Lexical Decisions: The Effects of Priming on Reaction Time

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Abstract

This experiment sought an explanation of how semantic information is stored in long term memory. Until now, research on lexical decision has been limited to studying the reaction time of identifying a single string of letters. Twenty-one participants were presented with a sequence of 2 letter strings and instructed to make a lexical decision identifying whether the stimulus was a word or not. Reaction time of the second letter string in the sequence should be faster when it is semantically associated to the first. Results shown that the semantic relationship between 2 letter strings in a sequence did not affect participants' reactions time. However, participant's reaction time when identifying a sequence of 2 letter strings of words was significantly faster than when identifying a sequence of letter strings containing at least one non-word. In conclusion, individuals identify a sequence of 2 letter strings of words faster than a sequence of 2 letter strings containing a non-word, regardless of whether the words are associated.

Lexical Decisions: The Effects of Priming on Reaction Time

When words are being processed, our mental lexicon is used to it is mental dictionary that contains information regarding a words meaning and in accordance to its association with other words (Francis & Neath, 2003). Relationships of words are very important in the study of cognitive psychology. The understanding of the mental lexicon is that words that are closely related should be location near each other and words that are not associated with each other should be located farther apart in that lexicon. It is built upon the structure of a semantic network, which enables us to store information based on the semantic relationships between concepts. To investigate the concept of semantic relationships, researchers use lexical-decision task which Lexical decisions are classified as priming task that measure how quickly an individual can identify stimuli as words or non-words.

Previous research on lexical decisions has been limited to measuring the reaction time of a single string of letters per trial (Meyer & Schvaneveldt, 1971, p. 227). In a related study, Meyer and Schvaneveldt (1971) indicated that the amount of letters in each decision (string) was classified as either small (i.e. BUILDINGS) or relatively large (i.e. STRUCTURES). The study measured participants' reaction time in identifying whether the test stimuli were words or non-words. Results showed that response times were significantly faster for small decisions than for large decisions.

The Meyer and Schvaneveldt (1971) study exposed the dependence of the participants on a retrieval mechanism, which informed their processing of a string of words, non-words, associated and non-associated words. Their study borrowed from previous research, which examined how individuals could work out whether a string of letters formed a word. In turn, Meyer and Schvaneveldt's (1971) work was the basis for other related studies, such as the

Balota, et al. (2007) *English Lexicon Project*—that dealt with how individuals exploited their language vocabulary capabilities. However, Meyer and Schvaneveldt (1971) contended with the role that semantics play in enabling an individual to process a string of letters. Hence, they resorted to an extended lexical-decision task to increase the data in the solution space.

The Meyer and Schvaneveldt (1971) lexical-decision experiment first presented the participants with a pair of either letter strings in the combination of word-word, nonword-nonword, or word-nonword. Subsequently, the participants would respond with a "yes" for a word-word combination and with a "no" for a different combination. Nevertheless, since this approach was similar to earlier studies, such as Landauer and Freedman (1968; cited in Meyer and Schvaneveldt (1971)); the lexical-decision task incorporated a second expanded experiment that required participants to also point out the likeness between the pair of letter strings.

The Meyer and Schvaneveldt (1971) research findings uncovered the effect of other recall functions, such as the serial decision model, and consequently, indicated that there existed a definite processing and retrieval mechanism in the individuals' application of the linguistic capabilities. The lexical-decision experiments mirrored the approach of Perea, Carreiras, Rosa and Gómez (2000) and Perea, Rosa, and Gómez (2002), who found out that retrieval rates are subject to the effects of the applied stimuli.

The current experiment will investigate if the response time for a word is shorter if the word is associated to the previous word. In addition, it will examine how non-words play a role in this process. The purpose of this study was to examine further the relationship between word associations and reaction time when decisions are responded to correctly. Participants were given 70 trials of words and non-words organized in a sequence of two letter strings and instructed to identify whether each string of letters was a word or not. It is predicted that participants would

respond faster when the second letter string in each sequence is associated with the word presented before it.

Method

Participants

Twenty-two undergraduate college students, enrolled in an Experimental Psychology: Perception and Cognition class at the College of Staten Island, participated in this experiment.

Materials and Design

There were at least 70 trials in total a participants were shown a sequence of test stimuli which contained strings of letters. They were instructed to respond yes or no to identify if each letter string presented was a word or not. Participants were presented with one of five different sequences of letter strings; (word-associated word, word-unassociated word, word-non-word, non-word-word, non-word-non-word). Their reaction time was recorded in milliseconds (ms) and measured by the time required for participants to respond correctly to the second letter string in the sequence. Letter strings that were responded to incorrectly were repeated at the end. As a result, it was estimated that some of the participants would take more time to complete the experiment.

Procedure

A fixation point will appear in the middle of the screen, after one to four seconds a test stimulus will appear. The test stimulus consist of a string of letters either a word or a non-word. Participants press the '/' key if the letter string is a word and the 'z' key if it is not. Responses are made as fast possible and once a key is pressed, the letter string will disappear. Following one to four seconds of viewing a blank (black) screen, another letter string appears which may also be either a word or a non-word. On each trial, participants will view a string of letters and then

identify if it is a word or not. Reaction time is measured by the time it takes to respond to the second test stimulus (letter string). Therefore, participants either are presented with a sequence of two letter strings, which will be associated, not associated, or contain at least one non-word.

Results

The null hypothesis states that the type of letter string pair (i.e. associated, non-word-associated, word-non-word, non-word-word, non-word-non-word) will not have an effect on reaction time. Our hypothesis states that the letter-string-pair relationship will have an effect on participants' reaction time. A one-way between subjects ANOVA was conducted to compare the effect of letter string pair on participants' reaction time. The results in Table 1 show the mean reaction time for all letter-string pairs. The type of string pair had a significant effect on participants' reaction time, F (19, 4) = 6.721, $p < .004$. This indicates that type of letter string pair will affect participants' reaction time.

We used post-ANOVA pair wise comparison to investigate differences in reaction time further. Letters string pairs of associated words versus letter string pairs of non-associated words had no effect on participants' reaction time p =.803 (M = 760.34, SD = 218.985), (M = 764.69, SD = 204.03). Participants identified string pairs of associated words as fast as string pairs of non-associated words. Results show a significant difference in reaction times between letter string pairs of associated words when compared to associated-associated and word-nonword, word-nonword and nonword-nonword, and nonword-word and nonword-nonword, p = (.01, .022, .001), as well as a significant difference in reaction times between letter string pairs containing at least one non-word, p = (.014, .025, .001). This indicates that words are identified faster than non-words regardless of the association or non-association conditions.

Results showed no significance in reaction time when considering the position of the non-word and word in a letter string pair, $p = .085$. When non-words were displayed before a word ($M = 806.97$, $SD = 192.82$), or when a word was followed by a non-word ($M = 930.11$, $SD = 425.08$), participants reaction time showed no significant difference. However there was an effect on reaction time when participants were presented with letter string pairs consisting of a non-word then non-word compared to letter strings of non-word then word $p = .005$. When a non-word was followed by a word, ($M = 806.97$, $SD = 192.825$), participants identified the word slower than if they were presented with the non-word then non-word condition ($M = 924.82$, $SD = 312.12$).

Discussion

The pertinent tests examine the relationship between word associations and reaction time. The results of the study tested the expected outcome: reaction time should be faster when the pair of word strings was associated—consistent with semantic networking and the effects of priming on spreading activation (Meyer & Schvaneveldt, 1971).

After the analysis of the results, we had found convincing effects supporting the impact of type of word pair on reaction time. Based on the data, results show that type of word pair (i.e. word-non-word, associated-non-associated) had an effect on reaction time. According to our data, the time needed to indicate a word was faster than the time required to indicate a non-word in all word pair conditions. When making a decision we have to search our mental lexicon, therefore reaction time is directly related to the presence of a word in our lexicon. These results make sense since a non-word does not exist in our lexicon and thus require a longer search time prior to making a decision.

Further analysis of results revealed findings that were inconsistent with the conclusions of Meyer and Schvaneveldt (1971). Meyer and Schvaneveldt (1971) results also showed that participants respond to the "is it a word?" question at a faster rate (ms) when the words are associated with one another--showing the effects of priming and the concept of spreading activation. However, our results showed no difference in reaction time regardless if words were associated or non-associated indicating that we experienced no comprehension delay when accessing words from our mental lexicon. Prior knowledge of semantic networking and background reading of the experiment could have affected our skewed results.

Another unexpected outcome is in regards to the effect of a non-word stimulus on reaction time. According to Meyer and Schvaneveldt (1971), reaction time should be faster when the non-word is positioned before the word, because we already identified the previous stimuli as a non-word. However, our results showed the opposite effect, a slower reaction time when identifying words that followed a non-word stimulus.

Ultimately, the results were inconsistent with the findings of Meyer and Schvaneveldt (1971). Although our results show that the type of word-string pair has an effect on reaction time, the specific pairs in which the differences occurred do not correspond with the previous findings. As a result, our findings did not show the effects of priming. The most convincing finding from our data is in regards to the differences in reaction time for identifying a word from a non-word, in which participants always identified the word at a faster rate. To further test this theory to see if we could achieve the effects of priming, it would be interesting to do a study including pictures, words, and, non-words, and then determine if the stimuli were related.

The Lexical Decision Task gives us insight on how semantic networking works in the mind. The effects on the Lexical Decision Task can be related to real life when it comes to

memories. Certain events we experienced are constantly primed due to that memories relation to another item or event. Using this knowledge, we can perhaps strengthen memory in those with memory deficiencies.

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Appendix

Table 1: Participants' Means and Standard Deviations of Associated and Not Associated Words

	Means	Standard Deviations
Associated Words	572.59	89.47
Non-Associated Words	612.68	99.75