

The Effect of Depth of Processing on the Retention of Words:  
A Classroom Experiment

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## I. Introduction

According to Mergel (1998), one of the most influential papers on memory and information processing has been on the approach involving deep processing ( Craik and Lockhart, 1972). By 1980, in just eight years, Roediger (1980) found that this article had been cited over 700 times! The belief is that the more deeply you process information, the better it is retained. Craik and Lockhart theorize that people can analyze stimuli (i.e. information) at different levels, and thus referred to it as the *Level of Processing* (LOP) framework. In a typical level of processing experiment, when subjects are presented with words and are required to respond (e.g., to **shallow orientation questions**: “Is this word in capital letters?”, or **deep orientation questions**: “Does this word refer to an animal?”), and memory is subsequently tested, it is consistently found that memory is strongest for words subjected to a deep orienting task. They proposed that the shallow levels involve analysis in terms of physical or sensory characteristics, and the deeper levels involve meaning. Shallow processing is said to lead to short-term retention and deeper processing to longer retention.

Whitt (2000) explains that some have challenged this theory and have stated that the *amount of time* spent processing information is what allows people to retain information for longer periods of time. However, Whitt reports that experiments show that the time spent rehearsing information is not always related to how well the information is recalled. He relates the story of a Professor named Sanford who estimated he had read the same mealtime prayer at least 5000 times over a 25-year period and still could not repeat it from memory. Whitt explains this apparent discrepancy by proposing that it is the depth at which information is processed that determines the persistence of a memory.

However, this framework is not without fault. Whitt (2000) reports that the depth of processing theory of Craik and Lockhart has had some fairly severe criticism centering on the vague nature of the term “depth”. As a result, Craik and Lockhart have been accused of circular reasoning: information is deeply processed if it *can* be remembered for a long time and information can be remembered for a long time because it has been deeply processed. Further, the inability of the theorists to adequately define what may constitute “depth” has led to a certain loss of enthusiasm for those who desire to test the limits of the depth of processing model. Certainly, it is difficult to test limits where the theoretical parameters are not clearly defined. Nevertheless, testing of the depth of processing model of information processing has continued to the present in an effort to define what limits or properties may be included in the definition of deep processing of information.

In 1975, Craik & Tulving designed ten experiments to explore the levels of processing framework for human memory research proposed by Craik and Lockhart (1972). The basic philosophy is that, “the episodic memory trace may be thought of as a rather automatic by-product of operations carried out by the cognitive system and that the durability of the trace is a positive result of “depth” of processing,” (p. ) where depth refers to greater degrees of semantic analysis. Subjects were encouraged to process words to different depths by answering various questions about the words. For example, shallow encodings were achieved by asking questions about **typescript**; intermediate levels of encoding were accomplished by asking questions about **rhyme**; deep levels were induced by asking whether the word would fit into a given **category** or **sentence frame**. After the encoding phase was completed, subjects were given a recall or recognition test for the words. In general, deeper encodings were associated with higher levels of performance on the subsequent memory test. It was further suggested that the durability of the memory trace is a function of depth of processing. That is, stimuli which are analyzed only to a shallow sensory level, result in very weak memory traces. Conversely, stimuli that are fully analyzed result in a long-lasting memory trace.

## II. The Purpose of This Paper

In this paper, an attempt will be made to replicate 2 of the experiments that were carried out by Craik & Tulving (1975), specifically the two experiments involved in “*Experiment 9: Classroom Demonstration*” (See Appendix A for *Experiment 9*) which involve using only three levels of encoding in a classroom context – as opposed to the first 8 experiments which involve rigid laboratory conditions. The 3 levels of encoding involve: questions concerning type-script (uppercase or lowercase), rhyme questions, and sentence questions (in which subjects were either given a sentence frame with one word missing or were asked a category question). The results of such experiments are expected to give teachers a clearer picture of what learners are capable of in terms of their retention abilities. Although this paper only investigates how well learners remember words in a normal classroom setting and whether motivation improves their performance, in fact, the results of this experiment can hopefully be translated into a better awareness of our learners’ abilities and tendencies. The following experiment was carried out in this spirit, however, several changes from the original experiment were necessary:

- \* A larger number of participants were asked to participate and all at once, not two at a time.
- \* The participants are non-native speakers of English.
- \* Questions were orally read, not presented on paper as in *Experiment 9*.
- \* The students were shown the words for 2 seconds instead of 1 second.
- \* As a way of motivating the second group, grades were used instead of money.

This experiment will hopefully help in answering the following 2 questions:

- 1) Will the results of this experiment be similar to those of the original experiment keeping in mind that this experiment was done with non-native speakers of English?
- 2) Will motivating students enhance their retention abilities?

## III. The Experiment

The participants in this experiment were Level 5 College of Languages and Translation female students majoring in Translation. The first group (Group A,  $n = 31$ ) was only informed that the experiment concerned perception and memory, however, the second group (Group B,  $n = 34$ ) was also informed of this but they were also told that they would be awarded  $\frac{1}{2}$  a point for every 5 words they were able to recognize on the subsequent retention test (which would be included as part of their final course grade) and therefore they should attempt to learn each word. It was emphasized to all participants that their main task was to remember the words, and that a recognition test would be given after the presentation phase.

**Phase One:** During the initial perceptual or encoding phase, the participants were first given a sheet (see Appendix C) which included 60 YES/NO choices. On each trial, the participants were orally asked a question, then a different word (a five-letter common noun) was exposed on a computer screen for exactly 2 seconds using the Microsoft PowerPoint program. The purpose of the question was to induce the students to process the word to one of several levels of analysis. Three types of questions were asked in the initial encoding phase. (a) An analysis of the physical structure of the word was achieved by asking about the physical structure of the word (e.g., “Is the word printed in capital letters?”). (b) A phonemic level of analysis was induced by asking about the word's rhyming characteristics (e.g., “Does the word rhyme with BRAIN?”). (c) A semantic analysis was activated by asking either a categorical question (e.g., “Is the word a boy’s name?”) or a “sentence” question (e.g., “Would the word fit the following sentence: “The boy kicked the \_\_\_\_ in the air””). At each of the three levels of processing, half of the questions yielded YES responses and half NO responses.

**Phase Two:** The general procedure thus consisted of giving the participants a long series of trials (60 words) in which both the type of question and YES-NO decisions were randomized (see Appendix B for the questions and words). The students upon hearing each question had exactly 6 seconds to either choose YES or NO as their answer. Once the 60 words and questions ended, the students were given a final retention test. The retention test included the 60 words the students saw on the computer screen and an additional 140 five-letter common noun distractors (see Appendix D). The participants were asked to

check all the words they saw on the computer screen in the encoding phase. Both groups were given 10 minutes to complete the retention test. Once the 10 minutes were over, all sheets were collected promptly. The two groups were thanked for their cooperation and Group B was informed that this was just an experiment and that they would not be given the extra points. They graciously accepted this with no objections. The expectation was that memory performance would vary systematically with the depth of processing and that the “motivated” Group B would perform better than Group A.

#### IV. Results & Discussion

Correctly recognized words were tallied for each student in both Groups A & B. Using the Microsoft Excel program, the data were analyzed. Table 1 shows that some of the results of this experiment are quite different from those of *Experiment 9* (see Table 2).

**Table 1**  
*Proportion of Words Recognized from the Replication of Experiment 9*

Response Type	Case	Rhyme	Ca./Fr.
<b>Group A (n = 31)</b>			
YES	.37	.59	.65
NO	.59	.79	.77
<b>Group B (n = 34)</b>			
YES	.39	.53	.60
NO	.60	.82	.72

**Table 2**  
*Experiment 9*

Response type	Case	Rhyme	Category
1st study			
Yes	.23	.59	.81
No	.28	.33	.62
2nd study			
Yes	.42	.65	.90
No	.37	.50	.65

(Craik & Tulving, 1975, p. 287)

According to the levels of processing framework, the deeper the level of processing on an item, the more likely it should be remembered. In Craik and Tulving's original report of this experiment, a difference in the frequency with which YES and NO items were remembered was found. Specifically, they found that, words to which a YES response was given in the encoding phase were recognized better than those to which a NO response was given. Surprisingly, the exact opposite pattern is evident in the present data (see Table 1). Another unpredictable finding is that in both Group A & Group B, recognition performance was best for rhyme words (which only require an intermediate level of processing) to which a NO response was given, not for category/sentence frame words. Furthermore, a comparison of recognition of case words in Table 1 and Table 2 reveals that in general, the participants in *this* experiment had better recognition of case words (that require shallow processing) than did the participants in the original experiment. Last but not least, with the striking exception of rhyme words to which a NO response was given, an overall evaluation of both Tables 1 & 2 confirms that a similar pattern in both exists; deeply processed/encoded words are recognized better than shallow-encoded/processed words.

#### V. Conclusions & Implications

These results confirm and extend, to some extent, the findings of other similar investigations. The findings, indeed, have provided useful answers to the two questions posited in this paper. Regarding question 1, the first and most important finding is that this experiment, just like Craik and Tulving's *Experiment 9* has proved, once again, that, in general, deep processing of words leads to better retention of them. However, in this experiment, there appears to be some kind of retention boost for rhyme words

for which NO responses were given regardless of whether there was motivation provided or not. For the time being, the only modest explanation that can be provided is that participants were probably able to remember these words because the rhyme pair that they were provided with was quite striking, e.g., “heart, ear”, “onion, onions”, “north, south”. However, another experiment, exactly like this one, would be required with 2 other similar samples in order to establish the consistency of this phenomenon. If the results match the ones found in this experiment, then it would be interesting to investigate the reasons behind our nonnative English participants’ ability to remember words that involve rhyme-encoding more than the other encoding processes. Such information can be experimented with in vocabulary classes to determine whether or not using a “rhyming technique” really does help in improving students’ vocabulary skills. However, if this experiment is replicated and the results tend to be more like Craik and Tulving's, then this means that most probably, the results found for rhyme words in this experiment are not very significant after all.

In this experiment, there was better recognition for words for which NO responses were given whereas in Craik and Tulving's experiment, words to which a YES response was given in the encoding phase were recognized better than those to which a NO response was given. In fact, this is probably the most striking difference. Again, another experiment, similar to the one in this paper, needs to be conducted to confirm this finding. If the results prove to be similar, however, then such findings can be pedagogically applied. In fact, there has always been strong criticism targeted towards providing students with wrong alternatives during class explanations (e.g., to write on the board, “Ok, now I am \_\_\_\_\_ walking or walks?” in a grammar class) and if the findings of this experiment are found to be reliable, then this will confirm, more than ever, that students should not be given incorrect alternatives as an explanation technique because these wrong alternatives will be the ones that stick in the learners’ minds. In a recent post-meeting with the participants, this explanation was confirmed but they also added something very interesting. The majority stated that when they did not know how to answer, they simply answered NO and that this caused them frustration and guilt but it was a strategy that they had actually applied. Does this mean that when strong emotions are associated with an event (e.g., in this case it was the encoding phase of words), better retention, in general, will occur? If so, then this can be used as one the strategies used in boosting ones memory of things, may it be vocabulary words, faces, names, etc.

Another interesting finding is that participants of this experiment had better recognition of case words than the participants in *Experiment 9*. A logical explanation for this, although one cannot be sure 100%, is that the Saudi system of education supports verbatim memorization, mainly because instructional material and testing provided in Arab schools ultimately depend on one’s ability to memorize information well. This is due to the existence of subjects involving religion that can only be learned this way. Therefore, it is not surprising that Arab students would have a better ability of memorizing words. It is believed that this is what happened with the recognition of case words; Arab learners are simply better at memorizing, thus, they are consequently better at recognizing case words. Further proof comes from the rest of the data; our participants’ mean score on case and rhyme words - which require more memorization – is considerably higher ( $M = .58$ ) than that of Craik and Tulving's participants ( $M = .42$ ).

As for question 2, Table 1 shows that recognition performance for only some types of words (case words and rhyme words to which a NO response was given) was just slightly better in the group that was motivated. Hence, this proves that for the participants of this experiment, motivation “with grades” did not have a positive influence on their retention abilities whereas motivation “with money” did slightly enhance the participants overall recognition performance in *Experiment 9*. To be very honest, this was the most unexpected outcome of all because students are usually very eager to obtain more points at any given opportunity. In this experiment, grades were practically being offered to Group B on a silver platter, but even then, the difference between their recognition performance and that of Group A is extremely insignificant; in fact, the average mean score for Group B was less than that for Group A (Group A:  $M = .62$ ) & (Group B “motivated”:  $M = .61$ )! The only way to know why this happened was to directly ask Group B about their inability to do better when there were so many grades at stake. Students, in fact, were very recently asked about this and most suggested that *because* so many grades were at stake, they had become quite nervous and that this may have affected their performance level.

## VI. Suggestions

The most important question generated by such experiments is: What are the encoding operations underlying "normal" learning and remembering? These experiments have shown that people do not necessarily learn best when they are merely given "learn" instructions. The results of such findings imply that certain types of "deep" encoding can benefit people's learning & memory capacity in many ways:

**A)** First and most important, you must make sure that you understand new material before trying to remember it. In fact, you cannot form a clear and correct memory trace from a fuzzy or poorly understood concept. For example, in the classroom, one should not hesitate to ask the instructor to further explain a point that is not clear (adapted from Intelegen Inc., 2005).

**B)** Using the funnel approach is also useful. This means learning general concepts before moving on to specific details. When you study in this manner, you understand the general concepts first, then the details seem to make more sense since they can be easily related to one another. For example, one usually uses this type of approach when studying from an outline, table, or concept map. (adapted from Intelegen Inc., 2005).

**C)** One way to process information more deeply is to make associations; thinking of one thing helps bring the other to mind. For instance, when you are having difficulty recalling new material, you can help bring it to mind by thinking about what you have associated it with. In addition, when learning something new and unfamiliar, try pairing it with something you know very well, such as images, events, etc. The association does not have to make logical sense; particularly funny associations for some reason stay in our minds. For example, some people remember names this way: they may remember the name "Robert Green" by picturing Robert playing golf (on the green), wearing green clothes, or covered in green paint (adapted from Intelegen Inc., 2005).

**D)** Another way to create meaningful associations is to think about how the information can be personally meaningful. You might think about how the new material relates to your life, your experience, or your goals. If you can link new information to memories already stored ("mental hooks"), you'll have more cues to recall the new material (adapted from Intelegen Inc., 2005).

**E)** In more specific pedagogical contexts, (Healey, 2000, p.1) cites James Coady (1997) who offers a synthesis of research on second language vocabulary acquisition: "Three main principles appear to underlie effective vocabulary teaching. First, learners should be provided with both definitional and contextual information about words. In the case of L2 learners, this could be related to their often-felt need for dictionary access. Second, learners should be encouraged to process information about words at a deeper level. Among L2 learners this could be reflected in the current emphasis on authentic communicative activities. Finally, learners need multiple exposures to words. ... Extensive reading is the most often cited remedy for this lack." Don't these principles seem similar to the 3 levels of processing?

**F)** Healey (2000) also refers to Brown & Perry (1991) who describe different vocabulary learning strategies, focusing on the keyword method and semantic processing techniques. The cognitive basis for both of these is the concept of "depth of processing". Simply put, the idea is that when more cognitive resources are used in processing a word or phrase, more attention is paid, and the word or phrase is better retained. The keyword method has the learner associate a word with an image or aural cue -- producing a deeper level of processing. When context is provided, the learner's past experience is associated, and schema are active, semantic processing takes place - a very deep level. What Brown & Perry found in their research with Arabic-speaking EFL students learning English was that a combination of keyword and semantic processing methods worked best.

In conclusion, the levels of processing framework states that memory for an event depends upon the nature of the processing it underwent when it was experienced or encoded. The deeper the event is encoded, the more likely it will be remembered. The findings of Craik and Tulving's *Experiment 9*, as well as the results of the experiment in this paper, both support this conclusion. Keenan (2001) states that there can be no doubt that the levels of processing framework has fulfilled an important role by providing and developing a strong foundation that has led researchers to more fully appreciate the role of encoding processes in determining memory performance.

## References

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## Appendix A

### *Experiment 9: A Classroom Demonstration*

Throughout this series of experiments, experimental rigor was strictly observed. Words were exposed for exactly 200 msec; great care was exercised to ensure that subjects would not inform future subjects that a memory test formed part of the experiment; subjects were told that the experiment concerned perception and reaction time; response latencies were painstakingly recorded in all cases. One of the authors, by nature more skeptical than the other had formed a growing suspicion that this rigor reflected superstitious behavior rather than essential features of the paradigm. This feeling of suspicion was increased by the finding of the typical pattern of results in Experiment 9, which was conducted under intentional learning conditions. Accordingly, a simplified version of Experiment 2 was formulated which violated many of the rules observed in previous studies. Subjects were informed that the main purpose of the experiment was to study an aspect of memory; thus the final recognition test was expected and encoding was intentional rather than incidental. Words were presented serially on a screen at a 6-sec rate; during each 6-sec interval subjects recorded their response to the encoding question. Indeed, the subjects were tested in one group of 12 in a classroom situation during a course on learning and memory; they recorded their own judgments on a question sheet and subsequently attempted to recognize the target words from a second sheet. Reaction times were not measured.

The point of this study was not to attack experimental rigor, but rather to determine to what extent the now familiar pattern of results would emerge under these much looser conditions. If such a pattern does emerge, it will force a further examination of what is meant by deeper levels of processing and what factors underlie the superior retention of deeply processed stimuli.

*Method.* On a projection screen, 60 words were presented, one at a time, for 1 sec each with a 5-sec inter-word interval. All subjects saw the same sequence of words, but different subjects were asked different questions about each word. For example, if the first word was copper, one subject would be asked, "Is the word a metal?", a second, "Is the word a kind of fruit?", a third, "Does the word rhyme with stopper?", and so on. For each word, six questions were asked (case, rhyme, category  $\times$  yes-no). During the series of 60 words, each subject received 10 trials of each question response combination, but in a different random order. The questions were presented in booklets, 20 questions per page. Six types of question sheet were made up, each type presented to two subjects. These sheets balanced the words across question types. The subject studied the question, saw the word exposed on the screen, then answered the question by checking yes or no on the sheet. After the 60 encoding trials, subjects received a further sheet containing 180 words consisting of the original 60 target words plus 120 distractors. The subjects were asked to check exactly 60 words as "old." Two different randomizations of the recognition list were constructed; this control variable was crossed with the six types of question sheets. Thus each of the 12 subjects served in a unique replication of the experiment. Instructions to subjects emphasized that their main task was to remember the words, and that a recognition test would be given after the presentation phase. The materials used are presented in the Appendix.

*Result.* The top of Table 6 shows that the results of Experiment 9 are quite similar to those of Experiment 2, despite the fact that in the present study subjects knew of the recognition test and words were presented at the rate of 6 sec each. The finding that subjects show exactly the same pattern of results under those very different conditions attests to the fact that the basic phenomenon under study is a robust one. It parallels results from Experiment 4 and previous findings of Hyde and Jenkins (1969, 1973). Before considering the implications of Experiment 9, a replication will be mentioned. This second experiment was a complete replication with 12 other subjects. The results of the second study are also shown in Table 6.

TABLE 6  
Proportion of Words Recognized from Two Replications of Experiment 9

Response type	Case	Rhyme	Category
1st study			
Yes	.23	.59	.81
No	.28	.33	.62
2nd study			
Yes	.42	.65	.90
No	.37	.50	.65

Overall recognition performance was higher, especially with case questions, but the pattern is the same. The results of these two studies are quite surprising. Despite intentional learning conditions and a slow presentation rate, subjects were quite poor at recognizing words which had been given shallow encodings. Since subjects in this experiment were asked to circle exactly 60 words, they could not have used a strict criterion of responding. Thus their low level of recognition performance in the case task must reflect inadequate initial registration of the information or rapid loss of registered information. Indeed, chance performance in this task would be 33%; we have not corrected the data for chance in any experiment. The question now arises as to why subjects do not encode case words to a deeper level during the time after their judgment was recorded. It is possible that recognition of the less well-encoded items is somehow adversely affected by well-encoded items. It is also possible that subjects do not know how best to prepare for a memory test and thus do no further processing of each word beyond the particular judgment that is asked. A third hypothesis, that subjects were poorly motivated and thus simply did not bother to rehearse case words in a more effective way, is put to test in the final experiment. Here subjects were paid by results; in one condition the recognition of case words carried a much higher reward than the recognition of category words.

In any event, Experiment 9 has demonstrated that encoding operations constitute an important determinant of learning or repetition under a wide variety of experimental conditions. The finding of a strong effect under quite loosely controlled classroom conditions, without the trappings of timers and tachistoscopes, is difficult to reconcile with the view that was implicit in the initial experiments of the series: that processing of an item is somehow stopped at a particular level and that an additional fraction of a second would have led to better performance. This view is therefore now rejected. It seems to be the qualitative nature of the encoding achieved that is important for memory, regardless of how much time the system requires to reach some hypothetical level or depth of encoding.

( Craik & Tulving, 1975, pp. 287 – 288)

## Appendix B

60 Questions and Words Presented to the Students for the Experiment

- 1) Would the word fit the following sentence:  
I just can't seem to get rid of this blood \_\_\_\_\_. **stain**
- 2) Does the word rhyme with plump? **thumb**
- 3) Would the word fit the following sentence:  
I was so scared yesterday. I had to walk down a very dark \_\_\_\_\_ to get to my friend's house. **alley**
- 4) Is this word a girl's name? **ankle**
- 5) Does the word rhyme with piper? **viper**
- 6) Does the word rhyme with rumor? **tumor**
- 7) Does the word rhyme with tooth? **booth**
- 8) Is the word printed in capital letters? **PORCH**
- 9) Would the word fit the following sentence:  
Wow! This \_\_\_\_\_ smells really delicious. Did you buy it or make it yourself? **piano**
- 10) Is this something we carry money in? **purse**
- 11) Is the word printed in capital letters? **TRACT**
- 12) Is this word found in a classroom? **train**
- 13) Does the word rhyme with secret? **sauce**
- 14) Is the word printed in capital letters? **RODEO**
- 15) Is the word printed in capital letters? **angel**
- 16) Does the word rhyme with funny? **bunny**
- 17) Is the word printed in capital letters? **chest**
- 18) Would the word fit the following sentence:  
The space shuttle had a safe \_\_\_\_\_ upon returning to Earth. **entry**
- 19) Is the word printed in capital letters? **RANGE**
- 20) Does the word rhyme with fence? **sense**
- 21) Does the word rhyme with peace? **prize**
- 22) Is the word printed in capital letters? **dairy**
- 23) Is this word used in cakes? **flour**
- 24) Is the word printed in capital letters? **bride**
- 25) Would the word fit the following sentence:  
You look really funny wearing that red nose; just like a \_\_\_\_\_! **clown**
- 26) Would the word fit the following sentence:  
The \_\_\_\_\_ of this pizza is filled with cheese. Yummy! **flash**
- 27) Is the word printed in capital letters? **GRAIN**
- 28) Is this word a something we listen to? **bagel**
- 29) Does the word rhyme with course? **horse**

- 30) Is the word printed in capital letters? **clove**
- 31) Is this word something we eat? **brick**
- 32) Does the word rhyme with ear? **heart**
- 33) Would the word fit the following sentence:  
As you can see, the \_\_\_\_\_ shows that pollution is increasing in the world. **graph**
- 34) Is the word printed in capital letters? **idiom**
- 35) Is the word printed in capital letters? **lease**
- 36) Does the word rhyme with leech? **beach**
- 37) Does the word rhyme with leader? **lobby**
- 38) Is the word printed in capital letters? **motor**
- 39) Would the word fit the following sentence:  
This \_ is really dirty. The next time I come to Riyadh, I'll stay at the Sheraton. **medal**
- 40) Does the word rhyme with west? **north**
- 41) Does the word rhyme with onions? **onion**
- 42) Is the word printed in capital letters? **plane**
- 43) Is the word printed in capital letters? **TOWER**
- 44) Is this word something we put in the bedroom? **truck**
- 45) Would the word fit the following sentence:  
Your\_\_\_\_\_ is very low. If you don't study harder, you may fail this course. **radar**
- 46) Does the word rhyme with skull? **scene**
- 47) Is this word something we use when we cook? **spice**
- 48) Does the word rhyme with born? **thorn**
- 49) Does the word rhyme with lake? **snake**
- 50) Is this word a body part? **trial**
- 51) Is the word printed in capital letters? **VENUE**
- 52) Does the word rhyme with little? **latch**
- 53) Is the word printed in capital letters? **MEDIA**
- 54) Does the word rhyme with fairy? **diary**
- 55) Would the word fit the following sentence:  
I'd like to buy a \_\_\_\_\_ of flowers, please. **scoop**
- 56) Does the word rhyme with ghost? **flood**
- 57) Is the word printed in capital letters? **STORK**
- 58) Is the word printed in capital letters? **faith**
- 59) Is the word printed in capital letters? **PASTA**
- 60) Is this word something we read? **story**

#### Appendix C

**Instructions:** Please choose “YES” or “NO” *Thank you!*

(sample)	<input type="radio"/>	<b>YES</b>	<input type="radio"/>	<b>NO</b>
(sample)	<input type="radio"/>	<b>YES</b>	<input type="radio"/>	<b>NO</b>
(sample)	<input type="radio"/>	<b>YES</b>	<input type="radio"/>	<b>NO</b>
(sample)	<input type="radio"/>	<b>YES</b>	<input type="radio"/>	<b>NO</b>
1.	<input type="radio"/>	YES	<input type="radio"/>	NO
2.	<input type="radio"/>	YES	<input type="radio"/>	NO
3.	<input type="radio"/>	YES	<input type="radio"/>	NO
4.	<input type="radio"/>	YES	<input type="radio"/>	NO
5.	<input type="radio"/>	YES	<input type="radio"/>	NO
6.	<input type="radio"/>	YES	<input type="radio"/>	NO
7.	<input type="radio"/>	YES	<input type="radio"/>	NO
8.	<input type="radio"/>	YES	<input type="radio"/>	NO
9.	<input type="radio"/>	YES	<input type="radio"/>	NO
10.	<input type="radio"/>	YES	<input type="radio"/>	NO
11.	<input type="radio"/>	YES	<input type="radio"/>	NO
12.	<input type="radio"/>	YES	<input type="radio"/>	NO
13.	<input type="radio"/>	YES	<input type="radio"/>	NO
14.	<input type="radio"/>	YES	<input type="radio"/>	NO
15.	<input type="radio"/>	YES	<input type="radio"/>	NO
16.	<input type="radio"/>	YES	<input type="radio"/>	NO
17.	<input type="radio"/>	YES	<input type="radio"/>	NO
18.	<input type="radio"/>	YES	<input type="radio"/>	NO
19.	<input type="radio"/>	YES	<input type="radio"/>	NO
20.	<input type="radio"/>	YES	<input type="radio"/>	NO
21.	<input type="radio"/>	YES	<input type="radio"/>	NO
22.	<input type="radio"/>	YES	<input type="radio"/>	NO
23.	<input type="radio"/>	YES	<input type="radio"/>	NO
24.	<input type="radio"/>	YES	<input type="radio"/>	NO
25.	<input type="radio"/>	YES	<input type="radio"/>	NO
26.	<input type="radio"/>	YES	<input type="radio"/>	NO
27.	<input type="radio"/>	YES	<input type="radio"/>	NO
28.	<input type="radio"/>	YES	<input type="radio"/>	NO

29.	<input type="radio"/>	YES	<input type="radio"/>	NO
30.	<input type="radio"/>	YES	<input type="radio"/>	NO
31.	<input type="radio"/>	YES	<input type="radio"/>	NO
32.	<input type="radio"/>	YES	<input type="radio"/>	NO
33.	<input type="radio"/>	YES	<input type="radio"/>	NO
34.	<input type="radio"/>	YES	<input type="radio"/>	NO
35.	<input type="radio"/>	YES	<input type="radio"/>	NO
36.	<input type="radio"/>	YES	<input type="radio"/>	NO
37.	<input type="radio"/>	YES	<input type="radio"/>	NO
38.	<input type="radio"/>	YES	<input type="radio"/>	NO
39.	<input type="radio"/>	YES	<input type="radio"/>	NO
40.	<input type="radio"/>	YES	<input type="radio"/>	NO
41.	<input type="radio"/>	YES	<input type="radio"/>	NO
42.	<input type="radio"/>	YES	<input type="radio"/>	NO
43.	<input type="radio"/>	YES	<input type="radio"/>	NO
44.	<input type="radio"/>	YES	<input type="radio"/>	NO
45.	<input type="radio"/>	YES	<input type="radio"/>	NO
46.	<input type="radio"/>	YES	<input type="radio"/>	NO
47.	<input type="radio"/>	YES	<input type="radio"/>	NO
48.	<input type="radio"/>	YES	<input type="radio"/>	NO
49.	<input type="radio"/>	YES	<input type="radio"/>	NO
50.	<input type="radio"/>	YES	<input type="radio"/>	NO
51.	<input type="radio"/>	YES	<input type="radio"/>	NO
52.	<input type="radio"/>	YES	<input type="radio"/>	NO
53.	<input type="radio"/>	YES	<input type="radio"/>	NO
54.	<input type="radio"/>	YES	<input type="radio"/>	NO
55.	<input type="radio"/>	YES	<input type="radio"/>	NO
56.	<input type="radio"/>	YES	<input type="radio"/>	NO
57.	<input type="radio"/>	YES	<input type="radio"/>	NO
58.	<input type="radio"/>	YES	<input type="radio"/>	NO
59.	<input type="radio"/>	YES	<input type="radio"/>	NO
60.	<input type="radio"/>	YES	<input type="radio"/>	NO

Appendix D

**Instructions:** Please choose all the words you saw on the computer screen (60 words).  
You have 10 minutes. *Thank you!*

Aisle  
 Mouse  
 Ameba  
 Haven  
 Angel  
 Angle  
 Quest  
 Arena  
 Patch  
 Arrow  
 Basil  
 Laser  
 Beach  
 Radio  
 Board  
 Grain  
 Brass  
 Piano  
 Brick  
 Range  
 Brush  
 Magic  
 Bully  
 Opium  
 Canon  
 Ratio  
 Cheek  
 Thumb  
 Chest  
 Horse  
 Cider  
 Trail  
 Cloak  
 Trunk  
 Cloth  
 Clove  
 Sauce  
 Clone  
 Venue  
 Crust

Scalp  
 Diary  
 Merit  
 Dough  
 Enemy  
 Meter  
 Fairy  
 Pulse  
 Ferry  
 Motor  
 Fever  
 Route  
 Flame  
 Hotel  
 Fleet  
 Plane  
 Flood  
 Query  
 Floor  
 Level  
 Flour  
 Porch  
 Frame  
 Storm  
 Grace  
 Tract  
 Cigar  
 Train  
 Lobby  
 Trick  
 Scene  
 Trial  
 Scone  
 Clock  
 Tumor  
 Snack  
 Ulcer  
 Crate  
 Vapor  
 Space

Grade  
 Booth  
 Grape  
 Media  
 Grass  
 Hatch  
 Amber  
 Heart  
 Chick  
 House  
 Flash  
 Idiom  
 Pasta  
 Latch  
 Larva  
 Bagel  
 Lease  
 Floss  
 Lever  
 Trait  
 Lodge  
 Lorry  
 Buddy  
 Manic  
 Maple  
 Straw  
 Thigh  
 Press  
 Thorn  
 Chess  
 Thump  
 North  
 Towel  
 Sauna  
 Trace  
 Verse  
 Spear  
 Viper  
 Patio  
 Vitae

Medal  
 Doubt  
 Metal  
 Graph  
 Entry  
 Motto  
 Alley  
 Molar  
 Fetus  
 Motel  
 Story  
 Nanny  
 Tower  
 Notch  
 Onion  
 Bunny  
 Paste  
 Idiot  
 Armor  
 Pause  
 Virus  
 Bread  
 Plant  
 Flesh  
 Plate  
 Forum  
 Pouch  
 Thing  
 Price  
 Stock  
 Stone  
 Cloud  
 Store  
 Frown  
 Stork  
 Stove  
 Crane  
 Uncle  
 Crowd  
 Spine

Prize  
 Faith  
 Purse  
 Quail  
 Ankle  
 Queue  
 Plane  
 Quilt  
 Ranch  
 Bride  
 Bench  
 Radar  
 Canoe  
 Roost  
 Flake  
 Robot  
 Stain  
 Rover  
 Salad  
 Clown  
 Track  
 Daisy  
 Scarf  
 Tribe  
 Scent  
 Truck  
 Scoop  
 Sense  
 Tutor  
 Snake  
 Venom  
 Spark  
 Venus  
 Spice  
 Crumb  
 Sport  
 Rodeo  
 Stair  
 Mummy  
 Dairy