pack)

Kid
1. The smartest kid in the class wrote the paper. (girl)
2. That kid is the bully of the neighborhood. (boy)
3. The farmer have the hungry kid some oats. (cow)
4. The shepherd prodded the stray kid to hurry it along. (goat)

Kind
1. The kind gentleman offered me his seat. (young)
2. He helped the kind old lady across the street. (nice)
3. She did not buy the right kind of soap. (brand)
4. That is my favorite kind of dessert. (flavor)

Lap
1. He held the new puppy in his lap all the way home. (basket)
2. She likes to sit on her grandmother's lap and listen to stories. (chair)
3. After the last lap, the tired runner collapsed. (turn)
4. She could only run one lap because of her injury. (race)

Lie
1. We discovered her lie during the trial. (problem)
2. I told one lie but its effects spread to the whole family. (secret)
3. He did not feel well so he went to lie down. (sit)
4. She asked him not to lie on the new carpet. (walk)

Light
1. The light color looked nice in the bathroom. (soft)
2. She decorated her house in light colors. (vivid)
3. The child was light so I carried him. (tired)
4. I lifted the box easily because it was light. (empty)

Litter
1. If you litter in the park you will be arrested. (drink)
2. The litter was strewn across the parking lot. (garbage)
3. The cat's litter of kittens was larger than we expected. (batch)
4. Our dog had four puppies in her litter. (house)

Match
1. He held a burning match between his fingers. (torch)
2. The smoker found a match for his cigarette. (lighter)
3. We watched the doubles match on television. (game)
4. The Olympic wrestler won the match. (medal)

Mint
1. The waitress brought me a mint after dinner. (dessert)
2. She flavored the cookies by adding mint to the mix. (cocoa)
3. While we were visiting the mint we received new coins. (museum)
4. The mint makes new coins everyday. (bank)

Mole
1. The mole dug so many holes it destroyed the field. (gopher)
2. We watched the mole crawl out of his hole. (snake)
3. He had a mole on the side of his arm. (scar)
4. The doctor removed the mole from his back. (pain)

Net
1. The acrobats used a net throughout their routine. (trapeze)
2. We used a net to catch the fish. (pole)
3. My net earnings are comparatively small. (total)
4. The company's net profit for the year was good. (entire)

Note
1. She left a note in my mailbox asking me to lunch. (letter)
2. The girl passed a note to her friend during class. (message)
3. She played the wrong note at the end of the song. (key)
4. We recognized the tune when we heard the first note. (verse)

Organ
1. The keys to the organ were splintered and broken. (piano)
2. She learned to play the organ while in school. (guitar)
3. The doctor removed the cancerous organ during surgery. (disease)
4. The man had to have an organ transplant. (liver)

Page
1. The author autographed the page of his book. (cover)
2. The first page of the novel was boring. (chapter)
3. He got a job as a page in Washington. (reporter)
4. The page delivered a message to the Congressman. (secretary)

Pen
1. The teacher used a red pen to correct the tests. (mark)
2. My pen ran out of ink during the exam. (friend)
3. My father built a large pen for our dog. (house)
4. We made a pen out of wire and wood. (fort)

Play
1. The quarterback called for a pass play and won the game. (option)
2. The teacher sent the children outside to play. (exercise)
3. The play received rave reviews from the critics. (actress)
4. Auditions for the play will be held after school. (show)

Pot
1. They bought some South American pot from a pusher. (drugs)
2. The parents were concerned about students smoking pot at school. (cigarettes)
3. She used a large pot to cook the chicken. (pan)
4. The pot on the stove began to boil over. (soup)

Punch
1. Even though Ali ducked the wild punch hit him. (man)
2. The boxer beat his opponent with one punch. (round)
3. We drank the punch because we were thirsty. (soda)
4. They served punch at the school dance. (coke)

Race
1. After the race he collapsed from exhaustion. (work-out)
2. He prepared for the race by running ten miles a day. (meet)
3. He felt his race kept him from getting the job. (grades)
4. The Constitution forbids discrimination on the basis of race. (sex)

Racket
1. He bought a new tennis racket for the game. (jacket)
2. The racket broke when he hit the ball. (stick)
3. Several politicians were involved in an illegal racket. (project)
4. The store served as a front for the gambling racket. (business)

Ring
1. The man gave his wife a ring for their anniversary. (necklace)
2. She wore her new ring everywhere she went. (coat)
3. The loud ring on the telephone startled me. (bell)
4. The bells began to ring to announce the victory. (sound)

Rock
1. They put a large rock in their front lawn. (statue)
2. The children slid down the rock into the water. (slide)
3. His parents did not like the rock band. (loud)
4. The school board would not allow rock music. (punk)

Roll
1. They learned to roll and tumble in gym class. (jump)
2. The gymnast performed a perfect forward roll. (vault)
3. My friend brought me a roll and coffee for breakfast. (bagel)
4. I did not like the roll I was served with dinner. (salad)

Right
1. He got every question right on the test. (wrong)
2. The teacher gave the right answers to the class. (best)
3. You should turn right at the next corner. (around)
4. The traffic cop directed cars to the right of the accident. (left)

Seal
1. The trained seal is my favorite circus act. (elephant)
2. The seal at the zoo entertained the children. (monkey)
3. The torn seal was the most incriminating evidence. (curtain)
4. The mailman checked the seal on the package. (address)

Sentence
1. Diagramming the sentence was difficult for the student. (problem)
2. He wrote one sentence to summarize his feelings. (paragraph)
3. The judge changed the sentence to life in prison. (punishment)
4. The death sentence was carried out by the hooded executioner. (penalty)

Spring
1. Last spring was very cold and rainy. (night)
2. She thinks spring is the prettiest time of the year. (Christmas)
3. The mechanic repaired the broken spring in the car. (motor)
4. The broken and rusty old spring was replaced. (frame)

Suit
1. I wore my blue suit for the interview. (tie)
2. She was required to wear a suit to work. (dress)
3. She filed a paternity suit against him. (case)
4. They settled their suit out of court. (problem)

Top
1. I reached the top after years of struggling. (end)
2. We climbed to the top of the mountain. (side)
3. The boy received a toy top for Christmas. (car)
4. The swirling top eventually stopped. (ball)

Watch

1. The president was given a gold watch when he retired. (plate)
2. She was unaware of the time until she looked at her watch. (clock)
3. He was assigned the night watch on the ship. (duty)
4. After the robbery someone stayed on watch duty continuously. (guard)

Will

1. He showed a tremendous amount of will power. (internal)
2. He exercised his free will when he made the decision. (choice)
3. The reading of the will was quite uncomfortable. (decree)
4. The will did not mention either of his children. (story)

Appendix D

STIMULUS ITEMS

The stimuli listed below are in alphabetical order and represent those sentences which do not make sense.

Base
1. The wheels of the base ended the show.
2. He ran the base of the gray jacket.

Bass
1. He proposed to the girl while running on his bass.
2. He joined to play bass on his way down.

Bay
1. The garden by the bay played very well.
2. The bay was able to trap the dolls.

Bear
1. The bear wanted to book the tape on it.
2. He had to bear the example of the tree.

Block
1. He asked to block the committee's state.
2. The block threw the sign up the street.

Blow
1. The blow of the paper went on the way.
2. They wanted to blow the button on the screen.

Blue
1. The blue hair grew out of the piano.
2. He was blue in the age because he was angry.

Bluff
1. We visited the bluff during the wheel.
2. The new bluff began to watch the children.

Board
1. Her first board was so early it surprised us.
2. The other board that appears is over.

Bolt
1. The man cleaned a bolt to match his eyes.
2. The blot counted the coins in the bag.

Boot
1. He wore the boot and walked to the tape.
2. During the summer the record raised the boot.

Bound
1. The light snow was needed to bound the bus.
2. The sweater shrank because it was bound.

Box
1. He used the box for several cold bells.
2. The box was carved to the street below.

Bridge
1. We drove to the bridge in the green sentence.
2. The camp played a bridge on the children.

Cable
1. The nurse knew it was an elderly cable to fix.
2. The man tried many jokes on his cable.

Call
1. His call was a strange color for the water.
2. This singer went to a call to see her friend.

Can
1. She can work softly with the even set of tables.
2. He ordered the can when he changed the cart.

Cane
1. The plaid cane was her favorite dress.
2. She put her hair in a cane to match her dress.

Cap
1. We put the cap on to try to get a glass.
2. My friend drank his cap before he got.

Cards
1. I made the cards and am now washing the pool.
2. The doctor put the scissors in the cards.

Cast
1. She curled the cast for the party.
2. They were cast by a nail for the production.

Change
1. We had change bread in the new kitchen.
2. The paper decided to change the difficult deal.

Chew
1. He went to the barn because she was having chew pains.
2. We asked to chew the sun at the college.

Chop
1. I enjoyed our vacation at the chop.
2. We wanted to chop, but the price was not.

Count
1. The handsome count was caught in the print.
2. She was unable to count the water.

Crook
1. The crook pretended to hit the fruit.
2. He got a crook when we hid the jar.

Deck
1. She bought her dog a deck at the grocery store.
2. The deck fit perfectly on the kitchen table.

Desert
1. We fixed our desert with a screwdriver.
2. Please do not desert to water the plants.

Die
1. We had a die on the hill.
2. I thought the new house was a die.

Digit
1. Her digit was beautiful but expensive.
2. The pattern on that digit looks nice.

Duck
1. That woman could duck any lime.
2. She found a duck with her paper.

Fence
1. The fence jumped the best part of the land.
2. He liked to fence but his friend was loud.

Fire
1. He was asked to fire the new basket.
2. We gathered by the fire to bring a pig.

Fit
1. The fit was good but the gallon was not.
2. He asked a fit by walking with attention.

Flat
1. The turning flat enjoyed a drink with my friend.
2. Our flat was a happy time in that cover.

Grace
1. The girl had grace but disappointed her glasses.
2. She was happy to know the grace had stopped.

Grade
1. He erased the grace after the milk complained.
2. We chose a new grade for the post.

Grill
1. The grill began to bother my doctor's toe.
2. We asked to see the grill over the time.

Ground
1. We handled ground with the old bed.
2. My sister put ground carpet in the mill.

Hatch
1. We watched the chicks hatch on the pencil.
2. The hatch went when he was on the list.

Hem
1. The lady asked for some more hem.
2. The boy grew his father's hem.

Jerk
1. The car began to jerk forward because she lied.
2. The man thought that jerk was almost the floor.

Key
1. The little boy carried his key and played a plug.
2. My sister returned the stem but aimed the key.

Land
1. The boy wanted to dive into the land.
2. We tried to land her but she copied.

Left
1. Some fabrics find they have value left.
2. The absent was on the left.

Letter
1. The boy asked a letter for help on the steam.
2. They learned the door's way of starting a letter.

Marble
1. The marble lifted the jar of chains.
2. I gave him a marble for the start.

Mold
1. My sister used a mold to end the talk.
2. She walked to the mold and ended it.

Nut
1. The girl used a cup to tighten the nut.
2. The nut of the book was fascinating.

Pass
1. We asked the pass to speak louder.
2. They opened the pass and took the prize.

Peer
1. The jump by the peer was seen as a statement.
2. Her mother told her not to peer or drop the wool.

Plane
1. The children lifted the plane from the old road.
2. We studied the plane and found it happy.

Port
1. The family drove the port to the store.
2. We drank the clock of port after dinner.

Pound
1. He actually gave a pound during the training.
2. We walked to the pound to find an old one.

Present
1. One present compared the class by using a test.
2. He was not present, so they turned the method.

Pupil
1. The pupil decided to go to the angry list.
2. The pupil was chosen as the teacher's hammer.

Rest
1. They all stopped to take a rest at the plug.
2. We left the rest folding words for the speech.

Rose
1. The book gave his wife a beautiful rose.
2. He rose with the chair and left the room.

Shot
1. The workers put a shot for their boss.
2. We shot the informed fabric in the night.

Spell
1. The cowboy's spell worked on the clothes.
2. His teacher asked him to spell the climb.

Stall
1. She worked the stall by putting on an eraser.
2. They tried to stall the wreath before we went.

Star
1. My brother put the toys in her star.
2. I missed the star after they closed the store.

State
1. Please carry the state in your bag.
2. That section of the state narrows at the lady.

Stick
1. The boy asked the stick for his grandmother's mug.
2. He called the cane to stick on the sidewalk.

Story
1. We arrived at the story and enclosed the flower.
2. I gently tapped as I marked the story.

Tap
1. It was a sunny morning and the tap was blue.
2. He asked for a tap but got a button instead.

Temple
1. The temple needed to be circular for the place.
2. The girl was upset when the temple asked her to stop the noise.

Tip
1. They went to the tip to get a good life.
2. The tip was the best size for the copy.

Tire
1. My mother likes to have a tire at work.
2. My sister is a tire at that school.

Toast
1. We took a toast and blanket to camp.
2. The group met to discuss and toast the ice.

Volume
1. The volume allowed the children to cross the street.
2. The musician stopped by the volume of the shirt.

Yard
1. During the summer the yard fell through the light.
2. We asked him to give the yard a mouse.

Appendix E

INFORMED CONSENT STATEMENT

Sentence Reading Study

Invitation to Participate

You are invited to participate in a research project on sentence reading and word recognition.

PURPOSE OF THE STUDY AND EXPLANATION OF PROCEDURES

In this experiment, we are interested in how people read printed words in sentences and what information may affect the reading process. On each trial of this experiment, you will be asked to read a sentence and decide whether or not it makes sense and do this as quickly as you can. There are no risks involved. Your identity will be kept strictly confidential and you name will not be associated with the research findings. We recommend that one hour (2 points) of extra credit be given for this study. Of course, other opportunities for extra credit may exist, and you should discuss these with your instructor.

WITHDRAWAL FROM THE STUDY

Your participation is voluntary. Your decision whether or not to participate will not affect your relationship with the University of Nebraska. Even if you decide to participate, you may withdraw your consent at any time. If you have any questions regarding the research, please feel free to contact the investigator, Merilee Krueger, at 559-5795, or Dr. Greg Simpson, at 554-2331.

YOU ARE VOLUNTARILY MAKING A DECISION WHETHER OR NOT TO PARTICIPATE. YOUR SIGNATURE INDICATES THAT YOU HAVE DECIDED TO PARTICIPATE HAVING READ THE INFORMATION PROVIDED ABOVE.

_____ _____

SIGNATURE OF SUBJECT DATE

_____ _____

SIGNATURE OF RESEARCHER DATE