THE INFLUENCE OF WORD FREQUENCY AND PROBLEM SIZE ON PRODUCTIVE THINKING

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ABSTRACT

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By

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The influence of word frequency and problem size on a divergent problem solving task, the sentence problem, was examined for college and sixth-grade samples. Three dependent measures were employed, including originality, unusual uses, and sentence length. In the first experiment, college freshmen were used, and as expected, a 2 (Word Frequency) X 3 (Problem Size) independent groups design found more original solutions were produced with problems employing high-frequency words, while more unusual uses were produced with problems employing low-frequency words. No support was found for the hypothesized effects of problem size on any of the dependent measures.

In the second experiment, sixth-grade subjects were used and a 2 (Word Frequency) X 2 (Problem Size) independent groups design found more original solutions were produced with problems employing high-frequency

words, but no support was found for the hypothesized effect of word frequency on unusual uses production. As expected, as problem size increased, mean originality performance decreased while mean unusual uses performance increased.

A third experiment assessed the nature and extent of transfer in originality and unusual uses production on the sentence problem when changing from one level of word frequency to another, and examined how knowledge of the provided task words influenced the originality and unusual uses results. While there was no support for transfer in originality, there was support for transfer in unusual uses production. The magnitude of the reported word frequency effects was reduced when knowledge of the provided words was taken into consideration. The results from the three experiments were interpreted in terms of word association theory. Implications regarding the role of knowledge and creativity, classroom and developmental research on divergent problem solving, and the conditions and processes influencing divergent problem solving were suggested.

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By

Ronald Curtis Kidder

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To Tefra

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CHAPTER I

INTRODUCTION

Two decades ago, Guilford (1956) emphasized the distinction between convergent and divergent thinking. Convergent thinking is characterized by problems having a single correct solution, while divergent thinking is characterized by problems having solutions that cannot be characterized as right or wrong and which may be rated in respect to such qualities as appropriateness, usefulness, cleverness, or originality. Interest in Guilford's tests of productive thinking has declined because they are not independent of conventional intelligence tests (Wallach, 1970), and because their use in predicting scientific creativity has been disappointing (Taylor and Holland, 1964). Creativity, an extremely high level of accomplishment, is not typically captured in the laboratory setting. Nevertheless, this research has emphasized the importance of divergent thinking and raised questions about how it occurs.

While considerable theoretical and empirical research on convergent problem solving has been published, there has been relatively little research on divergent problem solving. There is a large "practical" literature

of books and articles on how to be creative in general, with no reference to empirical data. In contrast, the present research attempts to investigate in some detail the conditions and processes that influence the production of solutions to a verbal problem: writing a sentence.

Characteristics of the Sentence Problem

An example of the sentence problem is a request to write a sentence using the words happy, expensive, horse, and lake. Such problems have been employed previously in laboratory research (Johnson, Parrott, and Stratton, 1968; Stratton, 1970; Stratton, Parrott, and Johnson, 1970; and Kidder, 1972) and in classroom research (Johnson and Kidder, 1972). The sentence problem has been a good device for studying productive thinking for numerous reasons. First, the task is interesting to college students because it offers some intellectual challenge. Tasks such as writing uncommon associations or unusual uses have been criticized as trivial in that they require only a superficial level of verbal fluency. The sentence problem requires the subject to absorb information and integrate it into an appropriate and clever solution. Second, the task is convenient for research because the words supplied can be varied in several respects. Third, a considerable amount of experience in judging the solutions to the sentence problem has accumulated such that ratings of the sentences produced

can be made with high interjudge agreement. Fourth, since most persons write sentences frequently, the results of the research on this problem may have some generality. And fifth, research and theory on associations between single words can be applied in making predictions about productive thinking on this task. This is not possible in many of the other productive thinking tasks.

Criteria for Rating

Solutions to the sentence problem can be examined in a number of ways including ratings of originality, unusual uses, and sentence length. Each of these measures has its own set of criteria.

Unusual uses. Many studies of divergent thinking have involved the production of unusual uses, as in thinking of unusual uses for a brick or penny. In the case of the sentence problem, each of the provided words is rated according to how it is employed in the sentence. In order for a word to be rated unusual it must be used appropriately and satisfy one of the following conditions: use as a name of a person, place, or thing; use as a part of dialect which is indicated by the subject; or use as an unusual meaning or sense of the word. As an example, the use of the word horse as an animal is commonplace, but its use as a slang for heroine, as the name of a person, Crazy Horse, or a place, Horse Lake, or its use as in horsing around would be rated as unusual.

Depending upon the experiment, each of the provided words in the solution sentence can be rated with regard to unusualness in which case the range of possible scores for any one problem would depend on the number of words provided, or a simple all-or-none scoring system can be adopted. In this case if at least one of the provided words is used unusually, the solution is rated unusual.

Originality. The criterion of unusual uses refers to single words, while the notion of originality refers to the meaning of the whole sentence. An original sentence should be grammatically defensible, and all of the words should be integrated smoothly into the sentence structure. The sentence, The happy horse jumped into the expensive lake, is as much a list of the given words as it is a sentence; the given words are as obvious as the meaning of the sentence. On the other hand, in the following sentence the given words are unobtrusive and the overall meaning of the sentence is more obvious: A beautiful, peaceful lake and a spirited horse, neither of which were expensive in comparison to how happy they made her, proved the best cure for Anne's dejected state of mind.

The criteria employed to rate originality in the sentence problem are summarized in Table 1. These criteria are basically the same as those employed in previous research which has used the sentence problem. From the table, it is apparent that an original sentence is one

Table 1

Originality Rating Guide for the

Sentence Problem

Rating	Characteristics
1	Does not use all of the words.
2	A listing of the words, or an approximation to a listing of the words.
3	A clumsy, mediocre sentence; a choppy sentence; a sentence expressing a trivial fact; or a sentence that uses one of the words inappropriately.
4	A well constructed sentence that uses all of the words appropriately, but one that expresses the common idea for the words provided.
5	A well constructed, complex sentence; a sentence or phrase that is witty or humorous; or a well constructed sentence that uses some of the provided words in novel ways.
6	Includes at least two of the characteristics for a rating of "5".
7	An exceptionally witty or humorous sentence that is well constructed. One of a kind. A sentence or phrase that has a considerable impact.

which is well constructed with all of the words used appropriately and integrated smoothly into the sentence structure. In addition to this basic requirement, a sentence may receive a higher originality rating if it expresses a novel idea, uses the provided words in novel ways, or if it is witty or humorous. Also taken into consideration are phrases or "one-liners" that are one of a kind and carry an impact.

Sentence length. Sentence length is another characteristic that appears in the writing of sentences, and this one is easily measured by a simple count of the words in the sentence.

Previous research and pilot research suggests that these three aspects of sentences are not identical. Each may contribute some new information about divergent thinking.

Application of Word Association Theory to the Sentence Problem

Research and theory on associations between single words is well developed, and some aspects are pertinent to the production of sentences from a few supplied words.

Meaningfulness or Word Frequency

The meaningfulness of the supplied words would be expected to have an influence on productive thinking, and according to Underwood and Schultz (1960) high-frequency

words have more meaning than low-frequency words because they elicit more diverse associations. Zipf (1945) and Thorndike (1948), as reported by Cofer and Shevitz (1952), arrived at a similar conclusion when they found a relationship between word frequency and the number of meanings words have according to dictionaries. Lepley (1950) has found more synonyms are produced to words that are rated as familiar than are produced to words that are rated as unfamiliar. It would appear that meaningfulness of the sentence problem can easily be manipulated by selecting high- and low-frequency words from the Thorndike-Lorge Word Book (1956).

The impact of word frequency on productive thinking has received very little attention even though this variable has been found salient in a number of other verbal problems. In anagram problems, it was Mayzner and Tresselt (1958), having noted the relation of word frequency to word perception time, who first demonstrated the role of this variable. In their study, anagrams with solution words that were very frequent, frequent, infrequent, and very infrequent were constructed according to the Thorndike-Lorge frequency counts. The letters were arranged into both easy and hard orders. They found that for both orders the number of anagrams solved and the time for solving were clearly functions of solution word frequency. The effect has been replicated in several studies

(Erlebacher, 1962; Dominowski, 1965 and 1967; Ronning, 1965), and is one of the most reliable in anagram problems.

Using anagrams with three or more solutions, Johnson and Von Mondfrans (1965) found the order of occurrence of solution words was a direct function of word frequency as determined by the Thorndike-Lorge frequency counts. In a study using anagrams with two solutions that differed in word frequency, Mayzner and Tresselt (1966) found that, when both solutions were asked for, the high-frequency solutions was given first. The usual interpretation to these results and those reported above assumes that high-frequency words are more readily evoked because such words are readily accessible and are relatively high in a subject's response reportoire.

The response reportoire or response availability notion has also been employed by other investigators to explain the word frequency effect with different problems and producers. Cofer and Shevitz (1952) employed two sets of stimulus words, one consisting of high-frequency words and the other of low-frequency words, and asked their subjects to write all the words they could associate with each of the stimulus words. Significantly more associations were produced to the high-frequency words which suggested to these investigators the existance of a greater response availability to high-frequency words. This effect has been replicated (Mednick, Mednick, and Jung, 1964).

In a study reported by Piers and Kirchner (1971), a continued association task to each of a number of high- and low-frequency words was administered and followed by two measures of creativity. They found more associations were produced to high-frequency words which is consistent with the results previously reported in the literature. They also found that common associations occurred early in the production sequence, while unique associations occurred much later.

On the basis of these studies it is apparent that high-frequency words tend to elicit more responses than low-frequency words, and that high-frequency words are the first to be retrieved and elicited as responses. Word frequency is expected to affect productive thinking to the extent that each of these factors contributes to the creative process.

Word Frequency Hypotheses

The influence of word frequency on the sentence problem was examined in relation to its effect on three measures of productive thinking, including originality, unusual uses, and sentence length.

Originality. Originality was expected to be better when the sentence problem was comprised of high-frequency words rather than low-frequency words. This was expected because high-frequency words typically have more associations

(Cofer and Shevitz, 1952; Piers and Kirchner, 1971) and a greater number of meanings (Zipf, 1945; Thorndike, 1948; Underwood and Schultz, 1960). When generating original solutions to the sentence problem, it was assumed that the subject first attempts to consider the different meanings or senses of the words provided by the problem, and then finds some relationship between these meanings which guides the production of the sentence. With high-frequency words there are more meanings or senses to consider and there are several ways in which these senses may be integrated into well constructed sentences expressing some degree of originality. Both the number of senses and the number of original relationships between the senses were assumed to be more limited with the low-frequency words.

Unusual uses. The generation of unusual uses, on the other hand, was expected to be better with problems using low-frequency words. Previous research has shown that the first associates produced are more common and that unique associates are not produced until much later (Piers and Kirchner, 1971). Since high-frequency words elicit more associations, it seemed reasonable to expect that a considerable number of common responses to the high-frequency words must be considered to arrive at unusual responses. For low-frequency words, there are

fewer associations and fewer responses must be considered to arrive at the unusual senses or uses of the words.

Sentence length. An increase in sentence length corresponding to an increase in word frequency was expected since high-frequency words are more meaningful and their use in the construction of more complex, lengthy sentences should be facilitated.

Application of the Problem Size Literature to the Sentence Problem

In research on convergent problem-solving, the size of the problem has been a powerful variable. Hayes (1965) has found that the solution time for problems requiring the traversing of complex verbal mazes increases linearly with the number of alleys. Davidson (1969) found that increasing the number of switches on a problem requiring the production of a specified light pattern produces a linear increase in problem difficulty. Other studies of problem size have involved manipulations in the number of letters in anagram solutions (Kaplan and Caravellas, 1968), the number of pieces in a puzzle (Solley and Snyder, 1958), the number of alternatives in simple and choice reaction time experiments (Hyman, 1953; Hick, 1952; Brainard, Irly, Fitts, and Alluisi, 1962), and the number of relevant and irrelevant dimensions in concept learning (Dominowski, 1969; Keele and Archer, 1967). In each of these studies it is not

surprising that with increasing problem size there is an increase in the difficulty of the problem.

Problem Size Hypotheses

Originality. Problem size in the sentence problem was manipulated by altering the number of provided words. As the number of provided words was increased, the task of writing a sentence which relates each of the words was expected to become more difficult. Further, as the number of provided words was increased, the context created by the words was assumed to be more difficult to overcome which would also inhibit originality.

Unusual uses. The hypothesized effect of problem size on the generation of unusual uses was somewhat counterintuitive. It was based upon an assumption regarding the subject's strategy and was developed out of past research experience with the sentence problem (Johnson and Kidder, 1972; Kidder, 1972). As problem size was increased more unusual uses were expected because generating unusual uses was assumed to be an effective way to eliminate words from further consideration. More time would then be available to integrate the remaining words into a well written, original sentence. The greater the number of words provided, the greater the opportunity to employ this strategy.

Sentence length. Increasing the number of provided words was hypothesized to increase sentence length, first,

because of the increase in the number of words, and second, because of the need for a greater number of connecting words.

CHAPTER II

EXPERIMENT 1

Method

Subjects

A sample of 60 students (30 male, 30 female) enrolled in introductory psychology courses volunteered to serve as subjects.

Materials

Six five-item tests were constructed to measure productive thinking using the sentence problem. The tests were constructed to examine the effects of two levels of word frequency (high and low) and three levels of problem size (two, three, and four words). The high-frequency words were defined as those words that could be used as either nouns or verbs and which had a Thorndike-Lorge general rating of AA. The low-frequency words were defined as those words that could be used as either nouns or verbs and which occurred in Part II of the Thorndike-Lorge Word Book (pp. 211-242). These words occurred at least once per million but more than once per four million. Refer to Appendix A for the tests and words used.

Procedure

Prior to the administration of the productive thinking tests the subjects were read the following instructions, after which the tests were randomly administered.

> On this task we would like you to try to write imaginative sentences. We will provide you with a couple of words that are to be used in your sentences. Make sure that you use all of the words given. Try not to simply list the words. For example, if you were to use the words: expensive, happy, horse, and lake, a poor sentence would be: The happy expensive horse jumped into the lake. Try to use the words given to you so that they are not obvious. Have an adjective modify words other than the given nouns. Try to be humorous, clever, or witty. A good sentence using the above four words would be: I'm happy that our expensive weekend at Horse Lake is over with. Another good sentence would be: A beautiful peaceful lake and a spirited horse, neither of which were expensive in comparison to how they made her, proved the best cure for Anne's dejected state of mind. Are there any questions?

Results and Discussion

The responses to each item were rated for originality, unusual uses, and sentence length, providing three measures of productive thinking.

Originality

Two judges working independently rated the responses to each item on a scale from one to seven. A rating of one reflected a very poor solution while a rating of seven reflected a very good solution. The correlation between raters obtained for each item on each of the six tests are found in Table A1. The correlations ranged from .71 to

1.00. High correlations were found predominately on tests employing low-frequency words where originality scores were rather low. Characteristic of the rating scale, lower level ratings were much more objective than higher level ratings.

The effects of Word Frequency and Problem Size were examined in a 2 (Word Frequency) X 3 (Problem Size) analysis of variance, the results of which are summarized in Table A2. The means and standard deviations for each of the groups are summarized in Table 2. As expected, originality was better when high-frequency words were employed. The Word Frequency effect, F (1,59) = 66.24, $p < .001$, was significant, but the Problem Size effect, F (2,59) = 2.41, and the Word Frequency X Problem Size interaction, F (2,59) = 1.16, were not significant.

Table 2

Means and Standard Deviations of Originality Scores in Experiment 1

Word Frequency		Problem Size		
		2 Words	3 Words	4 Words
High	$\bar{X}$	43.9	40.1	41.3
	S.D.	5.3	9.9	6.5
Low	$\bar{X}$	30.4	28.9	23.7
	S.D.	6.83	6.45	3.92

Note: N = 10 for each group.

Unusual Uses

In order for a word to be rated unusual, it had to be used appropriately and satisfy at least one of the following conditions: use as a name of a person, place, or thing; use as a dialect which is indicated by the subject; or use as an unusual meaning or sense of the word. An all-or-none scoring system was adopted. If one of the provided words was used in an unusual way, the problem solution was rated unusual. Since there were five problems per test, the maximum score for any subject was five while the lowest score was zero.

A 2 (Word Frequency) X 3 (Problem Size) analysis of variance examining the effects of problem size and word frequency on the generation of unusual uses was performed, the results of which are summarized in Table A3. The means and standard deviations to each of the groups are summarized in Table 3. Significantly more unusual uses were generated when low-frequency words were employed in the sentence problem. The Word Frequency effect, F (1.59) = 4.845, $p < .05$, was significant, but the Problem Size effect, F (2,59) = 2.830, and the Word Frequency x Problem Size interaction, F (2,59) = 1.493, were not significant.

Sentence Length

A 2 (Word Frequency) X 3 (Problem Size) analysis of variance was performed examining the effects of word

Table 3

Means and Standard Deviations of Unusual Uses Scores in Experiment 1

Word Frequency		Problem Size		
		2 Words	3 Words	4 Words
High	$\bar{X}$	.7	1.6	2.4
	S.D.	.82	1.26	1.43
Low	$\bar{X}$	2.3	2.1	2.6
	S.D.	1.70	1.45	1.76

Note: N = 10 for each group.

frequency and problem size on sentence length. The results of this analysis are summarized in Table A4. The means and standard deviations for each of the groups is summarized in Table 4. The Word Frequency effect, F (1,59 = .056, the Problem Size effect, F (2,59) = .601, and the Word Frequency X Problem Size interaction, F (2,59) = .192, were not significant.

Word Frequency Effects

To summarize, originality scores were significantly better when high-frequency words were used in the sentence problem while the generation of unusual uses was significantly better when low-frequency words were used. No support was found for the hypothesized effect of word frequency on sentence length. These findings are basically

Table 4

Means and Standard Deviations of Sentence Length Scores in Experiment 1

Word Frequency		Problem Size		
		2 Words	3 Words	4 Words
High	$\bar{X}$	116.4	115.1	123.3
	S.D.	39.46	26.73	19.47
Low	$\bar{X}$	107.7	118.2	123.0
	S.D.	26.76	47.19	24.80

Note: N = 10 for each group.

in agreement with those previously reported in the literature (Cofer and Shevitz, 1952; Piers and Kirchner, 1971). Because high-frequency words have more of a response availability than low-frequency words, these words elicit more responses. Since high-frequency words elicit more responses or associations, they have more meaning and this results in their more successful integration into sentences which manifest some degree of originality. Since more common associations must be considered prior to reaching any unusual associations, however, fewer unusual uses of high-frequency words were obtained. The implications of these results will be discussed further in the General Discussion.

Problem Size Effects

No support was offered for the hypothesized effects of problem size on the originality, unusual uses, of sentence length measures. As problem size was increased, there was an increase in the number of unusual uses generated and sentence length and a decrease in originality, but none of the effects reached significance. Apparently the verbal skills of the college sample were sufficient to integrate four words into an original sentence about as well two or three words. Because of this, there was little need to generate unusual uses of the provided words. If the sample size were sufficiently increased or if there had been a greater range in problem size, the effects of this variable might have reached significance. But the magnitude of the problem size effect was very small.

Correlation of Dependent Measures

The three productive thinking measures were correlated over subjects in each of the six independent groups. Significance tests were then computed for each of the obtained correlations. These results are summarized in Table 5. Originality scores and unusual uses scores were significantly related within three of the groups while originality scores and sentence length were significantly related in one of the groups. An inspection of the originality rating scale is helpful in accounting for

Table 5

Correlation of the Originality (O.), Unusual Uses (U.U.), and Sentence Length (S.L.) Measures in Experiment 1

Word Frequency		Problem Size: 2 Words U.U.	2 Words S.L.	3 Words U.U.	3 Words S.L.	4 Words U.U.	4 Words S.L.
High	0	.348	.738*	-.175	-.164	.703*	.422
	U.U.		-.019		-.146		.286
Low	0	.714*	-.576	-.118	.528	.691*	.441
	U.U.		-.575		.283		.349

*p < .05

these results. Many of the criteria for the higher originality ratings involve the use of either novel word meanings or uses, or the construction of complex, well constructed sentences. A positive correlation between these measures is, therefore, to some extent expected.

The correlation results suggest an interesting question. How can there exist a positive correlation between originality scores and unusual uses scores when originality scores are highest with high-frequency words but unusual uses scores are highest with low-frequency words? The answer is illustrated in Figure 1 which represents a scatterplot of the originality and unusual

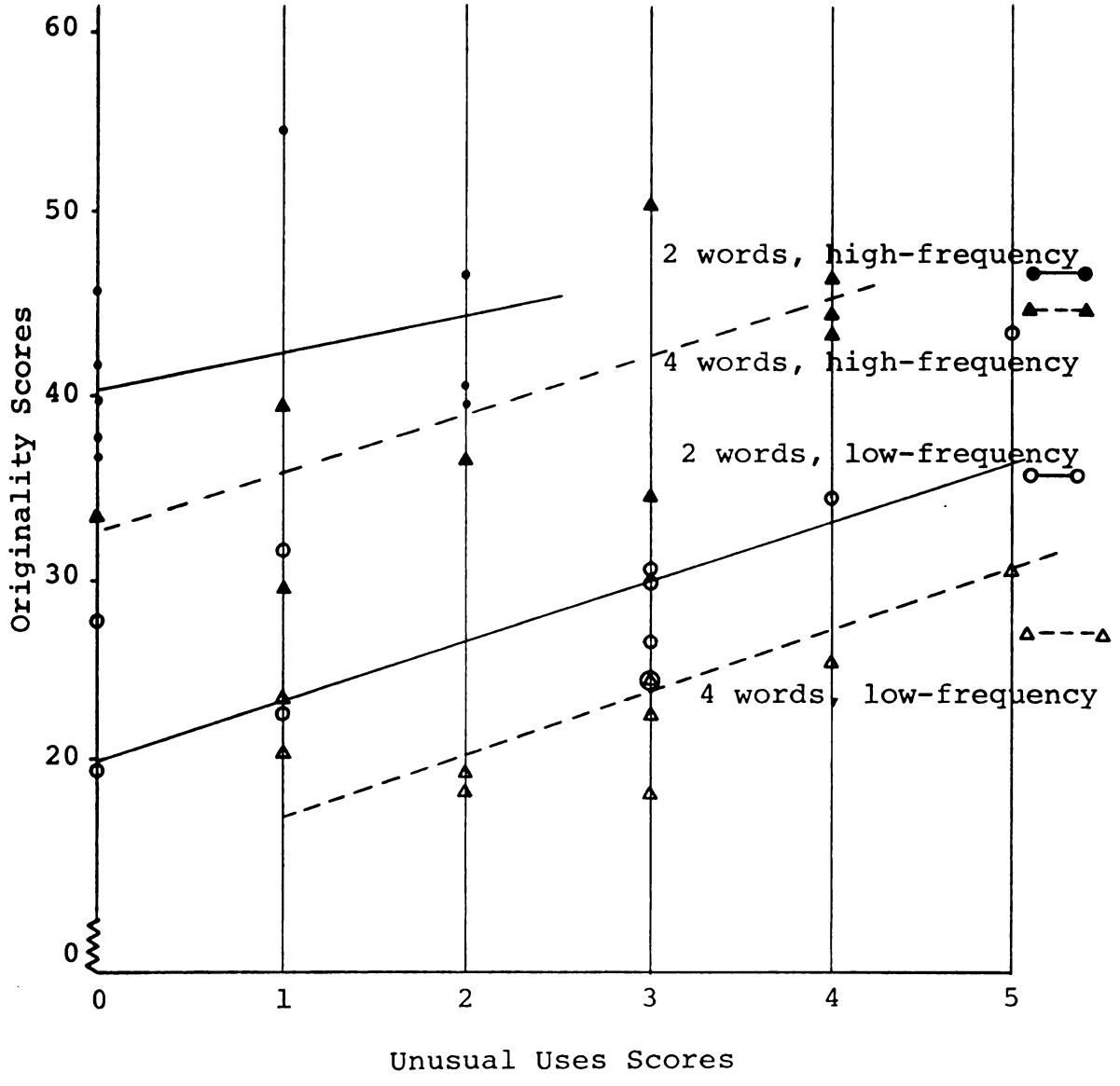

Figure 1. Scatterplot of originality and unusual uses scores for four groups in Experiment 1.

uses scores for the subjects in the two- and four-word groups. As is apparent, the mean originality scores are highest for the high-frequency conditions while the mean unusual uses scores are highest for the low-frequency conditions. Within each group, a positive correlation between originality and unusual uses scores is seen to exist. The high- and low-frequency conditions simply fall on different sections of the graph. More will be said about this effect later.

CHAPTER III

EXPERIMENT 2

A second experiment was designed to examine the effects of problem size and word frequency on a population whose verbal skills were less advanced that the population of the first experiment. In general, the second experiment was identical to the first experiment except for the following changes: (a) the sample consisted of sixth-grade subjects; (b) a change to a more suitable level of word frequency for this sample; (c) a reduction in the number of levels of problem size; (d) a slight modifications in instructions; and (e) a change in one of the raters.

Method

Subjects

A sample of 68 students (29 female, 39 male) enrolled in the sixth-grade of a suburban school served as subjects.

Materials

Four five-item tests were constructed to measure productive thinking using the sentence problem. The

tests were constructed to examine the effects of two levels of word frequency and two levels or problem size (two and three words). The high-frequency words were defined as those words that could be used as either nouns or verbs and which had a Thorndike-Lorge general valve of AA. The low-frequency words were defined as those words that could be used as nouns or verbs and which had a Thorndike-Lorge general value between one and nine. Refer to Appendix B for the tests and words used.

Procedure

The procedure for Experiment 2 was the same as that for Experiment 1 with one exception. The second example of a "good" sentence was omitted since it was considered too difficult for the sixth-graders.

Results and Discussion

The responses to each item were rated for originality, unusual uses, and sentence length providing three measures of productive thinking.

Originality

Two judges working independently rated the responses to each item on a scale from one to seven. The correlations between judges for each item on each of the four tests ranged from .86 to .96 and may be found

in Table A5. The correlations are considered satisfactory for research purposes.

The effects of word frequency and problem size were examined in a 2 (Word Frequency) X 2 (Problem Size) analysis of variance the results of which are summarized in Table A6. The means and standard deviations are summarized in Table 6. The Word Frequency effect, F (1,67) = 19.35, $p < .001$, and the Problem Size effect, F (1,67) = 9.63, $p < .001$, were significant. The Word Frequency X Problem Size interaction, F (1,67) = .02, was not significant. Originality increased when high-frequency words were employed in the sentence problem and when problem size was small.

Table 6

Means and Standard Deviations of Originality Scores in Experiment 2

Word Frequency		Problem Size	
		2 Words	3 Words
High	$\bar{X}$	35.76	29.23
	S.D.	9.28	8.23
Low	$\bar{X}$	26.65	20.76
	S.D.	8.99	6.08

Note: N = 17 for each group.

Unusual Uses

A 2 (Word Frequency) X 2 (Problem Size) analysis of variance examining the effects of word frequency and problem size on the generation of unusual uses was performed, the results of which are summarized in Table A7. The means and standard deviations are summarized in Table 7. The Problem Size effect, F (1,67) = 7.67, $p < .05$, was significant. Increasing problem size resulted in an increase in the generation of unusual uses. The Word Frequency effect, F (1,67) = 1.515, and the Word Frequency X Problem Size interaction, F (1,67) = .095, were not significant, however.

Table 7

Means and Standard Deviations of Unusual Uses Scores in Experiment 2

Word Frequency		Problem Size: 2 Words	Problem Size: 3 Words
High	$\bar{X}$	.24	.82
	S.D.	.44	.81
Low	$\bar{X}$	.53	1.00
	S.D.	.87	.94

Note: N = 17 for each group.

Sentence Length

A 2 (Word Frequency) X 2 (Problem Size) analysis of variance was performed examining the effects of both word frequency and problem size on sentence length. The results of this analysis are summarized in Table A8. The means and standard deviations are summarized in Table 8. The Word Frequency effect, F (1,67) = 1.594, the Problem Size effect, F (1,67) = .26, and the Word Frequency X Proglem Size interaction, F (1,67) = .049, were not significant.

Table 8

Means and Standard Deviations of Sentence Length Scores in Experiment 2

Word Frequency		Problem Size	
		2 Words	3 Words
High	$\bar{X}$	54.53	58.71
	S.D.	18.55	23.17
Low	$\bar{X}$	48.59	50.24
	S.D.	22.76	28.55

Note: N = 17 for each group.

Word Frequency Effects

The word frequency effect was partly replicated in the second study. As in the first experiment, word

frequency did not influence sentence length, but it did influence originality. Originality was significantly better with sentence problems employing high-frequency words than with problems employing low-frequency words. Contrary to the findings of the first experiment, word frequency did not significantly influence the generation of unusual uses. The notion of response availability will be invoked to account for these findings.

It would appear that the sixth-graders had more meanings or associations to high-frequency words than low-frequency words because their originality scores were significantly better when using high-frequency words. The difference in the number of meanings was significant enough to affect the facility with which the words were integrated into well constructed sentences. For this population, however, the assumption that high-frequency words had many more associations than low-frequency words was not supported. While the high-frequency words had more meanings than the low-frequency words, the difference in the number of meanings is interpreted to be insufficient to produce a significant difference in the availability of uncommon or unique meanings. This may have been a function of the stimulus materials (levels of word frequency were too close) or of the verbal characteristics of the sixth-graders (storage of only a few common meanings or senses of each word), or both.

Problem Size Effects

Problem size significantly influenced both originality and the generation of unusual uses. While the effect of this variable was minimal with the college sample, with the sixth-grade sample, increasing the size of the sentence problem from two to three words resulted in a significant decrement in originality performance. This finding supports previous research which has found an increase in problem difficulty corresponding to an increase in problem size (Neimark and Wagner, 1964; Kaplan and Caravellas, 1958; Hyman, 1953).

Increasing problem size resulted in an increase in the generation of unusual uses of the supplied words. Or in other words, increasing problem size resulted in a decrease in problem difficulty for this dependent measure. This effect has not been reported previously in the literature but was expected in the present study with the sentence problem. The use of a supplied word in an unusual way was hypothesized to be an effective strategy for dealing with a problem containing too much information to handle in the conventional way. By using a supplied word, horse, for example, in an unusual way such as the name for a person, Crazy Horse, or a place, Horse Lake, one of the criteria for originality is satisfied and problem size is effectively reduced by one word.

This interpretation suggests the generation of unusual uses in the sentence problem may be a form of productive thinking that can be easily modified through training if its utility is made apparent. On the other hand, originality would appear to be much more difficult to modify through training. While the generation of unusual uses may enhance an originality score, a good originality score also necessitates that all of the supplied words be integrated smoothly into the sentence structure and the sentence is a whole must express a witty or novel idea. The unusual uses measure may be a superficial rating of productive thinking, while the originality measure is much more encompassing. More will be said of this later.

Correlation of Dependent Measures

The three productive thinking measures were correlated over subjects in each of the four independent groups. Significance tests were then computed for each of the obtained correlations. These results are summarized in Table 9. Originality scores and unusual scores were significantly related in two of the groups while originality scores and sentence length were significantly related in three of the groups.

A scatterplot of the originality and unusual scores for each of the four groups is presented in Figure 2. As in the first experiment, the mean originality scores are

Table 9

Interjudge Correlations of Originality Ratings in Experiment 3

	Task 1		Task 2	
Item	Test A	Test D	Test B	Test C
1	.90	.78	.81	.88
2	.91	.84	.77	.87
3	.58	.87	.88	.92
4	.92	.80	.88	.91
5	.88	.87	.84	.83

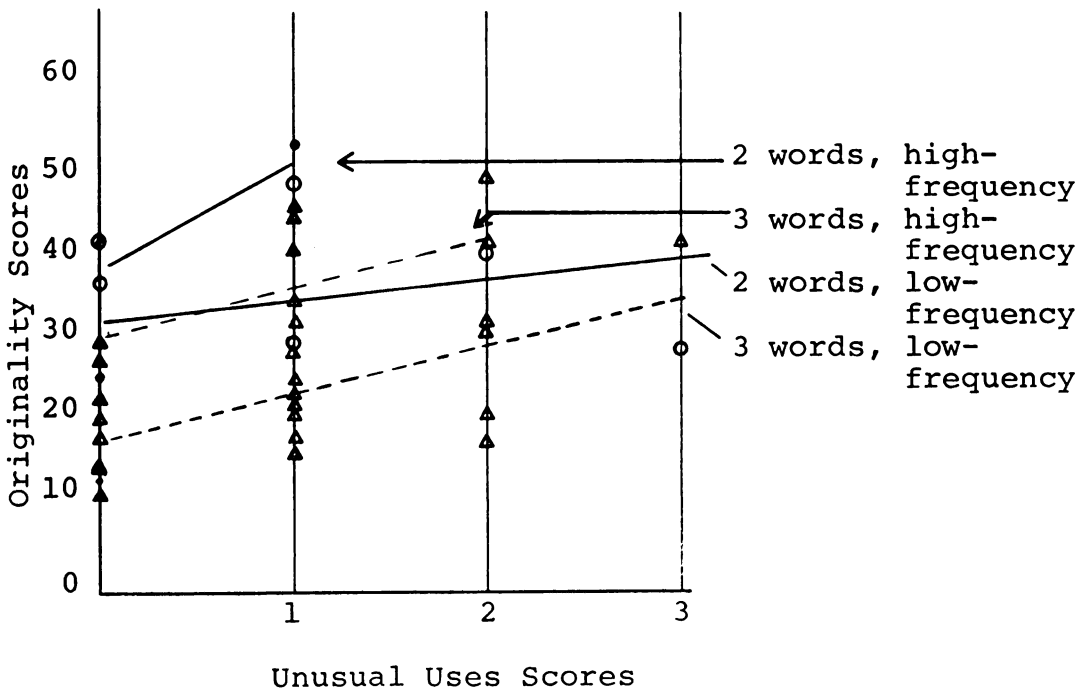

Figure 2. Scatterplot of originality and unusual uses scores for each group in Experiment 2.

highest for the high-frequency conditions while the mean unusual uses scores are highest for the low-frequency conditions. Within each group, a positive correlation between originality and unusual uses scores is seen to exist.

The major difference between these results and those of the first experiment was in the greater consistency with which originality scores and sentence length were correlated. An inspection of the originality scale is helpful in accounting for this relationship. Many of the criteria for the lower originality ratings suggest sentences that may be shorter in length. For example, a solution sentence that does not employ all of the words receives a rating of 1, a sentence that simply lists the words receives a rating of 2, and a choppy sentence receives a rating of 3. On the other hand, the criteria for the higher originality ratings may involve sentences that are lengthy. For example, for a rating of 4 the sentence must be well constructed, and for a rating of 5 the sentence might be quite complex in structure. Of course, it is also possible to write short sentences that are rated original if they are witty, humorous, use the words in unusual ways, or carry an impact.

The results suggest that the original solutions of the sixth-graders were typically better constructed

and more complex than the less original solutions which were more likely to be listings of the words, choppy, or expressions of trivial ideas. The fact that the relationship between originality and sentence length was not as strong in the college sample suggests a greater occurrence of original solutions that were shorter in length, i.e. they were witty, humorous, or employed unusual uses. Together, these findings suggest the processes involved in constructing original sentences were quite different between these age levels.

CHAPTER IV

EXPERIMENT 3

A third experiment attempted to investigate in further detail the conditions and processes that influence productive thinking on the sentence problem. Among other things, the first two studies have found that the generation of unusual uses is most readily evoked when word frequency is low. This was interpreted to result from the steeper and shorter response hierarchies caused by the low-frequency words. Continued experience on the sentence problem with this kind of material may also result in the development of an unusual uses generating strategy. That this may occur has important implications for originality research.

The above notion is supported by past research using a different kind of problem. On a free association task, Maltzman, Bogartz, and Breger (1958) found the generation of unusual uses was enhanced under certain conditions. In their study, the repeated evocation of different associative responses to the same stimuli resulted in an increase in the number of unusual responses to both practice and test stimuli. The effect was enhanced

with instructions to give different responses and when verbal reinforcements for uncommon responses were provided. Evidence of transfer from such training to the production of unique uses on Guilford's test was also found.

The third experiment attempted to assess the nature and extent of transfer in originality and unusual uses production on the sentence problem when changing from one level of word frequency to another. If such transfer was found to exist, some insight into the processes which influence productive thinking may be obtained. The subjects were randomly assigned to four groups. Two of the groups received tasks using high-frequency words and two of the groups received tasks using low-frequency words. After completing the first task a second task was administered. Half of the subjects continued to work on problems having the same level of word frequency experienced on the first task (high-high and low-low groups), while the other subjects worked on problems having the alternative word frequency (high-low and low-high groups).

After the two productive thinking tests were administered, a multiple-choice test of word definitions followed. Each of the provided words on the two tasks and a number of other words with similar word frequencies appeared. The task was to match the word with the correct definition. The results of the first experiment indicated that inappropriate word uses were found predominately with

these words. The vocabulary test was administered to determine the number of known and unknown words in each of the high- and low-frequency conditions. This would allow for a finer analysis of the results. For example, one could determine if the unusual uses were generated predominately among the unknown words rather than the known words, or if there was any difference in the kind of unusual uses that were generated between the known and unknown words.

On the initial task, originality was expected to be higher when high-frequency words were employed, while the generation of unusual uses was expected to be higher when low-frequency words were employed. Previous theoretical considerations and research support these hypotheses. The hypotheses predicting performance on the transfer task may be divided into two groups: within-group comparisons between Task 1 and Task 2, and between-group comparisons on Task 2.

Within-group comparisons: The performance of the control groups (HH and LL), whether measured in terms of originality or unusual uses, was expected to remain the same or show a slight gain on the transfer task. If the initial task contained high-frequency but the second task contained low-frequency words, originality scores were expected to decrease on the second task while unusual uses scores were expected to increase. On the other hand,

if the initial task contained low-frequency words but the second task contained high-frequency words, originality scores were expected to increase on the second task while unusual uses scores were expected to decrease. The results of the first two studies suggest these hypotheses.

Between-group comparisons: The amount of transfer involved when changing from one level of word frequency to another will be assessed by comparing the performance of the four groups on the second task. From the above hypotheses, the group expected to have the highest originality scores on Task 2 is the high-high group, while the low-low group is expected to have the lowest originality scores.

If there exists any transfer in the ability to produce original solutions when changing from one level of word frequency to another, it should be demonstrated by the high-low group versus the low-low group comparison. While the originality scores for the high-low are expected to drop on the second task, they should not drop to a level equal to that of the low-low group if there is any benefit from the initial task. Should the high-low group drop to the performance level of the low-low group one would conclude there is no transfer. Similarly, while the originality scores for the low-high group are expected to increase on the second task, these scores are not

expected to attain the level of the high-high group if there was any gain from the initial high-frequency condition.

A similar argument for the existence of transfer applies for the generation of unusual uses. From the within-group comparisons, the group that is expected to have the highest unusual uses scores on the second task is the low-low group, and the group expected to have the lowest unusual uses scores is the high-high group. The critical comparisons for the existence of transfer are between the low-high group and the high-high group and between the high-low group and the low-low group. The unusual uses scores for the low-high group are expected to drop on the second task, but the decline should not reach a level equal to that of the high-high group if there is any benefit from the initial task. Similarly, while the unusual uses scores for the high-low group are expected to increase on the second task, they should not attain the level of the low-low group if there was any benefit from the initial low-frequency condition.

Method

Subjects

A sample of 80 students (40 female, 40 male) enrolled in introductory psychology courese volunteered to serve as subjects.

Materials

Four five-item tests were constructed to measure productive thinking using the sentence problem. The tests were constructed to examine the effects of two levels of word frequency. The levels were the same as those employed in Experiment 1. The high-frequency words were defined as those words that can be used as nouns or verbs and which have a Thorndike-Lorge rating of AA. The low-frequency words were defined as those words that can be used as nouns or verbs and which occurred in Part II of the Thorndike-Lorge word book (pp. 211-242). Refer to Appendix C for the tests and words used.

Two vocabulary tests were constructed, one consisting of 43 high-frequency words, the other of 43 low-frequency words. The words that appeared on the productive thinking tasks and a number of words with similar word frequencies were used. Four alternative definitions were offered to each word, of which, only one was correct. The correct definition was one of the most common senses of a word appearing in a college dictionary. Refer to Appendix D for the vocabulary tests used.

Procedure

Prior to the administration of the productive thinking tasks the subjects were read the following instructions:

> In this study you will be given three words from which you must write an imaginative sentence. Make sure that you use each of the three words given. Try to fit the words into the sentence unobtrusively. For example, if you were given the words: expensive, happy, and horse, an uncreative sentence would be: The happy expensive horse jumped into the lake. While the sentence constructed included each of the words, it essentially listed the words, happy, expensive, and horse. Try to use the words in unusual ways. For example, horse may be used as a name as in Horse Lake or Crazy Horse. It may also be used as a slang for heroine or as in horsing around. If you use a word in an unusual way, make sure that your use is appropriate. For example, it would be inappropriate to use the above words in the following manner: John happy the expensive for a horse minute. While this may be original, it is not creative because it lacks appropriateness. A creative solution might be: Happy felt most sublime after he injected his expensive arm with some really great horse. It combines the words into novel configurations that express a new idea not suggested by the words themselves. Try to be clever or witty. To Freud, a torpedo is not a torpedo, it represents a form of envy. Are there any questions?

The forms were then passed out and the following instructions were read:

> When I say "begin," turn your paper over. You will find five problems which you will have about twelve minutes to work, so space your time accordingly. When I say "stop," turn your paper over and begin working on the second set of five problems. Do not start working on the second page until I tell you to do so. Are there any questions?

After completing the productive thinking tasks, the vocabulary tests were passed out. The order in which they occurred was counterbalanced.

Results and Discussion

Originality

The responses were rated independently by two judges. The correlation between raters ranged from .58 to .92, and are found in Table A9. The correlation between raters for item 3 of the first task was low (.58), but the correlations for each of the other items were considered satisfactory.

Between-group comparisons on the initial task. On the initial task, no significant difference in originality scores was found between the LL and LH groups, F (1,38) = 1.115. A significant difference was observed between the HH and HL groups, F (1,38) = 4.86, $p < .05$, which must be taken into consideration when testing for transfer. Since the subjects were randomly assigned to the groups, the difference is assumed to have resulted from a bad draw. When the HH and HL groups were pooled and compared to the pooled LL and LH groups, originality scores were found to be significantly better for the high-frequency condition, F (1,78) = 74.49, $p < .001$. This directly supports the findings of the first two studies.

Within-group comparisons on the initial and transfer tasks. The mean originality scores for each of the groups on both the initial and transfer tasks are illustrated in Figure 3. The performance of the HH

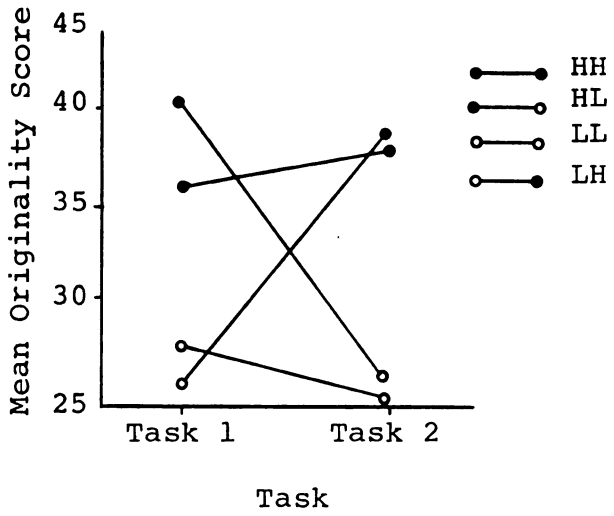

Figure 3. Mean originality scores for each of the four groups on the first and second tasks in Experiment 3.

group showed a slight improvement on the second task, but this was found insignificant, F (1,19) = 2.134. The LL group's performance declined significantly, F (1,19) = 5.968, $p < .05$. As expected, the LH group significantly improved on the second task, F (1,19) = 56.45, $p < .001$, while the HL group showed a significant decrement, F (1,19) = 50.66, $p < .001$.

Between-group comparisons on the transfer task. The influence of an initial high-frequency task hypothesized to facilitate performance on a subsequent low-frequency task was not supported. The performance of the HL group was not significantly different from the

LL group, F (1,38) = .60, but it was significantly different from both the HH group, F (1,38) = 44.03, p < .001, and the LH group, F (1,38) = 30.95, p < .001. The performance of the LH group was somewhat better than that of the HH group, though this was found insignificant, F (1,38) = .04. The latter finding is somewhat interesting and will be considered again when examining unusual uses production. Overall, the influence of the task being attempted at the time was far more important for originality performance than the influence of the preceding task. To have demonstrated transfer it was necessary for the HL group to have significantly better originality scores than the LL group, while having little difference in originality scores from the HH group. To repeat, there was no evidence to support the hypothesis that changing from a task employing one level of word frequency to another task employing a different level of word frequency results in a transfer in the ability to produce original solutions.

Unusual Uses

Each of the three provided words on each problem was rated by an experienced judge according to whether or not it was used unusually. In order for a word to be rated unusual, it had to be used appropriately and satisfy one of the following three conditions: use as

a name of a person, place, or thing; use as a part of dialect which is indicated by the subject; or use as an unusual meaning or sense of the word. On any single problem it was possible to receive a score of three. There were five problems per test.

Between-group comparisons on the initial task. On the initial task, the groups exposed to the low-frequency words (LL and LH) did not differ significantly in the number of unusual uses employed, F (1,38) = .023, nor did the groups exposed to the high-frequency words differ significantly, F (1,38) = 1.78. When the LL and LH groups were pooled and compared to the pooled HH and HL groups, significantly more unusual uses were generated in the low-frequency conditions, F (1,78) = 14.28, $p < .01$, supporting previous experimental results.

Within-group comparisons on the initial and transfer tasks. Figure 4 illustrates the mean number of unusual uses generated in both tasks for each of the groups. The HH group did not show any change in unusual uses performance from Task 1 to Task 2, F (1,19) = 1.00, but the HL group showed a significant increment in the number of unusual uses employed on Task 2, F (1,19) = 9.084, $p < 01$. The number of unusual uses generated from Task 1 to Task 2 increased in the LL group, but the increase was insignificant, F (1,19) = 2.437. The number of unusual uses generated in the LH group declined somewhat

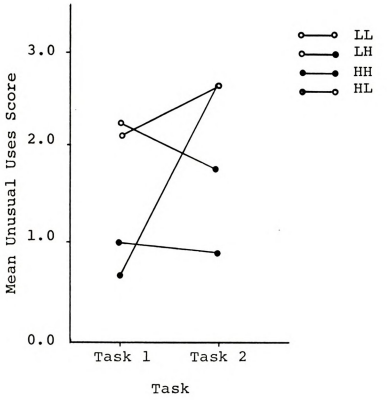

Figure 4. Mean unusual uses scores for each of the four groups on the first and second tasks in Experiment 3.

from Task 1 to Task 2, but the decline was not significant, F (1,19) = 1.085. The latter result is important because it represents an important prerequisite for the existance of transfer.

Between-group comparisons on the transfer task. The HL group was not significantly different from the LL group on Task 2 unusual uses performance, F (1,38) = 2.116, but was significantly different from the HH group on Task 2 performance, F (1,38) = 5.676, $p < .05$. The unusual uses performance of the HL group was not expected

to be equal to that of the LL group. It is possible that the word frequency effect produced by the low-frequency words on Task 2 was large enough to overshadow or mask the influence of the initial task on unusual uses production.

The number of unusual uses generated in the LH group was not significantly different from the number generated in the LL group, F (1,38) = 2.116, but was significantly greater than the number of unusual uses generated in the HH group, F (1,38) = 5.266, $p < .05$, providing evidence for a transfer effect. On both Task 1 and Task 2 there was no significant difference in the generation of unusual uses between the LL and LH groups, and on both tasks each of these groups generated significantly more unusual uses than the HH group. For the LH group, the initial exposure of the low-frequency words clearly affected performance on the transfer task. To repeat, the results provide support for the hypothesized transfer effect in unusual uses production when changing from a task employing low-frequency words to a subsequent task employing high-frequency words. The implications of these results will be addressed in the General Discussion.

Known vs Unknown Words

While the third experiment was designed primarily to assess the nature and extent of transfer in originality

and unusual uses production on the sentence problem when changing from one level of word frequency to another, a second emphasis of the experiment was to determine the number of known and unknown words within each of the high- and low-frequency conditions and to examine how this may have influenced the results. A number of questions are suggested: (1) Was there any difference in the number of known and unknown words between the high- and low-frequency conditions? (2) Within the high- and low-frequency conditions, were only the unknown words employed as unusual uses? (3) Within the high- and low-frequency conditions, were all of the unknown words employed as unusual uses? (4) Was the difference in the number of unusual uses between the high- and low-frequency conditions a result of any difference in the number of known and unknown words between the two conditions? and (5) Were there any differences in the nature of the known and unknown unusual uses?

Initial task comparisons. The mean number of known and unknown words as well as the mean number of known words employed unusually and unknown words employed unusually for each of the four groups on the initial task is presented in Table 10. The proportion of known unusual uses generated to the total number of known words and the proportion of unknown unusual uses generated to the total number of unknown words was determined for each subject.

Table 10

Knowledge of Words in Task 1 of Experiment 3 (means)

Group	Known Words	Unknown Words	Unusual Uses		Other Uses	
			Known	Unknown	Known	Unknown
LL	8.55	6.45	1.10	1.05	7.45	5.40
LH	8.40	6.60	1.25	1.00	7.17	5.60
HL	13.95	1.05	.65	.05	13.30	1.00
HH	14.80	.20	1.05	.00	13.75	.20

The mean proportions for each group are presented in Table A10. Table 10 shows there were more known high-frequency words than unknown high-frequency words. When the LL and LH groups were pooled and compared to the pooled HH and HL groups, the difference in the number of known words, F (1,78) = 161.404, $p < .001$, and the difference in the number of unknown words, F (1,78) = 161.432, $p < .001$, was significant.

A simplistic interpretation of the word frequency effect pertaining to unusual uses production assumes that the unusual uses were derived only from words that were unknown. Because there were more unknown words in the low-frequency condition, an apparent word frequency effect was obtained. Table 10 shows this simplistic interpretation was not supported. Within the high- and low-frequency

condition, both known and unknown words were employed in unusual ways. In the high-frequency condition, in fact, nearly all of the unusual uses were generated from known words; the mean number of known words employed unusually was 1.05 for the HH group and 0.65 for the HL group. The mean number of unknown words employed unusually was 0.00 for the HH group and 0.05 for the HL group. For the combined groups, only one of the unusual uses was an unknown word. When the known words used unusually in the HH group and the HL group were pooled and compared to the pooled unknown words used unusually in these groups, significantly more known words than unknown words were used unusually, F (1,39) = 37.208, $p < .001$.

In the low-frequency condition, the mean number of known words used unusually was 1.05 for the LL group and 1.00 for the LH group. The mean number of unknown words used unusually was 1.10 for the LL group and 1.25 for the LH group. When the known words used unusually in the LL and LH groups were pooled and compared to the unknown words used unusually in these groups, no significant difference was obtained, F (1,39) = .334.

It is also of interest to note that not all of the unknown words were employed in unusual ways. In the HH and HL groups, the mean number of unknown words not employed unusually was 0.20 and 1.00, respectively. While these high-frequency words were incorrectly defined

on the vocabulary test, in each case, they were appropriately used in the sentence problem. On the other hand, in the LL and LH groups, the mean number of unknown words not employed unusually was 5.40 and 5.60, respectively. In contrast to the appropriate use of the unknown words in the high-frequency condition, many of these low-frequency words were used inappropriately which partly explains the lower originality ratings in the low-frequency condition. Further, significantly more unknown words in the low-frequency condition were used inappropriately or in typical ways than in unusual wasy, F (1,39) = 87.277, $p < .001$.

One might ask why more of the unknown words weren't used in unusual ways. There are several possible explanations. First, an unknown word may have been mistaken for another word which was similar in sound, appearance, etc., which would have resulted in its inappropriate use. Second, it is possible that although the word was not correctly defined on the vocabulary test, its meaning was known and was therefore used appropriately but not unusually in the sentence problem. It is also possible that a word was used appropriately even though its meaning was unknown. And finally, any attempt to employ an unknown word in an unusual but appropriate way have been ignored, which would have resulted in inappropriate uses.

The word frequency effect in unusual uses production found in Experiments 1 and 3 may to some extent have resulted from the difference in the number of known and unknown words between the high- and low-frequency groups. It was previously reported that when the LL and LH groups were pooled and compared to the pooled HH and HL groups, significantly more unusual uses were generated in the low-frequency conditions, F (1,78) = 14.28, $p < .01$. When the known words used unusually in the LL and LH groups were pooled and compared to the pooled known words used unusually in the HH and Hl groups, there were more unusual uses in the low-frequency condition but the difference was not significant, F (1,78) = 1.363. When the unusual uses derived from the unknown words in the LL and LH groups were pooled and compared to the pooled unusual uses derived from the unknown words in the HH and HL groups, there were significantly more unusual uses in the low-frequency condition, F (1,78) = 35.524, $p < .001$, however.

These results indicate that the difference in the number of unusual uses between the high- and low-frequency conditions was due to the difference in the number of known words used unusually to a slight extent, but to a greater extent, the difference was due to the greater incidence of unknown words used usually in the low-frequency condition compared to the relative absence

of unknown words in the high-frequency condition. The difference was considered unavoidable when comparing unusual uses performance between high- and low-frequency groups, but it clearly indicates a need to take this variable into consideration not only on the present task, but on other tasks as well. In the General Discussion, more will be said about the methodological significance of this finding and how it relates to the results of the first two experiments.

A final point of interest concerns the evaluation of any differences in the nature of the known words used unusually and the unknown words used unusually in the high- and low-frequency conditions. The unusual uses in the high- and low-frequency conditions were classified into two categories: names of persons, places, and things, or dialects; and unusual senses or meanings. In the high-frequency conditions, there was little difference between the number of unusual uses categorized as names or as unusual senses for both the known and unknown words. Among the high-frequency words used unusually, 18 were names or dialects while 17 were unusual senses. There was only one unknown high-frequency word used unusually and it was employed as a name. In the low-frequency conditions, there were more unusual uses categorized as names or dialects than as unusual senses for both the known and unknown words. Among the known low-frequency

words used unusually, 44 were names or dialects while three were unusual senses. Among the unknown low-frequency words used unusually, 39 were names or dialects while only two were unusual senses.

In the low-frequency conditions only five of the unusual uses were different senses or meanings of the provided words. For the known words in this condition it is suggested that if only a single meaning or sense of the words was known, the use of the words as names or dialects may have been the only unusual way the words could have been used. For the unknown words in this condition where there may have been no appropriate meanings or senses, the use of the words as names or dialects may have been the only appropriate way the words could be used at all.

The results from the high- and low-frequency conditions suggest a hierarchy of word uses ranging from typical meanings or senses, to unusual meanings, to clever or unusual uses as names or dialects. This supports the hypotheses generated from word association theory advanced earlier.

Transfer task comparisons. The mean number of known and unknown words, as well as the mean number of known and unknown unusual uses for each of the four groups on the transfer task is presented in Table 11. The table shows there were more known high-frequency words than

Table 11

Knowledge of Words in Task 2 of Experiment 3 (means)

Group	Known Words	Unknown Words	Unusual Uses		Other Uses	
			Known	Unknown	Known	Unknown
LL	8.05	6.95	1.10	1.55	6.95	5.40
LH	14.80	.20	1.75	.05	13.05	.15
HL	6.30	8.70	1.05	1.60	5.25	7.10
HH	14.70	.30	.95	.00	13.75	.30

known low-frequency words, and there were more unknown low-frequency words than unknown high-frequency words. When the LL and LH groups were pooled and compared to the pooled HH and HL groups, the difference in the number of known words, F (1,78) = 362.47, $p < .001$, and the difference in the number of unknown words, F (1,78) = 362.13, $p < .001$, was significant.

Many of the other results regarding the differences between the known and unknown words in the high- and low-frequency conditions found in the initial task were unusually and not all of the unknown words were used unusually. But rather than re-examining these issues, the present analysis will focus on the unusual uses performance of the LH group, which manifested transfer in unusual uses production. Specifically two

issues will be addressed. One, was the transfer in unusual uses production in the LH group predominately among the known words or the unknown words? Secondly, since the unusual uses produced in the low-frequency condition on the initial task were predominately in the form of names and dialects, were there more names and dialects than unusual senses on the transfer task for the LH group?

It was previously reported that when the LH and HH groups were compared, significantly more unusual uses were produced in the LH group, F (1,38) = 5.266, $p < .05$. When the unusual uses derived from the known words in the LH and HH groups were compared, significantly more unusual uses were produced in the LH group, F (1,38) = 4.828, $p < .05$, but when the unusual uses from the unknown words were compared, F (1,38) = 1.00, there was not a significant effect. These results show the difference in unusual uses production on the transfer task was predominately among the known words.

It was previously reported that when the LH and LL groups were compared, there was no significant difference in unusual uses performance, F (1,38) = 2.116. When the unusual uses derived from the known words in the LH and LL groups were compared, F (1,38) = 2.74, there were more unusual uses in the LH group but the difference was not significant. When the unusual uses derived from the

unknown words in the two groups were compared, there were significantly more unusual uses in the LL group, F (1,38) = 17.136, $p < .001$. The unusual uses in the transfer task were generated primarily from the known words. There were more known unusual uses in the LH group than in the HH group, and there were sufficiently more known unusual uses in the LH group than in the LL group to offset the fact that there were more unknown unusual uses in the LL group than in the LH group.

The next question of interest concerns the nature of the unusual uses produced in the transfer group. While the unusual uses in the LH group were primarily names and dialects in the initial task, in the transfer task there was little difference in the number of unusual uses categorized as names or as unusual senses for both the known and unknown words. Among the known words, 15 were used as names and 18 were used as unusual senses and among the unknown words, one was used as a name while none were used as unusual senses. This is very similar to the results obtained with the high-frequency words on the initial task.

CHAPTER V

GENERAL DISCUSSION

Experiment 1

Experiment 1 confirmed the strong impact of stimulus properties on productive thinking with the sentence problem. The study provided the initial evidence demonstrating the effects of word frequency and problem size on the generation of unusual uses and the construction of original sentences. The first word frequency effect found more unusual senses of low-frequency words than high-frequency words. A similar finding has been reported by other investigators using free association tasks (Cofer and Shevitz, 1952; Mednick, Mednick, and Jung, 1964; Piers and Kirchner, 1971).

The hypothesized explanation accounting for this word frequency effect on each of these tasks, and others, involves the notion of response availability. Simply stated, high-frequency words elicit more responses than low-frequency words. The common or typical responses are elicited first, while the uncommon or atypical responses are elicited later in the production sequence. Since high-frequency words elicit more responses and since the initial responses are usually common, more

responses must be considered to arrive at the unusual senses or uses of a word. As a result there are fewer unusual uses or senses generated when high-frequency words are employed.

The generality of the above effect over a variety of tasks is interesting. But is there any real value in generating unusual uses on either a free association task, the sentence problem, or say, Guilford's tasks? One of the criteria that can be employed when answering this proposition with respect to the sentence problem is to examine a second index of creativity, originality, which considers the meaning of the sentence as a whole.

As expected, when comparing high- and low-frequency conditions, originality was better in the high-frequency condition. But within both the high- and low-frequency conditions there was a strong positive relationship between originality and the production of unusual uses in several of the groups. The question becomes, if there were more unusual uses produced in the low-frequency conditions, why weren't originality scores also higher in these conditions?

The following explanation is offered for the above question. If an unusual use is generated in a sentence in the low-frequency condition, the originality rating is typically higher than when no unusual uses are generated. In these sentences, however, the provided words are not

typically integrated such that the sentence can be judged original. For example, if one or all of the provided words is used unusually but the sentence expresses a trivial fact or thought, the originality rating remains low relative to the range of possible scores, e.g., 4 compared to 7. This rating might be considered high relative to other sentences which do not employ unusual uses and which are comprised of low-frequency words, e.g., 4 compared to 3. As another example, if one of the words is used unusually but some of the other provided words are inappropriately used, ratings of originality would remain relatively low. Sentences of this nature are rated low in originality relative to the possible range of originality scores, but high relative to other sentences not employing unusual uses and constructed of low-frequency words.

Originality ratings in the high-frequency condition were also higher for sentences containing unusual uses than for those which lacked them. Unlike the sentences in the low-frequency condition, when a sentence in the high-frequency condition contained an unusual use, there were fewer negative features of the sentence to reduce the originality rating. The words in these sentences were better integrated and there were fewer inappropriate word uses. This resulted in higher mean originality ratings even though the mean unusual uses ratings were lower.

To summarize, there is a value in generating unusual uses in the sentence problem because their presence can enhance originality scores. There is a positive correlation in both the high- and low-frequency conditions between originality and unusual uses production. Unusual uses are more likely to be produced with low-frequency words for the reasons previously stated. But to receive a high rating for originality, once an unusual use is generated it must be related to the other material in a meaningful way. This is most easily accomplished when that material is meaningful or familiar to the individual.

These results support the speculations of other researchers who have hypothesized that a knowledge of a field is necessary to permit originality in that field (Ray, 1962; Mednick, 1962). To these investigators originality consists of a recombination of elements into new patterns which either meet specified requirements or are in some way useful. The more mutually remote the elements, the more creative the solution. Relating this to the sentence problem, a minimum requirement for the generation of original solutions was a knowledge of the meaning of most of the provided words or elements. It was possible to generate an unusual use of a word which was low in meaning, but to be successful, it had to be related to the other elements and this was most easily accomplished when those elements were meaningful or familiar.

While these investigators feel that originality is predicated upon a knowledge of a field, an expert in that field is often thought to be the least able to create new ideas. This is because the expert's ideas are hypothesized to be firmly fixed into a system so that they are unavailable for use in new combinations. Such individuals are likely to have solved problems with given materials in a certain manner and are less likely to attain a creative solution with these materials. Relating this to the sentence problem, it was much more difficult with the highly meaningful words to arrive at unusual senses or novel meanings. Because of past experience, these words have typically been used in rather common ways and it was much more difficult to break away from this experience and employ the words as names of persons, places, things, or as other unusual but appropriate senses. A knowledge of a field and flexible thinking within that field are important for originality to occur.

Experiment 1 did not provide any support for the hypothesized effects of problem size on any of the dependent measures. As problem size was increased, there was an increase in the number of unusual uses generated and a decrease in originality, but neither effect reached significance. If the sample size were sufficiently increased or if there had been a greater

range in problem size, the effects of this variable might have reached significance. But the magnitude of the effect of this variable was very small. Apparently the verbal skills of the college sample were sufficient to integrate four words into original sentences about as well as two words or three words. A very different situation occurred with the sixth-grade sample that possessed less developed verbal skills. Their case will be considered shortly.

The first experiment has at least two other implications. First, if one desires to compare the findings of future research which employs the sentence problem, it would be advantageous to standardize the problem's size. Past research (Johnson and Kidder, 1972; Kidder, 1972) has generally used three words per problem, which was an intermediate level of difficulty in the first experiment.

The results of the first experiment also have implications for the use of the sentence problem in assessing originality in the classroom. Within this context, the words supplied in the task are typically key vocabulary words related to a topic of study. The task is to combine the words in a sentence which expresses an original or clever idea. That originality is most readily demonstrated when the supplied words are meaningful or familiar rather than when they are low in

meaning should seem important to most educators. A knowledge of the material is necessary to permit original thinking with the material. A possible exception to this would be the use of a supplied word as a name or dialect when the word's meaning was unknown. Depending upon the goals of the instructor, this could be eliminated by revising the unusual uses criteria to exclude this category of unusual use. This would also have to be mentioned in the instructions to the students. With the sentence problem, one has an assessment device that can be structured to any topic of study, that is easily and reliably scored, that requires a knowledge of the material to perform well, and that measures productive thinking rather than mere regurgitation. The sentence problem is much more suitable for assessing originality in the classroom than some of the other productive thinking tasks.

Experiment 2

Experiment 2, like Experiment 1, found that stimulus properties produce a strong effect on productive thinking with the sentence problem. A major difference between Experiments 1 and 2 was in the nature of the subjects used. The subjects in Experiment 2 were sixth-grade students compared to the college students in Experiment 1. The sixth-grade students were assumed to possess verbal

skills less developed than those possessed by the college students. This was expected to enhance the hypothesized effects of the problem size variable. The effects of the word frequency variable found in the first experiment were hypothesized to remain the same. Other important differences between the two studies included a change in the low-frequency level so that it was more suitable for the sixth-grade sample, a reduction in the number of levels of problem size, a slight modification in the instructions, and a change in one of the raters.

Some of the word frequency effects were replicated in the second study, and the hypothesized effects of problem size on the generation of unusual uses and originality were confirmed. Unlike the first experiment, in the second experiment there was no significant difference in the generation of unusual uses between the high- and low-frequency conditions. The difference between the high- and low-frequency words may have been too small. As in the first experiment, the high-frequency words had a Thorndike-Lorge value of AA, but the low-frequency words were changed and a had Thorndike-Lorge values ranging from one to nine. As a result there may have been no difference in the associative hierarchies between the high- and low-frequency words.

The above interpretation is not supported by the results from the originality measure, however, because

originality was significantly better in the high-frequency condition. There were more meanings or associations attached to the high-frequency words than to the low-frequency words and this greatly facilitated the production of original sentences. However, the difference in the number of meanings or associations was insufficient to affect the generation of unusual uses between the two conditions. It is also possible that most of the few associations that existed for both the high- and low-frequency words were common or usual senses of the words. This interpretation suggests that although the high-frequency words had a greater response availability, there was not a significant difference in the number of responses that had to be considered in order to arrive at unusual uses or senses of a word. This may have been a function of the stimulus materials (levels of word frequency were too close), or of the verbal characteristics of the sample (storage of only a few common meanings or senses of each word), or both.

Two important features regarding the effects of word frequency were replicated in Experiment 2. First, some value was indicated in the use of the provided words in unusual ways. Within two of the four groups there was a significant positive correlation between originality and unusual uses production. Originality in the sentence problem was enhanced by using the provided

words in unusual ways, providing the words were integrated into meaningful sentences. Second, originality was more likely to be attained when the material was meaningful or familiar. Significantly more original sentences were produced when high-frequency words were being utilized than when low-frequency words were being utilized. These results support many of the hypotheses and interpretations regarding the effects of word frequency found in Experiment 1. Not only were many of the effects replicated, but they were replicated with a much younger sample and with different levels of word frequency.

In the second experiment, as expected, the effects of problem size were enhanced. An increase in the size of the sentence problem from two to three words significantly impaired the originality of the sentences produced. An increase in problem difficulty corresponding to an increase in problem size has been demonstrated by other investigators on a variety of other tasks (Neimark and Wagner, 1964; Kaplan and Carvellas, 1968; Solley and Snyder, 1958). This represents the first experiment, however, that has demonstrated the hypothesized effects of problem size on a productive thinking task.

The impairment in originality produced by increasing the number of provided words in the sentence problem is interpreted to result from the increased difficulty involved in the integration of the increase in material

and the context that is produced by such an increase. As the number of provided words is increased, the task of writing a sentence that relates each of the provided words becomes more difficult. The task of writing a sentence that relates the provided words in an original, witty, or humorous manner becomes considerably more difficult. This was especially true for the sixth-grade students who are assumed to be in the process of developing their verbal skills.

Another interpretation for the reduction in originality corresponding to the increase in problem size focuses on the context that is produced by increasing the number of provided words in the sentence problem. Consider the following example. Suppose you are asked to write an original sentence using the words, bank and graph. It is assumed that one of the first steps a S performs in the above task is to find a relationship between the provided words. This would, in part, be determined by the context created by the words. The context created by the words graph and bank would probably result in a sentence that relates a bank, in the sense of a building where money is kept, and a graph, in the sense of a plot of points forming a line or lines. The more original subjects are assumed to find relationships between the more remote meanings of the words. For example, they may use bank, in the sense of a rebound, or

in the sense of relying on something, or as the side of a river. Graph may be used by these individuals in the sense of a skin transplant, or as the name of a person, place, thing, or as a dialect. A number of sentences are assumed to be implicitly generated which relate the words in different ways until a sentence is produced that closely matches the subject's concept of what is original. The closeness of the match depends on a variety of factors, including time for completion, the subject's concept of originality, etc.

In the latter interpretation, context is assumed to play a major role in the initial relationship that is formed between the provided words. As the number of words is increased, the context is assumed to become more firmly established and the direction the sentence will take becomes more fixed. In the above example, the addition of a single word, money, would provide another limitation in the direction of the sentence to be produced. The context produced by the words bank, graph, and money should limit the direction of the sentences to be produced more than the context produced by the words bank and graph. More research is suggested to empirically evaluate this interpretation. It would be interesting to determine if this effect is demonstrated over a wide range of words that are related to varying degrees.

What does the latter interpretation imply with regard to the generation of unusual uses and problem size? While at first glance it might appear that a context would inhibit the generation of unusual uses, this would not always be true. Within the context that is created by the provided words, some of the words could be used in unusual ways. Or an unusual use of a word might be suggested by a context. Without the context, the unusual use might not have been considered. And finally, if a provided word does not fit into a context created by two or three other words, it could be used as a name or dialect, or in some other unusual way. This would be more likely to occur if there were many provided words.

In Experiment 2, an increase in the size of the sentence problem from two to three words significantly increased the use of the unusual uses of the provided words. This effect seemed somewhat counterintuitive in the sense that an increase in problem size resulted in an apparent decline in problem difficulty for this dependent measure. But past research with the sentence problem has suggested that the production of unusual uses in this task may be facilitated when the task becomes more difficult. Using the provided words in unusual ways allows one to break away from the context created by the surrounding words and reduces the limitations in the manner in which the words can be integrated.

A relevant question becomes, as problem size was increased, why was there an increase in the generation of unusual uses in Experiment 2 but not in Experiment 1? Problem size is thought to directly affect the generation of unusual uses by affecting the difficulty involved in the integration of the provided words, through the generation of context effects, or by increasing the chance use of a word in an unusual way. Context effects may result in increases or decreases in the generation of unusual uses as was argued a short time before. But difficulties arising from the integration of a relatively large number of words are thought to increase the generation of unusual uses. Although the chance generation of unusual uses associated with increases in problem size may be important, it is the latter factor, difficulties in integration, that is thought to be largely responsible for the increase in unusual uses production in Experiment 2. The college sample in Experiment 1 was able to integrate four words into an original sentence about as well as two words or three words. The sixth-grade sample, on the other hand, found it much more difficult to integrate three words into an original sentence than two words. This was assumed to result from their less developed verbal skills.

In the second experiment, it is felt that more unusual uses were employed in the three word condition

in order to make the problem of integrating the material simpler. For example, by using a provided word in an unusual way such as the name of a person, Jack Graph, one of the originality criteria is satisfied and problem size is effectively reduced by one word.

One might ask why originality was lower in the three word condition if there were more unusual uses produced in this condition. The explanation is analogous to the one offered with regard to a similar finding concerning a word frequency effect found in Experiment 1. Within both the two and three word conditions, there was a strong positive correlation between originality and unusual uses production. Within both of these conditions originality scores were typically higher when unusual uses were employed than when they were not employed. The originality ratings of the sentences employing unusual uses in the three word condition were low, however, relative to the range of possible scores because the words in these sentences were not integrated very well. While generating unusual uses facilitated the integration of the increased number of words, it remained easier to integrate two words into an original sentence rather than three words (for this sample). The originality ratings of the sentences employing unusual uses in the two word condition were relatively high because these words were integrated together quite well.

The results of the second experiment suggest that future use of the sentence problem with subjects of this age would do well to limit the size of the problem to two words. The integration of a greater number of words with this population is much more difficult. Standardizing the size of the sentence problem has the additional advantage of enhancing the comparability of any future research which employs this task.

The intent of the first two studies was not to examine the developmental course of productive thinking. Such an analysis would have been invalid because of differences in materials (word frequency and problem size), in procedure, and in raters. But the use of the sentence problem to examine the developmental trends in productive thinking would appear to be very promising. There were marked individual differences in originality with both the college and sixth-grade samples. A number of interesting research questions are suggested. For example, is there any correlation in creative performance between one age level and another? Would originality as assessed by the sentence problem show the same discontinuities in creative growth as has been indicated by longitudinal research using different tasks (Torrance, 1963; Torrance, 1963; Cunnington and Torrance, 1965; Khatena, 1972)? How does this measure of creativity compare to the Sounds and Images Test used by Khatena (1972) or to

Torrance's Test of Creative Thinking (1963)? Some of the tasks employed to examine the course of creative development are nonverbal. Although the results at present are equivocal, there is some indication that verbal and nonverbal creativity are largely independent (Mednick, 1962; Torrance and Gowan, 1963). The sentence problem would be a good instrument to assess the developmental trends in verbal creativity over a wide age range.

Experiment 3, Initial Task

The Word Frequency Effects

Relevant to a discussion of the first and second experiments are many of the results from the initial task of Experiment 3. It will be remembered that the third experiment was designed to assess the nature and extent of transfer in originality and unusual uses production on the sentence problem when changing from one level of word frequency to another. Problem size remained constant and the word frequency levels were the same as those used in Experiment 1. There were four groups, two groups received an initial task using problems with high-frequency words (HH,HL), and two groups received an initial task using problems with low-frequency words (LL,LH). The effect of word frequency on originality scores found in Experiment 2, and the effects of word

frequency on both originality and unusual uses production found in Experiment 1 were replicated. As expected, originality was significantly better in the high-frequency conditions, while the production of unusual uses was significantly better in the low-frequency conditions.

Known vs Unknown Words

A second emphasis of the third experiment was to determine the number of known and unknown words in each of the high- and low-frequency conditions and to examine how this may have influenced the originality and unusual uses results. In the conbined low-frequency conditions (LL,LH), and in the combined high-frequency conditions (HH,HL), the mean number of undefined words in the initial task was 6.525 and 0.625, respectively. There were significantly more undefined words in the low-frequency conditions. Since there were five problems per task, the mean number of undefined words per problem was 1.305 and 0.125, respectively.

Implications for originality performance. Whenever one employs low-frequency words in any kind of experiment there exists the possibility that some of the words will not be known. The level of low-frequency words employed on the sentence problem in the first and third experiments was the same as that used by Mayzner and Tresselt (1958) in their anagram study. If their subjects were at all

similar to those employed in the present experiments, some of the solution words were probably unknown to their subjects, and it is doubtful that unknown words could be produced or recognized as solutions to anagrams. Future anagram research should take this into consideration.

In the present research, although it was found that on the average one of the three low-frequency words per sentence problem was unknown, it is important to note that the production of an original solution to these problems was possible. While the production of original solutions was possible, it was seldom achieved, however. The third experiment found that rather than employing the unknown low-frequency words appropriately as unusual uses, they were typically employed inappropriately, which partly explains the poor performance for the sentence problems employing these words.

While the low-frequency level selected in the first and third experiments represented a rather extreme position on the word frequency continuum, word association theory was still applicable in predicting originality performance. Originality was expected to decrease as the meaningfulness of the words (as indicated by word frequency) decreased, even when the words had relatively little meaning. It is possible to change the level of low-frequency words employed in the sentence problem so that all of the words are known, and then compare originality performance with sentence

problems employing high-frequency words. This is what essentially occurred in the second experiment. While no vocabulary test was administered in the second experiment, based on the fact that nearly all of the words were used appropriately, it is assumed that nearly all of the words were known. And in this experiment, word frequency significantly influenced originality. The results of the third experiment do not diminish the importance or significance of the findings and implications regarding the effects of word frequency on originality as discussed earlier. The consistency of the word frequency effect on originality performance over a wide range of levels and differences in population indicates the stability of the effect of this variable.

Implication for unusual uses performance. One of the more important things coming out of the third experiment was the development of a procedure for examining the word frequency effect for both known and unknown words. As expected, the initial analysis found more unusual uses were generated on sentence problems employing low-frequency words than on problems employing high-frequency words. When the unknown words in the high- and low-frequency conditions were compared, there were significantly more unusual uses produced with the low-frequency words. The significant difference in unknown unusual uses resulted from the relative absence of unknown

words in the high-frequency condition. When the known words in the high- and low-frequency conditions were compared, there were more unusual uses produced with known low-frequency words, but the difference was not significant. If the sample size were sufficiently increased the difference in the number of known words used unusually between the high- and low-frequency conditions probably would reach significance, but the results suggest the magnitude of the word frequency effect was much less among known words than unknown words. This interpretation is supported by the results of Experiment 2, which also found no significant difference in unusual uses production between the high- and low-frequency conditions. As was previously mentioned, while no vocabulary test was administered in the second experiment, most of the words were interpreted to be known since they were, in general, used appropriately.

Presenting the initial problem, following it with a vocabulary test, separating the known and unknown words, and employing separate analyses among known and unknown words for word frequency effects can also be employed with other tasks and is suggested when manipulating word frequency levels in future research. It is possible that the magnitude of the word frequency effect will be reduced on other tasks, as well as on the sentence task, when the subject's knowledge of the words is taken into consideration.

With sentence problem research, an interesting variation in this procedure would be to provide a list of common and uncommon definitions prior to the presentation of the actual problem and determine how this manipulation would affect originality and unusual uses performance. The more remote definitions might enhance originality and unusual uses performance, or it might have no effect. Past research has shown that passive procedures such as this have not been very effective in facilitating originality (Maltzman, Berger, and Bogartz, 1958). More research is suggested.

The nature of unusual uses among known and unknown words. With the low-frequency words, nearly all of the known and unknown words employed as unusual uses were names or dialects. This contrasted sharply with the high-frequency words where roughly half of the unusual uses were names and dialects while the other half were alternative meanings or senses of the words. These results support the notion of response availability advanced earlier. A hierarchy of word uses ranging from typical meanings or senses, to unusual meanings, to unusual or clever uses as names or dialects is suggested. For example, in the case of known low-frequency words, single meanings or senses of the words may be all that is available for use. These single meanings or senses could be used, but it would be difficult to use unusual

senses of these words because none is available. If words like this are to be used in unusual ways, their use as names or dialects may be the only alternative. In the case of unknown words of high- or low-frequency where there is a relative absence of meaning, their use as names or dialects would be the only appropriate sense available. In the case of known high-frequency words, the full range of possibilities exists. There might be several typical meanings, a few unusual senses, and finally, these words could be used as names or dialects. It was hypothesized that high-frequency words elicit more responses and since the initial responses are typically common, more responses must be cut through to arrive at the unusual senses of these words. As a result, fewer unusual uses are generated when high-frequency words are employed in the sentence problem.

Experiment 3, Transfer Task

Originality

On the transfer task, as expected, originality in the HH group was significantly better than in the LL group. In the HH group, originality scores increased somewhat from the initial task, but the increase was not significant. In the LL group there was a significant decrement in originality performance on the transfer task. The slight gain in originality performance in the

HH group and the decrement in performance in the LL group may be attributed to a number of factors. For example, the first and second tasks may have differed in difficulty. The second high-frequency task may have been easier than the first and the second low-frequency task may have been more difficult than the first. The difference could also be attributed to the experience provided by generating sentences in either of these conditions. To adequately determine which of these factors was operating it would have been necessary to employ a counterbalanced design which would include two additional groups: along with the H_1H_2 group and the L_1L_2 group, a H_2H_1 group and a L_2L_1 group would have to be used which reversed the order in which the first and second tasks were administered. The HH group and the LL group do provide an adequate control, however, for an analysis of the transfer effects hypothesized when changing from one level of word frequency to another.

As expected, originality scores in the HL group decreased from the first task to the second task but the decrement was too large to support the transfer hypothesis. In the transfer task, the performance of the HL group was significantly less than that of the HH group, and was not significantly different from that of the LL group. This does not mean there was a lack of transfer, but it does indicate that the impact of the low-frequency task

was far more important for originality performance than the influence of the preceding task.

The hypothesized transfer effects regarding originality in the sentence problem may be enhanced through a number of procedural changes. First, the number of problems in the initial high-frequency task could be increased. Originality scores should increase with an increase in practice. And second, the difficulty level of the low-frequency words in the transfer task could be changed. In the third experiment, the words were very low in word frequency and this may have masked any transfer in originality, if any, that was produced.

Originality in the LH group, as expected, improved in the second task. This was hypothesized to occur because originality in the sentence problem is typically higher when using high-frequency words. But the improvement was somewhat greater than expected. The originality performance of the LH group was better than that of the HH group, although not significantly better. The initial hypothesis failed to take into consideration the benefit to originality that would be produced if the transfer in unusual uses production occurred. Such an effect did occur, as will be discussed, and this enhanced originality in the sentence problem to a greater extent than continued exposure to the high-frequency condition.

Unusual Uses

In both the HH group and the LL group, there was no significant difference in the generation of unusual uses between the initial and transfer tasks. And as expected, the LL group produced significantly more unusual uses than the HH group in the transfer task. Unusual uses performance in the HL group improved from Task 1 to Task 2; the HL group produced as many unusual uses with the low-frequency problems as the group that worked continuously with the low-frequency problems. The HL group was not significantly different from the LL group in unusual uses production and this was attributed to the strong effect produced by the low-frequency words in the transfer task.

Initial exposure to the sentence problems employing low-frequency words affected subsequent performance on sentence problems employing high-frequency words. The number of unusual uses generated in the LH group declined somewhat from Task 1 to Task 2, but the decline was insignificant. In both the initial and transfer tasks, the number of unusual uses generated in the LH group was not significantly different from the number produced in the LL group. The number of unusual uses generated in the transfer task by the LH group was significantly greater than the number generated by the HH group. These

results provide strong support for a transfer effect in the generation of unusual uses.

Subsequent analyses on the LH group provided some rather interesting insights into (1) the role of known and unknown words in unusual uses production and (2) the nature of the unusual uses produced by the LH group. The unusual uses generated in the transfer task by the LH group were primarily from known words since there were relatively few unknown words. There were more known words used unusually in the LH group than in the HH group, and there sufficiently more known words used unusually in the LH group than in the LL group to offset the fact that there were significantly more unknown words used unusually in the LL group than in the LH group.

While the unusual uses in the LH group were primarily names and dialects in the initial task, in the transfer task there was little difference in the number of unusual uses categorized as names or as unusual senses for both the known and unknown words. In the LH group approximately half of the unusual uses employed in the transfer task were different meanings or senses of the provided words. The remainder of the unusual uses were names and dialects. This was very similar to the results obtained with the high-frequency words in the initial task. Not only were there significantly more unusual uses produced in the LH group, but the transfer in unusual uses production also had a generalized effect.

The finding of a transfer effect in unusual uses production on the sentence problem is interesting and significant. It suggests that a strategy of generating unusual uses may be induced by providing words on the sentence problem that are relatively low in word frequency or meaning. As was shown, the meaning of some of the low-frequency words was unknown, and the meaning of many of the other low-frequency words may have been minimal. This may have facilitated the development of the strategy since the only appropriate use of the unknown words would be as unusual uses. Using the words in unusual ways could promote a tendency within the subjects to be more flexible and to consider more of the alternative meanings of the provided words when solving the sentence problem. When the material in the sentence problem was low in meaning, the strategy did not significantly benefit originality performance. But when problems were introduced that employed more meaningful material, the originality performance of the individuals exposed to the initial low-frequency problems was as good or better than the performance of the individuals who worked continuously with the more meaningful problems. The former individuals considered more of the alternative meanings or sense of the provided words and because the material was meaningful, were better able to integrate

the words into original sentences that were often witty, clever, and humorous.

One of the implications of the transfer results is that tasks such as Guilford's Unusual Uses Test (1956) or the Free Association Test of Maltzman et al. (1958) may not be as trivial as they were once thought to be. Generating unusual uses or remote associations can be very beneficial when integrating material in an original way. The value of generating unusual uses goes beyond the simple act of generating the unusual use. Unusual uses of objects or associations to words can be employed in much more original ways than common uses or associates. Procedures which facilitate unusual uses performance on these tasks through the use of criteria-cued instructions, feedback, hints, etc., might enhance originality and unusual uses performance on the sentence problem. Similarly, experience on the sentence problem using low-frequency words might result in facilitated performance in the unusual uses task or the free association tasks. More research is needed to evaluate these possibilities.

The emphasis of the procedure employed in the third experiment was on facilitating flexibility. When solving the sentence problem, if a number of meanings or senses for each of the provided words were considered, it was hypothesized that more original solutions would be produced. The flexibility in considering alternative

word meanings was hypothesized to further enhance the flexibility with which the words could then be integrated into a sentence. The procedure employed in the third experiment was specific to promoting flexible word use and on tasks requiring flexible word use, there should be some degree of transfer. When solving problems whose solutions depend upon a knowledge of rules, principles, or relationships between variables, etc., the above procedure would probably have no effect on original problem solving. But any technique which can be designed to facilitate some degree of flexible thinking on such problems, should enhance original problem solving with those tasks. Hopefully, the present series of experiments has provided some insight into the conditions and processes that influence productive thinking not only with the sentence problem but with other problems as well. There is a clear need, however, for more empirical research on divergent problem solving.

BIBLIOGRAPHY

BIBLIOGRAPHY

Brainard, R., Irby, T., Fitts, P., and Alluisi, E. Some variables influencing the rate of gain of information. Journal of Experimental Psychology, 1962, 63, 105-110.

Cofer, C. and Shevitz, R. Word association as a function of word frequency. American Journal of Psychology, 1952, 65, 75-79.

Davidson, M. Positive versus negative instances in concept identification problems matched for logical complexity of solution procedures. Journal of Experimental Psychology, 1969, 80, 369-373.

Dominowski, R. Anagram solving as a function of bigram rank and word frequency. Proceedings of the 73rd annual convention of the American Psychological Association. Washington, D.C.: American Psychological Association, 1965, 87-88.

Dominowski, R. Concept attainment as a function of instance contiguity and number of irrelevant dimensions. Journal of Experimental Psychology, 1969, 82, 573-574.

Erlebacher, A. Parameters of Anagram Tasks. Doctoral dissertation, University of Wisconsin, 1962.

Guilford, J. The structure of intellect. Psychological Bulletin, 1956, 53, 267-293.

Hayes, J. R. Problem topology and the solution process. Journal of Verbal Learning and Verbal Behavior, 1965, 4, 371-379.

Hick, W. On the rate of gain of information. Quarterly Journal of Experimental Psychology, 1952, 4, 11-26.

Hyman, R. Stimulus information as a determinant of reaction time. Journal of Experimental Psychology, 1953, 45, 188-196.

Johnson, D. and Kidder, R. Productive thinking in psychology classes. American Psychologist, 1972, 27, 672-674.

Johnson, D., Parrott, G., and Stratton, R. Production and judgment of solutions to five problems. Journal of Educational Psychology, 1968, 59, Monograph Supplement No. 6.

Johnson, T. and Van Mondfrans, A. Order of solutions in ambiguous anagrams as a function of word frequency of the solution words. Psychonomic Science, 1965, 3, 565-566.

Kaplan, L., and Carvellas, T. Effect of word length on anagram solution time. Journal of Verbal Learning and Verbal Behavior, 1968, 7, 201-206.

Keele, S. and Archer, E. A comparison of two types of information in concept identification. Journal

of Verbal Learning and Verbal Behavior, 1967, 6, 185-192.

Khatena, J. Developmental patterns in production by children aged 9 to 19 of original verbal images as measured by sounds and images. Psychological Reports, 1972, 30, 649-50.

Kidder, R. Training, Assessment, and Transfer of Productive Thinking. Master's Thesis, Michigan State University, 1972.

Lepley, W. A hypothesis concerning the generation and use of synonyms. Journal of Experimental Psychology, 1950, 40, 527-530.

Maltzman, I., Bogartz, W., and Breger, L. A procedure for increasing word association originality and its transfer effects. Journal of Experimental Psychology, 1958, 56, 399-406.

Mayzner, M. and Tresselt, M. Anagram solution times: a function of letter order and word frequency. Journal of Experimental Psychology, 1958, 56, 376-379.

Mednick, S. The associative basis of the creative process. Psychological Review, 1962, 69, 220-232.

Mednick, M., Mednick, S., and Jung, C. Continual association of level of creativity and type of verbal stimulus. Journal of Abnormal and Social Psychology, 1964, 69, 511-515.

Neimark, E. and Wagner, H. Information gathering in diagnostic problem solving as a function of number of alternative solutions. Psychonomic Science, 1964, 1, 329-330.

Piers, E. and Kirchner, E. Productivity and uniqueness in continued word association as a function of subject creativity and stimulus properties. Journal of Personality, 1971, 39, 264-276.

Ray, W. The Experimental Psychology of Original Thinking. New York, New York: The Macmillan Company, 1967.

Ronning, R. Anagram solution times: a function of the "rule-out" factor. Journal of Experimental Psychology, 1965, 69, 35-39.

Solley, C. and Snyder, F. Information processing and problem solving. Journal of Experimental Psychology, 1958, 55, 384-387.

Stratton, R. Response Hierarchies in Productive Thinking. Doctoral Dissertation, Michigan State University, 1970.

Stratton, R., Parrott, G., and Johnson, D. Transfer of judgment training to production and judgment of solutions on a verbal problem. Journal of Educational Psychology, 1970, 61, 16-23.

Taylor, C. and Holland, J. Predictors of creative performance. In C. W. Taylor, Creativity: Progress and Potential. New York: McGraw-Hill, 1964.

Thornkide, E. On the frequency of semantic changes in modern English. Journal of General Psychology, 1948, 39, 23-27.

Thornkide, E. and Lorge, I. The Teacher's Wordbook of 30,000 Words. New York: Columbia University Press, 1956.

Torrance, E. and Gowan, J. The Reliability of the Minnesota tests of creative thinking. (Research Memorandum BER-63-4.) Minneapolis: Bureau of Educational Research, University of Minnesota, 1963.

Underwood, B. and Schultz, R. Meaningfulness and Verbal Learning. Philadelphia: Lippincott, 1960.

Wallach, M. Creativity. In P. H. Mussen, Carmichael's Manual of Child Psychology, 3rd Edition. Wiley, 1970.

Zipf, G. The meaning-frequency relationship of words. Journal of General Psychology, 1945, 33, 251-256.

APPENDICES

APPENDIX A

PRODUCTIVE THINKING FORMS FOR EXPERIMENT 1

APPENDIX A

Name _____

Sex _____

Productive Thinking Experiment
Form A

1. Write an imaginative sentence that includes the following words:

hand wind

2. Write an imaginative sentence that includes the following words:

part reason

3. Write an imaginative sentence that includes the following words:

face state

4. Write an imaginative sentence that includes the following words:

letter watch

5. Write an imaginative sentence that includes the following words:

present answer

Name _____

Sex M F

Productive Thinking Experiment
Form B

1. Write an imaginative sentence that includes the following words:

age cover force

2. Write an imaginative sentence that includes the following words:

fine work mark

3. Write an imaginative sentence that includes the following words:

name sound will

4. Write an imaginative sentence that includes the following words:

hope power water

5. Write an imaginative sentence that includes the following words:

wish pass talk

Name _____

Sex M F

Productive Thinking Experiment
Form C

1. Write an imaginative sentence that includes the following words:

turn cry bank plant

2. Write an imaginative sentence that includes the following words:

arm color supply play

3. Write an imaginative sentence that includes the following words:

point note laugh walk

4. Write an imaginative sentence that includes the following words:

figure cut line ship

5. Write an imaginative sentence that includes the following words:

question call dress fight

Name _____

Sex M F

Productive Thinking Experiment
Form D

1. Write an imaginative sentence that includes the following words:

biff grout

2. Write an imaginative sentence that includes the following words:

kern riffle

3. Write an imaginative sentence that includes the following words:

hone moil

4. Write an imaginative sentence that includes the following words:

dray fleer

5. Write an imaginative sentence that includes the following words:

blear rede

Name _____

Sex M F

Productive Thinking Experiment
Form E

1. Write an imaginative sentence that includes the following words:

snigger tweak hackle

2. Write an imaginative sentence that includes the following words:

tweadle withe palaver

3. Write an imaginative sentence that includes the following words:

chine hasp mime

4. Write an imaginative sentence that includes the following words:

jounce snaffle tiffin

5. Write an imaginative sentence that includes the following words:

jape reeve sough

Name _____

Sex M F

Productive Thinking Experiment
Form F

1. Write an imaginative sentence that includes the following words:

taw spume gloze molt

2. Write an imaginative sentence that includes the following words:

swill bream flitch lasso

3. Write an imaginative sentence that includes the following words:

toggle bruit dibble haft

4. Write an imaginative sentence that includes the following words:

truckle bilge shirr inlay

5. Write an imaginative sentence that includes the following words:

spoor gyve ravel joggle

APPENDIX B

PRODUCTIVE THINKING FORMS FOR EXPERIMENT 2

Name _____

Sex M F

Productive Thinking Experiment
Form 1A

1. Write an imaginative sentence that includes the following words:

hand wind

2. Write an imaginative sentence that includes the following words:

part reason

3. Write an imaginative sentence that includes the following words:

face state

4. Write an imaginative sentence that includes the following words:

letter watch

5. Write an imaginative sentence that includes the following words:

present answer

Name _____

Sex M F

Productive Thinking Experiment
Form 1B

1. Write an imaginative sentence that includes the following words:

age cover force

2. Write an imaginative sentence that includes the following words:

fine work mark

3. Write an imaginative sentence that includes the following words:

name sound will

4. Write an imaginative sentence that includes the following words:

hope power water

5. Write an imaginative sentence that includes the following words:

wish pass talk

Name _____

Sex M F

Productive Thinking Experiment
Form 1C

1. Write an imaginative sentence that includes the following words:

abuse extract

2. Write an imaginative sentence that includes the following words:

hem peer

3. Write an imaginative sentence that includes the following words:

bridle tile

4. Write an imaginative sentence that includes the following words:

discharge shear

5. Write an imaginative sentence that includes the following words:

deposit joust

Name _____

Sex M F

Productive Thinking Experiment
Form 1D

1. Write an imaginative sentence that includes the following words:

notch peep cement

2. Write an imaginative sentence that includes the following words:

pardon lance bribe

3. Write an imaginative sentence that includes the following words:

shudder interview import

4. Write an imaginative sentence that includes the following words:

scheme toil feast

5. Write an imaginative sentence that includes the following words:

signal boast aid

APPENDIX C

PRODUCTIVE THINKING FORMS FOR EXPERIMENT 3

APPENDIX C

Name _____

Sex M F

Creative Thinking Task
Form A

1. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

   hope taw swill

2. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

   molt bream lasso

3. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

   toggle haft gyve

4. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

   dibble ravel bilge

5. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

   inlay snigger spume

Name _____

Sex M F

Creative Thinking Task
Form B

1. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

joggle spoor palaver

2. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

hackle gloze biff

3. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

withe kern riffle

4. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

hasp blear jounce

5. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

mime sough jape

Name _____

Sex M F

Creative Thinking Task
Form C

1. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

wind talk color

2. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

figure call plant

3. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

state mark dress

4. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

fight note cover

5. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

fine water cut

Name _____

Sex M F

Creative Thinking Task
Form D

1. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

watch hope pass

2. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

line play reason

3. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

present name arm

4. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

turn age ship

5. Write an imaginative sentence that includes the following words. Try to be original, witty, or humorous.

face will bank

APPENDIX D

VOCABULARY TESTS FOR EXPERIMENT 3

APPENDIX D

Name _____

Sex M F

Creative Thinking Task
Form E

Circle the alternative that is the best definition or description for each of the terms that appear on the left.

1. wind
   (a) a liquid
   (b) a ruddy complexion
   (c) a movement of air
   (d) a group of emmigrants

2. talk
   (a) to speak
   (b) slack flesh
   (c) to knock out
   (d) a pigment

3. color
   (a) a course meal
   (b) a pigment
   (c) a scream
   (d) a sediment

4. hand
   (a) front of a building
   (b) a twist or change
   (c) a vigil
   (d) a grasping organ

5. bank
   (a) a place where toys are kept
   (b) a physical or mental effort
   (c) an article of protection
   (d) a business establishment

6. figure
   (a) the shape of something
   (b) a utensil
   (c) a precipice
   (d) something forthy

7. call
   (a) to fall over
   (b) to summon
   (c) to be apprehensive
   (d) to depend

Name _____

Sex M F

8. plant
   (a) an angle formed by two straight lines
   (b) indicates flatness
   (c) an organism having cellulose walls
   (d) a rumor

9. force
   (a) an active power
   (b) a real or precise meaning
   (c) a large value
   (d) a crude cabin

10. will
   (a) to fall asleep
   (b) to predict the future
   (c) to choose or decide
   (d) to run on top of

11. state
   (a) a set of circumstances
   (b) an expression of sorrow
   (c) anything branching out from a large mass
   (d) a specific capacity

12. mark
   (a) to gain position
   (b) a preliminary trial
   (c) an igneous rock
   (d) a visible trace

13. dress
   (a) a legal right
   (b) to move in single file
   (c) to shed drops
   (d) a form of clothing

14. part
   (a) an invocation of good will
   (b) a segment of the whole
   (c) an outburst
   (d) one who gives a lease

15. face
   (a) a space for anchoring
   (b) a cluster of bananas
   (c) front of the head
   (d) a round of applause

16. fight
   (a) a sharp, pointed object
   (b) a group of birds
   (c) to make labial
   (d) to struggle

Name _____

Sex M F

17. note
(a) a circular object
(b) a breeding ground
(c) an illicit lover
(d) a memory aid

18. cover
(a) to penetrate with a sharp edge
(b) to reap
(c) to sever
(d) to conceal

19. wish
(a) to want
(b) to run rapidly
(c) to switch
(d) to dip

20. laugh
(a) to express joy
(b) to assume a previous attitude
(c) to express an ideal
(d) to remain inactive

21. fine
(a) a yellowish drying oil
(b) a rumor
(c) a superior quality
(d) the propellor of an airplane

22. water
(a) a vigil
(b) a time instrument
(c) a transparent liquid
(d) a musical symbol

23. cut
(a) to slap with a great amount of force
(b) to sever
(c) to laugh irrationally
(d) to concern yourself with the art of witchcraft

24. letter
(a) an injury
(b) a threshold
(c) a symbol representing a sound
(d) a goal

25. walk
(a) to be slow in development
(b) to advance on foot
(c) to feed
(d) to catch

Name _____

Sex M F

26. watch
(a) to guard
(b) part of an outer covering
(c) a personal note
(d) to give greeting to

27. hope
(a) to write or speak a warm greeting
(b) to ask for the impossible to be performed
(c) to understand and be considerate
(d) to wish for something

28. play
(a) to guess at wittingly
(b) to act in jest or in sport
(c) to make gestures with your face
(d) to walk in a skip

29. name
(a) an old worn out horse
(b) an old fashioned song
(c) a descriptive word
(d) to spell a word the way it sounds

30. age
(a) an aggravating letter
(b) a period of life
(c) a distinguished reputation
(d) a person of authority

31. pass
(a) to move ahead of something
(b) to run on top of
(c) to render one's services
(d) to articulate

32. reason
(a) to laugh loudly
(b) assume many responsibilities at one time
(c) to think rationally
(d) to cry with remorse

33. arm
(a) the bulge of a barrel or cask
(b) an upper limb of the body
(c) the tiny hairlike cover on insects
(d) a crack or fissure

34. ship
(a) a fall from a high place
(b) a water vessel
(c) an occupation
(d) a measuring device

Name _____

Sex M F

35. work
(a) a form of retaliation
(b) to consent
(c) to stare at
(d) a physical or mental activity

36. answer
(a) a response or a reply
(b) to laugh at
(c) an outer covering
(d) to move from one place to another

37. power
(a) slight intoxication
(b) strength capable of being exerted
(c) one who purchases unnecessary things
(d) a long story

38. supply
(a) to become better
(b) to rise and fall
(c) to provide for
(d) to keep secret

39. question
(a) the wife or widow of a tribal chief
(b) a deep mass of loose sand
(c) an interrogative sentence
(d) a type of mineral

40. cry
(a) to scream
(b) to destroy
(c) to force into something
(d) to gain favor

41. line
(a) a mold in which metal is cast
(b) something that is suspended from a ceiling
(c) a cord
(d) a person under church censure

42. present
(a) apathetic
(b) a writing implement
(c) one who argues in favor of something
(d) in attendance

43. turn
(a) to revolve
(b) to make valid
(c) to anchor
(d) to swell or sprout

Name _____

Sex M F

Task F

For each term that appears on the left, circle the alternative on the right that is the best description or definition.

1. hone
   (a) a hard stone used to sharpen things
   (b) an enclosed area
   (c) a warehouse
   (d) a noose fastened to an elastic body

2. molt
   (a) to clutch or grasp
   (b) to shed an outer covering
   (c) to melt
   (d) to spread out

3. toggle
   (a) a large pointed object
   (b) a pin or bolt used to fasten something
   (c) a source of supply
   (d) an ornament

4. dibble
   (a) a small scar
   (b) a round cap worn in the 16th century
   (c) a pointed tool used for planting seeds
   (d) a thin, flattened piece or layer

5. inlay
   (a) to rest or recline
   (b) to form an opinion
   (c) to dissappoint
   (d) to set into a surface

6. taw
   (a) to convert into leather by tanning
   (b) to disengage and lay parallel
   (c) to remove by force
   (d) to guide the studies of

7. bream
   (a) the trimmings of a dress
   (b) a fresh water fish
   (c) a type of seaweed
   (d) an act of breathing

Name _____

Sex M F

8. haft
   (a) a type of rope
   (b) a precious Chinese jewel
   (c) a religious rite
   (d) a handle of a knife

9. ravel
   (a) to excite
   (b) to laugh at discretely
   (c) to clean by applying heat
   (d) to separate threads or parts

10. snigger
   (a) to snicker
   (b) to cry or wail
   (c) a projecting nose
   (d) an edible plant

11. grout
   (a) a large animal
   (b) a small hole in the skin
   (c) a plaster for finishing surfaces
   (d) a tangled mass

12. moil
   (a) to simmer gently
   (b) to moisten or make wet
   (c) to stay away from
   (d) to confuse or mixup

13. treadle
   (a) a lever moved by the foot to move something
   (b) a small boat
   (c) a form of durable cardboard
   (d) a British official

14. snaffle
   (a) a small snake
   (b) a horse muzzle
   (c) to eat rapidly
   (d) to change shape

15. reeve
   (a) an involuntary act
   (b) to supply
   (c) to pass a rope through
   (d) to reduce to a pure state

16. joggle
   (a) a small ant-like insect
   (b) a blend of herbal tea
   (c) to draw together or cause to converge
   (d) to shake or jolt

Name _____

Sex M F

17. hackle
(a) a form of plumage
(b) a pitted fruit
(c) a large acorn
(d) the propellor of an airplane

18. withe
(a) to bend or twist
(b) to cuddle
(c) a coat or covering
(d) a small animal

19. hasp
(a) an ancient Roman farce
(b) a form of unrefined rubber
(c) a Danish pastry
(d) to grasp or take

20. mime
(a) to make known
(b) a large mouse
(c) to act out emotions
(d) an old woman

21. swill
(a) food for animals
(b) a whimsical act
(c) loud laughter
(d) a playful kiss

22. lasso
(a) a very young Irish girl
(b) a long rope
(c) a football play
(d) a narrow, thin strip of metal

23. gyve
(a) a long, braided rope sailors use
(b) a prominent and important man
(c) a shackle or fetter
(d) the place where something is commonly found

24. bilge
(a) an extreme form of malnutrition
(b) the lowest inner part of a ships hull
(c) the top of anything
(d) a fork-like instrument

25. spume
(a) the spurs of a porcupine
(b) the foam or froth of a liquid
(c) an iron club
(d) a recess in a wall

Name _____

Sex M F

26. spoor
(a) the track or trail of an animal
(b) a leather or fur pouch
(c) the tiny hairlike cover on insects
(d) a type of pollen

27. gloze
(a) to weaken the will of
(b) to move at a very slow speed
(c) to minimize or gloss
(d) to bite gently

28. kern
(a) a sharp response or reaction
(b) a light-armed foot soldier
(c) a tight curl
(d) a unit of measure

29. blear
(a) to dim with water or tears
(b) to open and close ones eyes rapidly
(c) a thin roled pancake
(d) a warning light

30. sough
(a) to plunge into a liquid
(b) to let soak until something becomes soggy
(c) to make a soft rustling sound
(d) to be defective

31. palaver
(a) loose fitting trousers
(b) an animal living in trees
(c) a flat top used to cover goldfish tanks
(d) idle chatter

32. biff
(a) to do very quickly
(b) to be very thrifty
(c) to strike or punch
(d) to disappear

33. riffle
(a) a sandbar lying just below the surface of water
(b) an enclosed raised spot resembling a blister
(c) a preparation used in bleaching
(d) a noticeable imperfection

34. jounce
(a) something giving great pleasure
(b) a masculine given name
(c) to fight with javlins
(d) to move with bumps and jolts

Name _____

Sex M F

35. jape
(a) to pierce or put a hole into
(b) to stumble over words while speaking
(c) to joke or quip
(d) to swallow large amounts of food

36. flitch
(a) a salted and cured side of bacon
(b) a lifht, quick blow
(c) to throw with a brisk motion
(d) to shut ones eyes

37. truckle
(a) a staff carried as a symbol of office
(b) a short stick carried by gangs
(c) a small roller or caster
(d) a mythical being of folklore

38. fleer
(a) to snear, scoff, or scorn
(b) to run away quickly
(c) blurry eyes caused by rain
(d) to strip the skin form a whale

39. tweak
(a) to make unusual noises with your mouth
(b) to pinch, pluck, or twist sharply
(c) a sudden sharp stab of pain
(d) an act of leaping

40. chine
(a) a chant
(b) a small piece of iron
(c) a crack or fissure
(d) a backbone or spine

41. dray
(a) a vehicle used to haul goods
(b) a drawn card used to replace a discard
(c) a means by which liquid is drained
(d) a huge serpant

42. rede
(a) to set right
(b) to go back in thought
(c) to give council or advice
(d) to do over again

43. shirr
(a) to probe a market
(b) to gather together into a decorative collection
(c) an alcoholic drink
(d) a forked stick

APPENDIX E

TABLES

APPENDIX E

Table A1

Interjudge Correlations of Originality Ratings in Experiment 1

Items	Tests					
	A	B	C	D	E	F
1	.72	.92	.86	1.00	.89	.90
2	.71	.94	.86	.89	.92	1.00
3	.80	.92	.85	.90	.87	1.00
4	.76	.89	.86	.91	.84	.89
5	.71	.75	.74	.96	.95	.88

Table A2

ANOVA Summary for Originality Scores in Experiment 1

Source	S.S.	df	M.S.	F
Word Frequency	2982.15	1	2982.15	66.24*
Problem Size	217.64	2	108.82	2.41
Interaction	105.10	2	52.55	1.16
Within	2431.30	54	45.02	
Total	5736.19	59		

*$p < .001$

Table A3

ANOVA Summary for Unusual Uses Scores in Experiment 1

Source	S.S.	df	M.S.	F
Word Frequency	8.817	1	8.817	4.845*
Problem Size	10.300	2	5.150	2.830
Interaction	5.433	2	2.717	1.493
Within	98.300	54	1.820	
Total	122.85	59		

*$p < .05$

Table A4

ANOVA Summary for Sentence Length Scores in Experiment 1

Source	S.S.	df	M.S.	F
Word Frequency	58.017	1	58.017	.056
Problem Size	1244.134	2	622.067	.601
Interaction	398.933	2	199.466	.192
Within	55875.1	54	1034.724	
Total	56999.184	59		

Table A5

Interjudge Correlations of Originality Ratings in Experiment 2

	Tests			
Items	1A	1B	1C	1C
1	.86	.95	.86	.95
2	.92	.94	.92	.90
3	.87	.87	.96	.96
4	.94	.93	.96	.96
5	.89	.94	.88	.95

Table A6

ANOVA Summary for Originality Scores in Experiment 2

Source	S.S.	df	M.S.	F
Word Frequency	1314.72	1	1314.72	19.35*
Problem Size	654.72	1	654.72	9.63*
Interaction	1.78	1	1.78	.02
Within	4347.06	64	67.92	
Total	6318.28	67		

*$p < .001$

Table A7

ANOVA Summary for Unusual Uses Scores in Experiment 2

Source	S.S.	df	M.S.	F
Word Frequency	.941	1	.941	1.515
Problem Size	4.764	1	4.764	7.671*
Interaction	.059	1	.059	.059
Within	39.765	64	.621	
Total	45.529	67		

*$p < .05$

Table A8

ANOVA Summary for Sentence Length Scores in Experiment 2

Source	S.S.	df	M.S.	F
Word Frequency	882.721	1	882.721	1.594
Problem Size	144.133	1	144.133	.26
Interaction	27.19	1	27.19	.049
Within	35426.942	64	553.545	
Total	36480.986	67		

Table A9

Interjudge Correlations of Originality Ratings in Experiment 3

	Task 1		Task 2	
Items	Test A	Test D	Test B	Test C
1	.90	.78	.81	.88
2	.91	.84	.77	.87
3	.58	.87	.88	.92
4	.92	.80	.88	.91
5	.88	.87	.84	.83

Table A10

Proportion of Known and Unknown Unusual Uses in Tasks 1 and 2 of Experiment 3

	Unusual Uses in Task 1		Unusual Uses in Task 2	
Group	Known	Unknown	Known	Unknown
LL	.113	.179	.147	.208
LH	.135	.151	.118	.050
HL	.047	.008	.168	.191
HH	.071	.000	.065	.000