MEMORY REPRESENTATION FOR COMPOUND WORDS

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CHAPTER I

INTRODUCTION

In recent years a great deal of research has been directed towards the word coding process, i.e., what are the codes used to access a particular word in memory? Regular inflections of the verb LEND (LENDS, LENDED, and LENDING) seem to be stored with the base verb. When a language user encounters a regular inflection, he references not only the base verb stem but also the complex form, the inflection. Irregular past tense verbs (TAUGHT) seem to be stored as a unitary memory representation and not with the base verb (TEACH). Here, the irregular verb is referenced directly in memory, but the base verb is referenced only indirectly. Prefixed words with bound morphemes (PROGRESS) directly access their unitary memory representation and indirectly access the memory representation of words with the same stem (REGRESS and DIGRESS). Alternatively, a prefixed word with a free morpheme (UNTRUE) directly accessses the representation in memory of itself (UNTRUE) and that of its stem (TRUE).

Conceptually, it appears that words with free morpheme stems are processed by a different mechanism than those having bound morpheme stems. Thus, for words such as inflected and prefixed words with free morpheme stems the process seems to be that both the stem and the complex form (inflected verbs and prefixed words) are referenced when the complex form is read. Partitioning of the morphemes is implied. For cases involving bound morphemes (irregular verbs and prefixed words), however, the mechanism seems to be one where only the memory representation for the one form is referenced directly while the other forms are referenced indirectly. The present experiment took this concept of referencing complex words with free morphemes via these free morpheme components and applied it to the memory representation for compound words.

A compound word was operationally defined as a word composed of two free morphemes. For example, the word COWBOY is composed of COW and BOY, both free standing words. To fully understand how compound words are stored in memory it will be helpful to develop an understanding of four fundamentals: the logogen model, lexical-decision tasks, semantic and repetition priming.

CHAPTER II

REVIEW OF THE LITERATURE

The Logogen Model

The logogen model (Morton, 1968) is a conceptual reference point of this study. A logogen is a cognitive device which accepts information from sensory analysis mechanisms about the properties of linguistic stimuli and from context producing mechanisms. When the logogen has built up enough information, a response of a single word is made available. So, each logogen is defined by the information it can accept and the responses made available to it. Relevant information falls into semantic and acoustic sets. Incoming information has only a numerical effect on any logogen which merely counts the number of members of its defining set. Thus, when a word such as DOCTOR is read, semantically related words (e.g., NURSE) have their logogen increased through their semantic set. Also, the acoustic set is increased for the word SMYTHE when the acoustically similar word SMITH is read. If a word such as DOCTOR was followed by a second presentation of DOCTOR, it would cause an increase through both sets. When the count rises above the threshold, the corresponding response is made available.

Lexical-decision Task

A procedure used in many memory experiments, especially those involved with related words is the lexical-decision task. Basically, this procedure involves presenting a subject with a letter string, having him respond that the string is either a word in his vocabulary or not, and measuring the latency of the decision. This latency in decision time is known as the reaction time (RT) and is the dependent variable of the task. Frequently, the number of errors is also measured. To exemplify this, a subject sits and faces a monitor. A string of letters is presented on the monitor's screen. The string is either a word (NOSE) or a nonword (NISE) and the subject responds as such. The time it takes him to respond is recorded along with whether or not it was a correct decision. A lexical-decision task was used in the present study.

Priming

Priming takes place when the latency from a response in a lexical-decision task is decreased due to the effects of a word in some preceeding trial. Two types of priming have been demonstrated, semantic (Meyer & Schranevelt, 1971) and repetition (Forbach, Stanners, & Hochhaus, 1974; Scarborough, Cortese, & Scarborough, 1977). According to Morton's model, semantically related words would increase the logogen count for similar words through the semantic set. If DOCTOR were presented and then subsequently NURSE were presented, the logogen for NURSE would have been upcounted or "primed" so the response would be about 50 to 80 msec. faster than if DOCTOR had not proceeded it. In repetition priming, on the other hand, a first presentation of DOCTOR would be followed by a second presentation of DOCTOR. The logogen would increase from the visual and phonological sets as well as the semantic set. The second presentation would show a priming effect of approximately a 150 msec. decrease in the latency as compared to the first presentation.

Empirically, there are some substantial differences between semantic and repetition priming that would suggest they result in separate processes. Two major points of differentation are the characteristic size of the facilitation effects and the rates of decay. The facilitation from repetition priming is in the 150 msec. range (Forbach et al., 1974; Scarborough et al., 1977) while facilitation from semantic priming is in the 50 to 80 msec. range (Meyer & Schvaneveldt, 1971; Meyer & Schvaneveldt, 1976). In regard to the rate at which the facilitation decays, the repetition priming effect has been demonstrated to have a decay rate in terms of minutes (Forbach et al., 1974). However, Neiser (1979) indicated complete elimination of the semantic priming effect following a delay of only 15 to 18 seconds between the prime and target presentation. Thus, the processes associated with repetition and semantic priming seem to be fundamentally different.

Lexical Memory

Many words in the English language have both morphological and semantical similarities which may be important to the nature of the storage process in lexical memory. For example, a base verb such as REFUSE may be changed into a gerundive inflection (REFUSING) or into a derived nominal (REFUSAL). An early linguistic view of how these related words are stored in memory (Lees, 1960) is that the base (REFUSE) is contained in the lexicon, and the inflections and derivatives were produced by the transformational component of grammer. A more recent view (Chomsky, 1970) proposes an alternative position, the lexicalist hypothesis. According to Chomsky, the information for producing the derivatives from the base verb is incorporated into the lexicon rather than the transformational rules. Within the lexicalist position, there are at least two possibilities. One is that the entry in memory contains the base word and the information necessary to form the derivations. Another possibility is that there are separate lexical entries for each variation of a base word. Chomsky argues that the transformationalist position might be most appropriate for gerundive nominals while the lexicalist interpretation could best accomodate derived nominals.

Murrell and Morton (1974) conducted a tachistoscopic identification study that was mainly concerned with inflections. Subjects were presented with a learning task first, then tested for tachistoscopic identification. The test words were made up of words identical to learning task words, inflections and derivatives of learning task words, and words with no morphologic or semantic relationship. Identification was most facilitated for identical words, less facilitated for inflections and derivatives and not facilitated at all for the different words with high letter similarity. The fact that preexposure produced facilitation for the inflection-derivative condition led the authors to conclude that the base morpheme is accessed when an inflection or derivative is read.

In Experiment I (Stanners, Neiser, Hernon, & Hall, 1979) also concerned with inflections, the premise was that if there are separate memory locations for the verb LEND and suffix -ING (but not LENDING), a reader who encounters LENDING would have to access LEND in memory. Therefore, the priming effect of LENDING on LEND ought to be just as large as that of LEND itself. Inflections (LENDS, LENDED, LENDING) of verbs were the primes of the base verbs (critical targets), i.e., LENDING would preceed LEND. This was compared to a base verb being primed by itself (LEND...LEND).

Stanners et al. (1979) reported a substantial and reliable repetition priming effect. The priming effect of the inflections was just as large and indicates that the base verbs were fully activated in the process of reading the inflections. This could be interpreted as supporting the idea that inflections are stored as base verbs plus suffixes. Presumably when the inflection is read, the base verb and the suffix are partitioned prior to memory access and the base verb is directly accessed.

In Experiments II, III, and IV (Stanners, Neiser Hernon, and Hall, 1979) irregular past tense verbs were used as primes (TAUGHT, TEACH) and derived nominals or adjective derivatives were used as primes (REFUSAL, REFUSE or RETENTIVE, RETAIN) for their bases, respectively. In all of these conditions the critical primes did not prime the base as well as the base primed itself, indicating that words like TEACH and REFUSAL access their own memory representations and do not directly access the representation of their base word. However, the results indicate that the base word is at least partially activated. This is probably due to the close semantic relationship between the words. A substantial advantage of this approach is that the major experimental questions can be answered by comparison of latencies to exactly the same words under different priming conditions, eliminating the problems involved in matching on such variables as frequency or number of letters. This same technique was employed in the present study.

In an investigation of the storage and retrieval of compound words, Taft and Forester (1976) conducted a series of five experiments. In Experiment I, a variety of compound words (CW) and compound nonwords (CNW) were tested in a lexical-decision task. If compound nonwords (DUSTWORTH, MOWDFLISK) are classified as nonwords because of their constituent units rather than the word as a whole, then those nonwords with constituents of lexical status (DUST-WORTH) would have longer classification times than those nonwords with constituents of no lexical status (MOWDFLISK). Also, if classification time is based on a lexical search of just the first constituent, then the lexical status of the second constituent would be irrelevant. Thus, nonwords such as FOOTMILGE would take longer to classify than nonwords such as TROWBREAK. Conversely, if classification time is based on lexical search for only the second constituent, then TROWBREAK would take longer to classify than FOOTMILGE. If both constituents were important, then there would be no difference between the two.

Four compound item conditions were used. Conditions were defined by the status, word or nonword, of the two constituents: WW (DUSTWORTH), WN (FOOTMILGE), NW (TROWBREAK), and NN (MOWDFLISK). Looking at individual comparisons, it was found that both WW (DUSTWORTH) and WN (FOOTMILGE) were associated with significantly longer reaction times than NW (TROWBREAK) and NN (MOWDFLISK). These results indicate that compound items are addressed via their first syllable.

In Experiment V, the frequency of the first constituent of a compound word was manipulated in a lexical-decision task. Simply stated, if a compound word is recognized by accessing its first constituent, then the frequency of occurrence of the first constituent should influence reaction times. To give an example, although the words

LOINCLOTH and HEADSTAND have the same frequency of occurrence according the Kucera-Fransis word count, the word LOIN is much less frequent then HEAD. Therefore, since compound words are recognized on the basis of their first constituents, and since high-frequency words are accessed before low-frequency words (Rubenstein, Garfield & MilliKan, 1970), compound words such as LOINCLOTH should take longer to classify than words such as HEADSTAND. The results supported the predictions. Both Experiments I and V strongly support the notion that compound words are recognized on the basis of first constituents. They reported that the frequency of only the first constituent influenced the classification times. Also, the classification of compound nonwords took longer if the first constituent is a word (FOOTMILGE) rather than a nonword (TROWBREAK). Both of these results indicate that compound words are addressed via their first syllable.

In a study of the memory representation of prefixed words (Stanners, Neiser, & Painton, 1979) the focus was whether a prefixed word was represented in memory as two separate morphemes, prefix and stem, or whether the representation was unitary. Experiments I-III had a similar type of methodology that included three conditions of interest. Using prefixed words in a lexical-decision task, a prefixed word could be unprimed (control prime), primed by itself (control target), or primed by its constituents (critical target). The difference between the experiments is that Experiment I used bound morpheme stem words which had only one prefix (RETRIEVE), Experiment II used bound morpheme stem words that had multiple prefixes (PROGRESS), and Experiment III used free morpheme stem words (DISCOMFORT).

All three experiments had similar results in that all three conditions were significantly different from one and other. The rank order of means, from fastest to slowest, was: control target, critical target, and control prime. These results are not consistant with the theoretical view that a prefixed word is represented in memory as two separate elements, prefix and stem. If that were the case, the mean latencty for the critical target should not have been reliably different from that of the control target. If the only representation of the word is the stem, then priming with the stem plus the prefix should have fully activated the relevant memory representations. Another alternative which can be eliminated is the argument that processing the stem has no effect at all on the memory representation of the prefixed word. If such were the case, then the mean latency for the critical target should not have been different than that for the control prime. The model which is consistant with the results is the one which states that a prefixed word does have a unitary representation in memory, but that this representation can be accessed by the stem alone. The stem can access this representation but does not activate it fully.

Although Experiments I-III provide evidence counter to the view that prefixed words have the stem and prefix represented separately, the experiments did not directly address the question of prefix partitioning. Experiment IV (Stanners, Neiser & Painton, 1979) was disigned to answer that question. Prefixed words with free morphemes (UNTRUE) were used in a lexical-decision task. If a prefix and stem were partitioned during priming, then the memory representation for the stem would be fully activated. Therefore, UNTRUE would prime TRUE just as effectively as TRUE primes TRUE. This was, in fact, what the results indicated. A prefixed word with a free morpheme stem is partitioned and the stem is directly accessed.

The present study addressed the question of lexical storage and access of compound words. Simply stated, is a compound word such as COWBOY stored as COW and BOY with some combination rules for generating the compound, or is it stored as unitary, COWBOY? In reading a compound word, partitioning might take place as it did with free stem prefixed words such as the way UNTRUE accessed both TRUE as well as itself. Applying this to compound words, presenting COWBOY as a prime for COW and/or BOY as targets should result in a complete priming effect because the compound word would be partitioned into its components. But would COW and BOY facilitate the response to COWBOY as well if it were primed by itself?

As a conceptual reference point, Experiment III of Stanners, Neiser and Painton (1979) dealt with prefixed words having free morpheme stems, a direct parallel to this study. The result was a priming effect smaller than that for repetition priming but much longer lasting than semantic priming. Possibly, compound words work according to the same mechanisms as prefixed words with a free morpheme stem. Certainly, they do not have to in that prefixed words have a bound morpheme component (the prefix), whereas compounds have two free morphemes. However, it would be of interest if they show the same effects.

It was hypothesized that priming a compound word with itself, control prime-target (COWBOY...COWBOY) would have the usual repetition priming effect. Secondly, it was hypothesized that a compound word primed by both its component words (COW...BOY...COWBOY) would show one of three possible results with different implications for each. First, it could have no facilitation effect, a possible but improbable result considering past research. Second, it could have approximately a 150 msec. effect as in repetition priming (Forbach et al.) indicating that COW, BOY, and COWBOY have the same memory representation. Third, it could have a 50 to 80 msec. effect as in semantic priming, but should last much longer as in repetition priming (Stanners, Neiser, and Painton, 1979). In conclusion, considering the empirical findings reviewed here, this last alternative would be the most probable outcome for the expected results.

CHAPTER III

METHOD

Subjects

A total of 24 undergraduates, 11 males and 13 females, enrolled in psychology classes at Oklahoma State University served as subjects. All students received extra credit towards their final grade for their participation. All the subjects spoke English as a native language, had either normal eyesight or wore corrective lenses, and ranged from 18 to 26 years of age. The subjects were assigned to one of two experimental groups in alternate fashion according to the time they were scheduled.

Stimulus Material and List Construction

Subjects performed a lexical-decision task on sequentially presented word and nonword stimuli. The word stimuli consisted of 30 compound words which served as test items, 60 words obtained from separating the compound words into their two free morphemes, and 15 words with no relation to either the compound words or their two morphemes (see Appendix A). Test items ranged from seven to ten letters in length. The Kucera-Francis (1967) frequency of these items was from one to seven with 2.5 as an average value. The sample was divided into two subsets of 15 words each and matched on frequency for counterbalancing. Two types of nonword stimuli were used which included 30 items of each type. The first type, compound nonwords (CNW) were constructed by combining two free morphemes that together did not make a bona fide word (e.g., HEDGE and DATE make HEDGEDATE). The second type, nonwords (NW) were made by taking relatively high frequency words and changing one vowel so that they formed a nonword (e.g., TURN makes TIRN). Practice items were made of six compound words, six words unrelated to the compound words, four CNWs, and four NWs. The practice items were the same for all subjects.

The stimulus items were presented sequentially and consisted of 20 practice trials followed by 150 experimental trials. The items in the experimental trials were composed of six word conditions with 15 items each and two nonword conditions with 30 items each. The six word conditions were: 1) critical target (CTT), one half of the sampled compound words (e.g., COWBOY), 2) prime 1 (P1), the second morpheme of each of the CTTs (e.g., BOY), 3) prime 2 (P2), the first morpheme of the CTTs (e.g., COW), 4) control prime (CP) and 5) control target (CT), the remaining subset of 15 sampled compound words (e.g., BLOODSHOT, BLOODSHOT), and 6) words, (W), 15 monosyllable words with no relation to any other set of words, but added for counterbalancing. The two 30 item nonword conditions consisted of 7) compound nonwords

(CNW) and 8) nonwords (NW). These two additional conditions were used as distracters to control the subject strategy of automatically responding WORD on each trial.

The order of presentation of the experimental trials was a random arrangement of the 90 word items and 60 nonword items, with two constraints. The lag structure or number of items between CP and its yoked partner, CT was 8, 10, or 12 with 10 as the mean. The two lags, one between P1 - P2 and the other between P2 - CTT, associated with the critical target condition were (4 - 4), (5 - 5), and (6 - 6). The three lag structures were divided equally among the fifteen items.

Design

A single factor design having repeated measures (Winer, 1971) was employed. The three conditions of the within subjects factor were defined by the different types of primes each had (e.g., no prime, component prime, or repetition prime). The dependent variables were the response latency, in milliseconds, and the correct/error score for each test item.

The 30 test words were divided into two equal subsets and assigned to two groups of subjects randomly. Any effect for items was counterbalanced across subjects since all test items appeared an equal number of times in the three test conditions. To clarify this, the subjects in group 1 saw BOY...COW...COWBOY with COWBOY in the critical target condition. They received BLOODSHOT...BLOODSHOT as a control prime and control target. Conversely, group 2 subjects received SHOT...BLOOD...BLOODSHOT and COWBOY...COWBOY. The order of items were randomized within their condition for each subject. The eight sets of items were randomly presented while maintaining the same lag structure between primes and targets. Also, 30 compound nonwords, 30 nonwords, and 15 words were used as distracter items to control subject strategies.

Procedure

An Automated Data Systems 1800E minicomputer was used to randomize word lists, control presentation, provide feedback, and record reaction times and errors during the lexical-decision task. The materials were presented on a Lear/Siegler ADM-3 cathode ray tube. All stimulus items were presented in lower case letters at the center of the CRT display. The horizontal visual angle varied from approximately 1.8 degrees (seven letter item) to 2.6 degrees (ten letter item). The vertical visual angle was approximately 0.36 degrees. All visual angle calculations assume the subject was 50 cm. from the display screen.

A trial was constituted by the following sequence of events: The word READY appeared on the screen and indicated to the subject that a trial could begin. The trial was started by pressing down lightly with both forefingers on the righthand and lefthand buttons. With both buttons depressed, the screen went blank for 1.5 seconds followed by the presentation of a stimulus item. The item continued to be displayed until the subject responded by releasing the appropriate button. The subject had been instructed to respond as quickly and accurately as possible (see Appendix B). A feedback word, CORRECT or WRONG, was shown for 0.5 seconds, the screen blanked for 1.5 seconds, and then the READY signal again appeared. The next trial was then ready to start and this same general procedure continued until the last trial. The trials were self-paced and the subjects could and did take short breaks during the experimental session. After the last trial the words THANK YOU appeared and the session was over. The session lasted approximately 25 minutes and the subjects were debriefed immediately after the session.

CHAPTER IV

RESULTS

The conditions of interest in this study were the results for the control prime, control target, and critical target condition. Two major questions concerned the relationships among the three conditions. First, was the usual repetition priming effect of approximately 150 msec. (Forbach et al., 1974) between the control prime and control target demonstrated (e.g., did COWBOY facilitate COWBOY 150 msec. on the second presentation)? Second, what was the size of the component priming effect relative to repetition priming?

The latency data were first sorted by excluding all misclassification scores and all scores 2.5 standard deviations beyond the mean. These extreme scores were taken to indicate atypical lapses in attention. The mean latencies and percentages of errors along with example words are listed in Table I. Two sets of scores were computed from the remaining data. First, by collapsing over items for each condition within a subject, by-subject scores were figured. In a similar manner, collapsing over subjects for each condition within an item, by-item scores were figured.

The desired analysis was a quasi _F_ test so that both subjects and items were treated as random variables. A conservative approximation to the quasi *F* was proposed by Clark (1973). This latter min *F*' test was used in the present experiment. After the min *F*' was found to be significant, pair-wise comparisons were made using Fisher's least significant difference test (LSD) for both by-subjects and by-items scores (Winer, 1971). A summary for the analysis of variance can found in Table II. The overall test for differences among the conditions was significant, min $F'(2,104) = 23.21$, $p < 0.001$. From Table I, it is seen that the longest latency was for the control prime (836 msec.), then the critical target (735 msec.), and the shortest latency was for the control target (676 msec.). The results from the LSD tests indicate that a difference between means of 58.2 msec. for the by-subjects data would be significant at the $p < 0.01$ level. Also, times of 65.3 and 49.8 msec. for the by-items data were significant at the $p < 0.01$ and $p < 0.05$ level respectively. Thus, all comparisons among the conditions were significant at the $p < 0.01$ level with the exception of the control target-critical target difference for the by-items data which was significant at the $p < 0.05$ level.

CHAPTER V

DISCUSSION

There were two principle questions that this study sought to answer. First, as was hypothesized, there was an extremely strong facilitation (160 msec.) for the control target which was primed by itself. Second, as was expected, the critical target, where a compound word was primed by both its components, showed strong facilitation as compared to the control prime (101 msec.). Also, as expected, the critical target was not facilitated as strongly as the control target, the difference being 59 msec.

One interpretation of these latter results (i.e., the positioning of the mean latency of the critical target between the control target and control prime) is that there was support for semantic priming between the components of a compound word and the word itself. But, Neiser (1979) found that after eight seconds the effect of semantic priming was nonsignificant due to rapid decay. With the lag structure of ten and five items, a time lapse of approximately 100 seconds and 50 seconds occurred between the first prime (one component of the compound word) and the second prime (the second component of the compound word) and the critical target, respectively.

The results also indicate that priming with components follows a process different than repetition priming. If component priming and repetition priming involved the same cognitive operations, then the mean latencies for the control target and critical target would be approximately the same. The results found here contradict this argument and should be interpreted as supporting the concept that a third type priming, component priming is involved. The pattern of results is the same as that found in Experiment III of Stanners, Neiser, and Painton (1979).

The most plausible explanation for these results is as follows. When the physical presentation of COW occurs, the representation in memory for COW is fully activated and remains at least partially activated for minutes resulting in the long lasting effects seen in repetition priming. The memory representation for a semantically related word (e.g., HERD, STEER) is partially activated followed by quick decay and is essentially gone in 15 seconds. This accounts for the results found in semantic priming studies (Neiser, 1979). The representation in memory for words of which COW is a component (e.g., COWBOY and COWLICK) are strongly activated through COW and in a different manner than the repetition or semantic examples. This component priming has characteristics of its own. Namely, it is a much stronger effect than semantic priming but not as strong as repetition priming. Also, it does not have the rapid decay as found in semantic priming. Thus, component priming is not only quantitatively but also qualitatively different from both semantic and repetition priming.

A fairly simple quantitative argument, a network activation notion (Anderson, 1973), could seemingly account for the results. In priming, the amount of activation depends on "distance" in the network of lexical nodes. Distance is not necessarily a literal, physical distance, but it conceivably could be in a neural network. Maximum activation occurs through repetition priming. The closest a node can be is the node itself. In the case of prefixed words, irregular variations, and compounds, the nodes could be very close when high activation occurred. Semantic priming is a result of much greater distance in the network. A basic assumption, of course, would be that activation strength is proportional to distance, and this seems reasonable.

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APPENDIXES

APPENDIX A

INSTRUCTIONS TO SUBJECTS

INSTRUCTIONS TO SUBJECTS

This is an experiment concerned with simple judgements about verbal materials. It is not an intelligence test or any other kind of test and should not be interpreted as such. Also, there is no electric shock nor any other unpleasant stumulus involved. Although the task may seem to be a very simple one, our research indicates that it can provide important information about language behavior. We feel that your participation and cooperation in the experiment are very important. If for any reason during the course of the experiment you feel that you cannot fully cooperate, please let the experimenter know.

When the word, READY, is on the screen, a trial can be started by pressing down on both buttons (E indicates). A very short time later a string of letters will appear on the screen. Your job is to decide as quickly and accurately as possible whether or not the item on the screen is a word in your vocabulary. If you decide the item is not a word, immediately let up on the NONWORD button (E indicates sign). If you decide the item is a word, immediately let up on the WORD button (E indicates sign). After you make your decision and let up on the button of your choice, you can then let up on the other button and wait for the next trial. After each decision the word CORRECT or

WRONG will appear on the screen to tell you whether or not your decision was accurate. Try to respond as quickly and accurately as possible...in any case, strive to avoid making too many mistakes.

A short time after you have let up on both buttons the word READY will again appear on the screen. You can then start another trial by pressing down on both buttons. Make sure that when you start the trial that you are paying careful attention to the screen and that you are ready to release the appropriate button. This attention will increase the speed and accuracy of your decision. After you have made your choice you can then let up on the other button and wait for the ready signal. You do not have to start another trial as soon as the ready signal appears. If you want to take a short break, that is all right. When all the trials are over, the words THANK YOU will appear on the screen. You may then come out into the other room. If you have any general questions about the experiment at that time, I will be glad to try to answer them.

Do you have any questions about your task in the experiment?

APPENDIX B

SAMPLE OF STIMULUS ITEMS

SAMPLE OF STIMULUS ITEMS

1. Critical target - CTT

   COWBOY, GRAPEVINE, POPPYSEED

2. Prime 1 - P1

   BOY, VINE, SEED

3. Prime 2 - P2

   COW, GRAPE, POPPY

4. Control prime - CP

   BLOODSHOT, SEAWEED, JUNKYARD

5. Control target - CT

   BLOODSHOT, SEAWEED, JUNKYARD

6. Words - W

   PROBE, SAND, DAWN

7. Compound nonwords - CNW

   HOTSIGH, HEDGEDATE, PETDAMP

8. Nonwords - NW

   CHAEN, STARM, HONT

APPENDIX C

TABLES

TABLE I

MEAN REACTION TIMES AND ERRORS

Item	Mean*	%Errors
Control Prime	836	5.6
Control Target	676	1.7
Critical Target	735	1.4

*Mean is given in milliseconds.

TABLE II

ANALYSIS OF VARIANCE TABLE - TREATMENT BY SUBJECTS DATA

	Degrees of Freedom	Sum of Squares	Mean Square	F1 Ratio
Treatment	2	4.73	2.37	55.11
Treatment By Subjects	46	1.98	0.043	

TABLE III

ANALYSIS OF VARIANCE TABLE - TREATMENT BY ITEMS DATA

	Degrees of Freedom	Sum of Squares	Mean Square	F2 Ratio
Treatment	2	4.37	2.37	40.15
Treatment By Items	58	3.42	0.059	

Min $F'(2,104) = (F1 \times F2) / (F1 + F2) = 23.21$.

Critical $F(2,40) = 8.25$ for $p < 0.001$.
Critical $F(2,100) = 7.76$ for $p < 0.001$.

2

VITA

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