MEANINGFULNESS ($\bar{m}$)
IN CHILDREN'S VERBAL LEARNING

by

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ABSTRACT

The function of meaningfulness ($\bar{m}$) in children's verbal learning was examined in this thesis. Subjects were 423 children, aged nine in the calendar year, 1967.

A table of meaningfulness was constructed using Noble's production method for 120 nouns.

In addition to meaningfulness, experimental control was exercised over the following variables: form class, list length, item length, frequency of occurrence in the language, specificity, initial alphabetic structure, concreteness-abstractness, and inter-item associative strength.

Four experimental paradigms were used: a free-learning, free-recall paradigm in which a mixed list of high- and low-meaningfulness items was used as the learning task; a free-learning, free-recall paradigm in which separate lists of high- and low-meaningfulness verbal items were used; a paired-associates paradigm in which high-high- and low-low-meaningfulness items were paired and learned in a trials-to-criterion task; a serial-order paradigm in which separate lists of high- and low-meaningfulness verbal items were learned in a trials-to-criterion task.

In each of the four experiments, meaningfulness ($\bar{m}$)

was found to have a facilitating effect on children's verbal learning beyond the .01 level of confidence.

The experimental findings were discussed in terms of learning theory and in terms of their possible implications for further research in curriculum development and instruction in elementary education.

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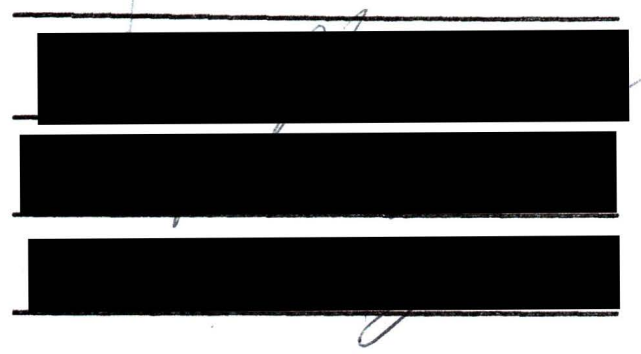

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I. Meaningfulness: Rationale and Significance

This thesis examines the role of meaningfulness ($\bar{m}$) in children's verbal learning. The critical question is simply put: Does meaningfulness ($\bar{m}$), as defined in this study, facilitate children's verbal learning? In order to answer this question, it is necessary to define meaningfulness precisely, to apply the concept in an experimental situation, and to examine the results in the light of empirical findings.

All too often in education and psychology, experimental research appears to have been conducted without reference to practical application. On the other hand, educational practice has been carried out on the basis of theory without support from empirical research. Although this may be defensible from certain points of view, isolation of basic science from applied science, when it persists, is unfortunate for the educator (Hilgard, 1966).

The first major concern, then, is to clarify the concept of meaningfulness. A major difficulty is the confusion which has traditionally existed between the terms "meaning" and "meaningfulness" in psychology and education. Perhaps one of the reasons for this has been that behaviorist, mediational, and cognitive theorists have taken divergent points of view and have, themselves, not been

precise in their terminology.

To the cognitive theorist, material becomes meaningful when it is subsumable under inclusive concepts already existing in cognitive structure. It is, in fact, the subsumability of logically meaningful propositions within a particular cognitive structure that creates the possibility of psychological meaning (Ausubel, 1963, p. 4).

To the mediational theorist, material is meaningful in terms of a representational, mediational process. Words are meaningful when they act as mediators to evoke in an organism a fractional part of the behavior elicited by a significate represented by a stimulus. Previous contiguity of non-significate and significate stimuli patterns accounts for the representational mediation (Osgood, Suci, and Tannenbaum, 1965, p. 7).

The behaviorist wishes to examine his theory in terms of empirical demonstration. To him, to speak of internal processes which cannot be observed is to create a linguistic fiction. The primary responsibility for the behaviorist is, therefore, that of description: what is the topography of any particular subdivision of human behavior? Given a word, for example, what is its observed meaningfulness for an individual? The critical question thus becomes one of measurement: can meaningfulness be quantified and examined empirically?

Glaze (1928) appears to have made the first systematic

attempt to order verbal units along a dimension of meaningfulness. He presented 2,019 CVC syllables (Appendix 1) to fifteen college sophomores asking them to indicate what the syllables meant. The meaningfulness of each syllable was calculated simply as the percentage of subjects who had an association to the syllable.

Hull (1933), Krueger (1934), and Witmer (1935) also experimented with measurements of meaningfulness.

Interest in the subject appears to have waned until Noble (1952) presented a concept of meaningfulness within a Hullian frame of reference. Unfortunately, he called his 1952 thesis "An Analysis of Meaning". It was a poorly phrased title in view of his intention to scale for meaningfulness. By Noble's own admission, his free use of the generic term "meaning" and the inappropriately chosen titles of his early papers resulted in confusion in later interpretations of his work (Noble, 1963, p. 96).

Noble (1952) stated that meaning was formally defined as a relationship between stimulus and response and that an index of stimulus meaning ($\bar{m}$) was operationally defined in terms of the mean frequency of continued written associations made by subjects within a sixty second time interval. He postulated that meanings increase as a simple linear function of the number of S multiple R connections acquired in a particular organism's history. According to Noble, if one were to ask a layman what he intended by saying that

"home" to him meant "family, spouse, children, friends, love, etc.", he would reply that he thought of these things when "home" was mentioned.

In compiling his indices of meaningfulness, Noble selected 96 units for scaling. Of these, 20% were paralogs with a CVCVC structure, 35% were words with a low G count selected from the Thorndike-Lorge scale (1944), and 45% were words with a high G count taken from the same scale. These verbal units, words, and paralogs, Noble called dissyllables.

In scaling for meaningfulness, Noble used the production method in which subjects were given a to-be scaled dissyllable and were asked to write in 60 seconds all the different words which occurred to them as a result of seeing the dissyllable. One hundred nineteen airmen were used as subjects and the range of meaningfulness was .99 to 9.61.

Noble (1963) clarified his concept of meaningfulness and left no doubt as to his original intention. Without changing his rationale, but with much more precision in terminology, Noble stated that a systematic approach to quantifying meaningfulness was essentially the same as he had outlined it in 1952. An appropriate behavioristic index of meaningfulness is given statistically by the average number of continued written associations made by a representative sample of subjects during a standard time interval (60 seconds).

Thus:

$$\bar{m} = \frac{\Sigma R}{N}$$

where $\bar{m}$ signifies meaningfulness, $\underline{R}$ the number of responses, and $\underline{N}$ the number of subjects (Noble, 1963, p. 84).

It is Noble's concept of meaningfulness which is used in this study. The emphasis is both connotative and denotative. Further, it is quantitative. The number, not the strength, nor the affect, of the associations is the critical variable. Skinner (1957) marshals convincing evidence to suggest that there is not a one-to-one correspondence between words and things, and that denotation, therefore, does not suffice to explain meaningfulness. To Skinner, connotation must supplement denotation and a study of the associative process, therefore, seems necessary (Skinner, 1957, p. 9).

Noble's concept of meaning does not subsume causation except that he sets it in a Hullian frame of reference wherein habit strengths and response hierarchies have common properties (Noble, 1952, p. 422). As Ausubel (1963, p. 37) rightly pointed out, however, a highly meaningful symbol tends to be both subjectively more familiar and to evoke more associations than a less meaningful symbol, but this is not the reason why it is meaningful in the first place. However, this in no way detracts from Noble's behavioristic concept of meaningfulness which, in fact, provides a compelling base for both theoretical speculation

and empirical research (Underwood & Schulz, 1960, p. 45).

II. Review of Relevant Literature

Subjects

Research in verbal learning has been conducted mainly using university students as subjects. One of the reasons for this probably has been the ready availability of college undergraduates. However, undoubtedly there also has been an implicit assumption that each act of learning contains in microcosm the whole problem of learning (Carroll, 1964, p. 337) and, therefore, that conclusions drawn from experimental data in studies with adults have relevance for subjects of all ages.

Several researchers, however, note the advisability of exploring the parameters of verbal learning using young children as subjects.

Keppel (1964) states that this is both an important and necessary step in the field of verbal learning. Paivio and Yuille (1966) point out the need for systematic studies to replicate adult findings with children and note that such studies are necessary in order to identify the roles of various verbal processes.

Underwood (1959), discussing verbal learning in education, feels that conclusions drawn from experimental work with adults cannot be automatically transferred to children. He concludes that representative experiments are mandatory in the classroom if laboratory principles are to

be generalized and applied to real life situations. Stroud (1940) makes a strong plea for closer coordination between the laboratory and the school setting. He underscores the need for experimental psychologists to familiarize themselves with educational problems and practices and for educational psychologists to give more attention to precise experimental procedures.

Norms

One of the major deficiencies in verbal learning studies with children has been the lack of normative data drawn from other than adult samples. Goss and Nodine (1965), for example, in summarizing 29 different scales of meaningfulness and related attributes reported only one (Shapiro, 1964 a, 1964 b) in which children were used as subjects. Shapiro herself emphasized the need for establishing norms for variables such as meaningfulness for a population from which samples could be drawn for intended further studies of verbal behavior and learning. Castaneda, Fahel, and Odom (1961) stated that word lists which had been standardized on elementary school-aged children were not currently available. Spreen and Schulz (1966) noted that there was a very limited amount of material suitable for use in verbal learning studies with subject populations other than college students.

Palermo, Flamer, and Jenkins (1964), concerned with the problem of finding suitable norms for use in children's verbal learning studies, used Archer's norms (1960) which had

been standardized on 216 college undergraduates. They constructed paired-associates lists for use by fifth-grade children and adults. By giving the two groups a common learning task, they concluded that insofar as CVC trigrams were concerned meaningfulness values based on adult norms exercised a similar effect for both adults and fifth-grade children. Their study, however, was predicated on the assumption that the meaningfulness of CVC trigrams was a function of the degree to which the trigrams departed from the parent language and orthography and that linguistic and orthographic habits in children and adults would be essentially the same. Whether or not this conclusion is valid for CVC's is a matter for conjecture. It certainly does not seem warranted, however, when meaningful verbal units, words, are being considered and when, therefore, there is, in fact, no departure from the parent language.

Shapiro (1964a, 1964b), interested in comparing adult and child meaningfulness indices, found a rank-order correlation of .66 for males and .58 for females when she used word CVC trigrams in a study with fourth-grade and college students. Unfortunately, in her comparison, the derivation of the meaningfulness indices differed for the two samples. She used a modified production method to obtain norms for the children and Noble's (1961) rated association indices for her college-aged subjects. Thus, even if her correlations had been higher, her findings would seem to have

limited use as a source of data in further empirical research on children's verbal learning.

Agrawal (1965) using 135 subjects, ages eight to eighteen, and employing Noble's method of deriving a meaningfulness index for each of ten concepts, found age to be positively related to meaningfulness. This finding would seem to underscore the need for caution in using adult norms in verbal learning research with children. It appears that the failure of most verbal learning studies to employ measures standardized on the population under consideration (Schutte & Hildebrand , 1966) constitutes a serious lack of empirical precision.

Scales of Meaningfulness

There seems to be no doubt that meaningfulness affects learning in adult subjects. Before examining the empirical findings, however, it appears necessary to review briefly the scales of meaningfulness which have been developed. Using the single association technique, Glaze (1928), Hull (1933), Krueger (1934), Trapp and Kausler (1959), and Archer (1960) constructed meaningfulness scales for CVC trigrams. Witmer (1935) used CCC trigrams. Taylor (1959) produced meaningfulness indices for 320 nouns and paralogs. Vanderplas and Garvin (1959), Goldstein (1961), and Battig (1962) used random shapes as stimuli to elicit associations from subjects and subsequently to compute a meaningfulness scale.

Using the multiple association technique, Noble (1952)

gave 192 airmen a 60-second period to respond to each of 96 dissyllables with as many words as possible. Noble and Parker (1960) repeated the experiment with college students and found a correlation of .97 between the two sets of meaningfulness values. Also using the multiple association method, Mandler (1955) developed a scale of meaningfulness for 100 CVC's and Underwood and Schulz (1960) used 42 trigrams in arriving at indices of meaningfulness. Anderson (1965) scaled the letters of the alphabet for meaningfulness.

Meaningfulness has also been scaled for various classes of words, again using the Noble method and employing college students as subjects. Postman (1965, p. 19) chose 48 nouns as stimuli, 24 of which were high-frequency words and 24 low-frequency on the Thorndike-Lorge scale (1944). Johnson, Frincke, and Martin (1961) developed indices of meaningfulness for 34 nouns, adjectives, and verbs of essentially equal Thorndike-Lorge frequencies. Epstein (1962), using 48 words in his scale of meaningfulness stratified his sample of stimulus units by using 16 concrete nouns, 16 abstract nouns, and 16 conjunctions. Koen (1962) used 60 words of various grammatical functions in developing a meaningfulness scale. Spreen and Schulz (1966), using 329 nouns rated A on the Thorndike-Lorge scale, and exploring the parameters of meaningfulness, abstraction, and pronunciability, used college undergraduates to scale for specificity, concreteness, and meaningfulness. Saltz (1967), with 45 psychology students as subjects, scaled for mean-

ingfulness for 100 nouns randomly selected from the Thorndike-Lorge list.

Tables of meaningfulness (m') also have been developed using associative-rating scale methods wherein subjects are usually asked to indicate whether or not the stimulus brings to mind an association, or to rate the meaningfulness of the stimulus along a linear scale of varying length. Cieutat (1963), for example, provided his subjects with a seven-point scale and asked them to rate each stimulus on the number of things or ideas the word brought to mind: none, much below average, below average, average, above average, much above average, extremely many. Noble (1961), Underwood and Schulz (1960), and Noble, Stockwell, and Pryer (1957) also developed rated scales of meaningfulness using adult subjects.

Battig and Spera (1962) developed a rated scale of meaningfulness for the set of numerals from zero to 100. Cochran and Wickens (1963) used a five-point scale to compute meaningfulness indices for the same numerals. In discussing the findings of both these studies, however, Cochran and Wickens noted that such computed values are valid only within the context of the particular experiment.

Only three relevant studies in which children were used in developing scales of meaningfulness appear to have been reported. Gaeth and Allen (1966) using a sample of Archer's CVC's (1960) and Witmer's CCC's (1935) derived rated mean-

ingfulness values in terms of the percentage of 361 subjects in grades four to six who responded "Yes" to the statement: "Just look at each set of letters separately and try to decide if it seems like a word" (p. 474). Although rated meaningfulness values (m') and meaningfulness indices derived from the production method ($\bar{m}$) have been shown to correlate in the order of .91 for adults (Noble, 1963, p. 86), no study was found which would justify generalizing this conclusion to children.

Agrawal (1965) in developing a meaningfulness scale for ten concepts used Noble's technique with subjects aged eleven to eighteen. However, the small number of words for which meaningfulness indices were computed severely limits the usefulness of this scale in further verbal learning research with children.

Shapiro (1964a, 1964b) developed a scale of meaningfulness for 65 words, 52 of which were CVC's and thirteen of which were representative of various grammatical word classes. Her subjects were 100 boys and 100 girls in each of grades 4, 6, and 8. Only eighteen seconds and a maximum of five responses were allowed, however, This ceiling of five associations and the short time allowed for responses severely limited the range of meaningfulness in this study: fourth grade from .84 to 3.51, sixth grade from 1.10 to 3.89, and eighth grade from 1.49 to 4.15. This characteristic of the Shapiro scale appears to have restricted its

usefulness for many types of verbal learning studies.

Meaningfulness in Verbal Learning

A large number of experiments have been conducted in the laboratory setting using various scales of meaningfulness in verbal learning by adults. Epstein, Rock and Zuckerman (1960), in a monograph describing a series of experiments in which meaningfulness was a variable of interest, outline five principles which have been advanced to explain the facilitating role of meaningfulness in verbal learning: associative principle, familiarity facilitation, transitional probability, habit formation, and organizational repertoire.

Much of the experimental work which has been done to examine the function of meaningfulness has been predicated on a behavioristic rationale and observed behavior has been the dependent variable of interest. In studies using the paired-associates paradigm, meaningfulness has been shown to facilitate learning on the response side (Cautela, 1965; Kothurkar, 1963; Martin, Cox & Boersma, 1965; Nodine, 1963; Underwood & Shulz, 1960), and on the stimulus side (Epstein & Platt, 1964; Mandler & Campbell, 1957; Paivio, Yuille, & Smythe, 1966; Richardson & Brown, 1966; Saltz, 1967). Epstein, Rock, and Zuckerman (1960), using a series of paired-associates tasks constructed of nouns, conjunctions and prepositions, and nonsense syllables, found significant differences in learning performances between each of three

degrees of meaningfulness.

In serial-learning studies, meaningfulness has again been shown to exert a facilitating effect (Badia, Rosenberg, & Langer, 1965). Imae and Umemoto (1966), using Umemoto and Imae (1965) values of meaningfulness for numbers found meaningfulness to be a good predictor of learning. Noble, Showell, and Jones (1966) concluded that scaled meaningfulness was more effective in predicting memorization of a serial-learning task than was associative strength or pronunciability.

Keppel (1964) noted that prior to the time of his writing, no studies had been reported in which meaningfulness had been manipulated as the variable of interest using children as subjects. A review of the literature confirms this statement although one study (Stoddard, 1929) demonstrated that high-school students showed about two times as much learning for French-English vocabulary pairs as for English-French. Assuming that English words were more meaningful to American students than French words, this study would seem to indicate a facilitating effect of response meaningfulness on paired-associates learning.

Since 1964 only a few studies have been reported in which meaningfulness was manipulated with children. Greenfeld and Prindle (1966), using secondary students unacquainted with Spanish, found that both meaningfulness and reinforcement were influential in the acquisition of Spanish

vocabulary items. Rearden and Gladstone (1966), using Krueger's norms at three levels of meaningfulness with fourth-, sixth-, eighth-, tenth-, and twelfth-grade students, and trials to mastery as the criterion measure of learning, concluded that both age and meaningfulness were significant variables in a paired-associates task. Gaeth (1964), using CVC's and three letter words, found learning to be a function of meaningfulness in a verbal learning study with school children.

Cooper and Gaeth (1967), studying interactions of modality with age and meaningfulness in verbal learning, and using five grade levels in the Detroit public school system, concluded that when Archer's norms were used in a paired-associates study, there was no preferred modality for high-meaningfulness materials. As the difficulty of the material increased, however, visual presentation was favored. In both the Rearden and Gladstone study, and the Cooper and Gaeth study, however, indices of meaningfulness were used which had been derived from adult subjects. Until verbal learning studies are undertaken which use indices of meaningfulness derived from samples of the population under consideration, research results can be at best only speculative. It is possible, for example, as Keppel (1964) pointed out, that future research will reveal that measures of meaningfulness will not predict learning for children as well as they do for adults.

Although meaningfulness has been shown to facilitate

adult learning, its effect on retention is far from clear. Vicory and Asher (1966) note that meaningfulness measures may be more clearly related to acquisition than to retention. Ekstrand and Underwood (1965) in a free-learning, free-recall situation where original learning was held constant, found that there was no difference in retention of high- and low-meaningfulness materials. Epstein (1963) concluded that short term retention of items learned under conditions of free recall did not differ for high-and low-meaningfulness items. Deese (1961) maintained that words once encoded should be equally well recalled. Underwood and Keppel (1963b), speaking of the reliable facts of forgetting, state that the degree of learning is the only variable involved in a substantial way in retention.

On the other hand, Gibson, Bishop, Schiff, and Smith (1964), testing retention by recognition and free recall, concluded that meaningfulness facilitated retention by providing a category for grouping the initial items, thus aiding retrieval. McNulty (1965), interested in short term retention, found low-meaningfulness material harder to recall, reconstruct, or serially anticipate than high meaningfulness material but found low-meaningfulness material easier to recognize. Dowling and Braun (1957) noted that the effect of meaningfulness on retention at one and seven days after learning was not significant when measured by relearning and reconstruction but was significant when measured by unaided or aided recall. Underwood and Richardson (1956)

reported that at 24 hours, meaningfulness did not significantly influence recall but did influence relearning. Heim, Watts, Bower, and Hawton (1966) in a study designed on a paired-associates paradigm, showed that those words which were learned most quickly were significantly more likely to be retained after 60 and 90 days.

No studies were found in which children were used in research designed to study retention as a function of meaningfulness. In view of Keppel's statement (1964) that factors which have been isolated for adult learning may have a differential influence on the verbal learning of children, and in view of the somewhat contradictory findings of the reported research on retention, the study of verbal learning and retention as a function of meaningfulness for children appears to be an area worthy of research.

Relevant Variables

In studying meaningfulness ($\bar{m}$) in children's verbal learning, it is necessary to exercise experimental control for other variables which have been shown to influence human learning. Chief among these are the abstract-concrete dimension, inter-item associative strength, length and pronunciability, phonemic structure, and frequency. Although it again must be stated that most of the studies reported have been carried out using adult subjects, these variables have been shown to exercise significant effects on adult learning and it would not seem justifiable to discount

their possible influence on children's verbal learning.

Abstract-Concrete Dimension

The abstract-concrete dimension has been an experimental variable in several studies. Gorman (1961), using a dichotomous scale for abstract and concrete nouns, found that abstract nouns were less well remembered than were concrete nouns. Bloomer (1961) concluded that the dimension of concreteness-abstractness was significantly related to reading difficulty. Spreen, Borkowski, and Gordon (1966), controlling for two measures of abstractness in a study with 30 normal and 60 mentally defective adults, found high-concrete words were more easily recognized in both groups. Dukes and Bastian (1966), in an immediate free-recall test using abstract and concrete nouns equated for meaningfulness, stated that more concrete than abstract nouns were recalled. Catalano (1960, p. 19) using a test of free recall, concluded that concrete nouns were better recalled than were conjunctions and prepositions, or abstract nouns. Riegel and Riegel (1961), interested in various stimulus parameters on word recognition thresholds, found that words which denoted concrete objects were more readily recognized than were words without perceivable referents.

In a paired-associates study, Paivio and Yuille (1966) noted that for children in the fourth, sixth, and eighth grades, concreteness had a facilitating effect on the stimulus side. Yarmey and Paivio (1965) and Paivio (1965) in

separate studies drew the same conclusion from data from adult subjects.

Associative Strength

Associative strength between verbal units has been the independent variable in several studies. Using the Castaneda, Fahel, and Odom norms (1961) with 40 fourth- and 40 sixth-grade children, McCullers (1961) found a significant difference in a trials-to-criterion task between lists constructed of high- and low-associative pairs. Unfortunately, although he stated that he constructed his lists alike in all other respects, McCullers did not elaborate on his specific criteria for control.

Deese (1959), using the Russel and Jenkins Minnesota norms (1954) concluded that inter-item associative strength in a free-recall paradigm was positively correlated with the number of words recalled. Keppel (1963) stated that variation in association value was highly related to learning, as did Castaneda, Fahel, and Odom (1961), Lindley (1963), Nikkel and Palermo (1965), and Pollio and Christy (1964).

Bousfield, Cohen, and Whitmarsh (1958) found that the more readily subjects could categorize groups of words, the more readily words were recalled, thus suggesting the facilitating effect of inter-item associative strength. Heim, Watts, Bower, and Hawton (1966), in a paired-associates, trials-to-criterion experiment concluded that association value exercised a significant effect on learning.

Palermo and Jenkins (1964a), working with fifth-grade children and using their own norms for word associations, found in a paired-associates task that the mean number of errors varied inversely with the associative strength of the pairs. Simon and Hess (1965) using the Simon, Lotsof and Pease norms (1963), in a free-recall experiment with fourth-, fifth-, and sixth-grade children, concluded that performance was reliably related to inter-item associative strength. Nikkel and Palermo (1965), in an experiment using 60 sixth-grade children, noted that children's natural word associations played an important role in the occurrence of mediational phenomena in learning. In this study, however, Kent-Rosanoff (1910), Palermo and Jenkins (1964b), and Archer (1960)norms were used, none of which had been developed from the children used in the study.

The need for developing and using association norms, as well as meaningfulness indices derived from samples subsumed by the population of experimental subjects, has been pointed out in several relevant experiments. Woodrow and Lowell (1916), for example, concluded that responses of children ages 9, 10, 11, and 12 differed markedly from responses of adults. This conclusion had been previously drawn in a study by Rosanoff and Rosanoff (1913). Entwisle, Forsyth, and Muuss (1964) and Entwisle (1966a), comparing child and adult associations, demonstrated that a shift from syntactic responses to paradigmatic responses occurred with

increases in age. Palermo and Jenkins (1963) noted that in word-association tests, children and adults differed in the frequency of superordinate responses. Brown and Berko (1960), and Ervin (1961) in two separate studies found evidence of a change in the type of associations given to a stimulus word. As the ages of the subjects advanced, there was an increase in paradigmatic responses.

Entwisle, Forsyth and Muuss (1964) in a comparison of their own norms with those of Woodrow and Lowell (1916) concluded that there was a marked change in associative responses of children over time.

Ruth and Nye (1967), in a comparative study using children in Albany, California, and Victoria, British Columbia, found that primary responses correlated .72 in both the Albany sample and the Victoria sample with those in the Palermo and Jenkins norms (1964). For 33 of the 50 items used as stimuli in their study, they found significant variation in associative strength between Victoria observations and the normative expectancies taken from the Palermo and Jenkins data.

Thus, not only does there appear to be an age differential in associative response but also an environmental factor, both geographical and temporal. The assumption that normative data on word associations derived from one population apply to another can only be speculative until research studies establish this fact empirically.

Length and Pronunciability

List length, length of words, and pronunciability of verbal items have also been variables of experimental interest, and the findings appear to be somewhat inconclusive. Bogartz and Headrick (1965) and Davis (1966) found that trials to criterion increased linearly with increased list length. Waugh (1967), however, in a study using 18 summer school students in a free recall experiment, stated that the number of items retained from a list was independent of the number of different items presented, and that the probability of recall occurrence increased in direct proportion to the number of seconds taken for presentation. She concluded, therefore, that the amount of time taken to present the list was the critical variable. Miller (1956), however, postulated a clear and definite limit to the number of items a subject could remember. He set the span of immediate memory at seven items, plus or minus two, believing it to be the limiting factor in the amount of information a subject could receive, process, and remember.

Underwood and Schulz (1960) presented evidence to show that pronunciability and rate of learning were related variables as did Underwood and Postman (1960). Lindley (1963, 1966), however, concluded that pronunciation did not facilitate learning. He stated that the effect of pronunciability depended on whether the experimenter or the subject did the pronouncing. Lindley and Stone (1967), using adult subjects,

found that associative strength, not pronunciability, was the critical factor in free recall of verbal items.

Length of words was shown to correlate highly with rated pronunciability by Spreen and Schulz (1966). In research exploring the parameters of abstraction, meaningfulness, and pronunciability, they found an intercorrelation of .83 between pronunciability ratings and length of words. They therefore concluded that it was unnecessary to retain both in analyzing their data. Hall (1967), examining relationships among a number of measures of meaningfulness for 100 subjects, presented data to warrant the conclusion that measures of pronunciability and association have much in common and that a single measure would satisfy the experimental requirements of many investigations.

Initial Alphabetic Structure

There is some evidence that initial alphabetic structure of a verbal unit affects learning. Peixotto (1948) showed that a positive relationship existed between recognition of syllables and the frequency of occurrence of the initial letter of the syllable. Broerse and Zwaan (1966), in a study using Dutch seven letter nouns unfamiliar to the subjects, presented data to confirm the hypothesis that the information value of the initial letter in the identification of words is a significant determinant in learning. Subjects in the study were able to enumerate more nouns if the initial letter was available than if the final letter was given.

The authors concluded that because words appeared to be retrieved from memory in a sequential pattern, the initial letter was the critical starting place for learning verbal units.

Frequency

Frequency of word usage has also been shown to affect learning. Using the Thorndike-Lorge scale (1944), Postman (1961) found that for college students, high-frequency words were learned faster in a trials-to-criterion serial-order task than were low-frequency words. Winnick and Kressel (1965) noted that word frequency had a consistent effect on measurements of tachistoscopic recognition and paired-associates learning. High frequency words were recognized more easily and learned more readily than were low-frequency words. Johnson (1962) established that the frequency with which the trigram appears in the language (Underwood and Schulz, 1960) was a predictor of rate of verbal learning. Johnson, Thomson, and Frincke (1960) found that the variable of frequency produced differential visual duration thresholds for words. Saltz (1967) noted the need to control for frequency of occurrence of verbal units in learning studies. Imae and Umemoto (1966) concluded that both meaningfulness and frequency of usage of each item were important variables affecting the rate of learning.

Verbal Learning Paradigms

The paired-associates paradigm, the serial-order task,

and the free-learning, free-recall methods have been used traditionally in verbal learning studies. The latter, although probably the least used in the laboratory, appears to be the method most applicable to classroom learning. Underwood and Keppel (1963a) and Underwood and Erlebacher (1965) outline the technique of free learning which appears to be used with increasing frequency in current verbal learning research.

Underwood (1964), for example, used free learning in a study on articulation in verbal learning. Underwood, Ekstrand, and Keppel (1964), studying distributed practice, used both a paired-associates paradigm and a free-learning design. Postman and Phillips (1961) tested subjects with a free-recall task, as did Bousfield (1953), Bousfield, Cohen, and Whitmarsh (1958), Garner and Whitman (1965), Horowitz (1961), and Miller (1958).

Cautela (1965) gave subjects a seven minute free-study period to learn a paired-associates task. Simon and Hess (1965) used a free-study, free-recall design in examining the facilitative effect of inter-item associative strength on learning. Paivio (1967) studied free recall of nouns as a function of concreteness, specificity, imagery and meaningfulness, and Lindley and Stone (1967) used a two-minute free-study, free-recall paradigm in examining measures of meaningfulness and free recall.

III. Table of Meaningfulness

In order to provide a source of empirical data for use in this and other verbal learning studies, a Table of Meaningfulness for 120 nouns was derived. Data were taken from a sample of 135 children all of whom were attending school in the Greater Victoria area and who were nine years old in the calendar year, 1967.

Intact groups of subjects were randomly selected from a list of classes in the Greater Victoria school system in which pupils completing their third year in school were heterogeneously grouped to the extent that they represented the total grade three population in the school (Appendix 2).

One hundred twenty mass and count nouns were randomly selected from the Thorndike-Lorge list (1944). The sample of words was stratified to include 60 A words and 60 AA words. In each category, 30 mass and 30 count nouns were included (Appendix 3).

Nouns were checked in the Dictionary of Canadian English, The Senior Dictionary (Avis, Drysdale, Gregg, and Scargill, 1967) to ensure the current use of words in the Canadian culture.

Words were randomly arranged on mimeographed sheets, four words to a sheet (Appendices 4 and 5).

Instructions to teachers and pupils were mimeographed (Appendix 6). One meeting was held with each teacher and one

demonstration session conducted by the experimenter.

Six data sheets, randomly assigned, were completed by each of five groups of subjects on successive days in May, 1967. Order of presentation was random.

Marking criteria, adapted from Noble, 1952, were defined (Appendix 7). Six hundred response forms, five for each of the 120 nouns, were randomly selected and marked separately by two markers. Twelve discrepancies of one point each occurred in the totals making an inter-marker agreement of 98 per cent.

A Table of Meaningfulness was derived from the data:

$$\bar{m} = \frac{\Sigma R}{N}$$

Range of meaningfulness was 8.41 to .41 with a median of 4.25 and a mean of 4.29 (Table I).

A sample of 204 subjects in Saanich, an adjacent school district to Greater Victoria, was used for cross-validation purposes. Random selection of classes was identical to the procedure followed in collecting data for the Table of Meaningfulness (Appendix 2).

Forty-eight nouns were selected from the Table of Meaningfulness, 16 high $\bar{m}$ nouns, 16 intermediate $\bar{m}$ nouns, and 16 low $\bar{m}$ nouns. Words were randomly arranged on data sheets, four words to a sheet as before (Appendix 8).

Each data sheet included one high $\bar{m}$ word, one low $\bar{m}$ word, one intermediate $\bar{m}$ word, and one noun selected from

the remaining pool of words. In each case, selection of words was random.

Three data sheets, randomly assigned, were completed by each of four groups of subjects in June, 1967, and indices of meaningfulness derived (Appendix 9).

A correlation coefficient (Pearson product-moment) of .92 was obtained between the two measures of meaningfulness for each of the nouns (Appendix 10).

Table I. Table of Meaningfulness

house	8.41	student	4.96	enemy	3.52
clothing	7.74	beauty	4.93	dollar	3.48
world	7.67	fashion	4.93	nut	3.48
breakfast	7.26	sugar	4.93	branch	3.44
weather	7.11	wool	4.85	gold	3.44
hospital	6.96	league	4.74	heart	3.41
lady	6.96	trail	4.74	pan	3.41
island	6.93	news	4.70	sword	3.33
room	6.63	prison	4.70	pupil	3.30
chicken	6.56	building	4.67	settlement	3.22
farm	6.52	joy	4.67	wind	3.22
food	6.52	paper	4.63	courage	3.15
office	6.37	finger	4.59	justice	3.11
town	6.33	stage	4.56	professor	3.11
mother	6.26	teeth	4.52	understanding	3.07
wood	6.26	passenger	4.44	nation	3.07
grass	6.19	oil	4.37	pleasure	3.04
fun	6.11	salt	4.37	strength	3.00
west	6.07	maid	4.33	inch	2.81
accident	6.04	deed	4.30	moment	2.78
meat	5.96	bill	4.19	spirit	2.77
shade	5.81	gas	4.19	faith	2.74
baby	5.66	pattern	4.19	defence	2.74
property	5.63	job	4.07	memory	2.74
sport	5.63	factory	4.07	height	2.59
meal	5.56	soil	4.07	freedom	2.52
arm	5.52	history	4.04	charm	2.52
darkness	5.52	material	4.00	shame	2.41
outside	5.44	season	3.96	wine	2.07
principal	5.41	ice	3.93	victory	1.96
woman	5.33	cream	3.89	peace	1.93
friend	5.30	eye	3.89	future	1.78
mouth	5.19	slave	3.85	committee	1.63
coin	5.11	truth	3.78	commerce	1.33
nose	5.11	temple	3.74	virtue	1.11
music	5.07	friendship	3.66	wealth	1.04
treasure	5.07	mile	3.66	quality	.96
minister	5.00	glory	3.59	content	.93
class	4.96	metal	3.59	concern	.93
sky	4.96	style	3.56	possession	.41

IV. Experiment I: Free Learning, Free Recall, Mixed List

Introduction

The function of meaningfulness ($\bar{m}$) in children's verbal learning, was examined in the first experiment in this thesis. A free-learning, free-recall paradigm was used in order to ascertain whether or not differing degrees of meaningfulness would differentially affect children's verbal learning.

Learning Task

A learning task was constructed consisting of a mixed list of nine high-and nine low-meaningfulness words selected from the Table of Meaningfulness. Range of $\bar{m}$ for the high-meaningfulness words was 4.85 - 7.74 with a mean of 6.02. Range of $\bar{m}$ for the low-meaningfulness words was .41 - 3.41 with a mean of 2.25.

Control of Relevant Variables

In addition to meaningfulness, experimental control was exercised over seven variables. Words were selected with as high an $\bar{m}$ value or as low an $\bar{m}$ value as possible for each of the two categories of meaningfulness. A word was eliminated from the learning task only if it failed to meet the criteria established for the seven variables as follows:

1. Length. List length, the number of syllables in each word, and the number of syllables in the total learning task were the criteria used to equate the length of high

and low $\bar{m}$ words. Nine words were used in each of the two categories. In each case, five one-syllable words, two two-syllable words, and one three syllable word were used. The high $\bar{m}$ list had one two-syllable word which was matched with a three-syllable word in the low $\bar{m}$ list. Total number of syllables in each learning task was 14 for high $\bar{m}$ items and 15 for low $\bar{m}$ items.

2. Frequency. In the high $\bar{m}$ category, six A words and three AA words were used. In the low $\bar{m}$ list, seven A words and two AA words were used. The J count served as a second control, high $\bar{m}$ words having a J count mean of 452 and low $\bar{m}$ words a J count mean of 408.

3. Form class. All words were nouns.

4. Specificity. Mass and count nouns were used. Both high $\bar{m}$ and low $\bar{m}$ lists had four count and five mass nouns.

5. Concrete-abstract dimension. Words were rated on a three point scale: concrete nouns (c), such as "chicken", or "branch"; concrete-general nouns (c-g) such as "wine", or "sugar"; abstract nouns (a) such as "charm", or "freedom". High $\bar{m}$ list consisted of four concrete, three concrete-general, and two abstract nouns, and low $\bar{m}$ words of four concrete, two concrete-general, and three abstract nouns.

6. Initial alphabetic structure. High $\bar{m}$ words and low $\bar{m}$ words used in the learning task had identical initial alphabetic structure with one exception. In the low $\bar{m}$ category a word beginning with "p" was included and matched with

a word beginning with "w" in the high $\bar{m}$ list. The learning task contained one consonant digraph "ch" in each category of meaningfulness and six consonant blends, three in the high $\bar{m}$ words and three in the low $\bar{m}$ words.

7. Inter-item associative strength. All words were checked in the Palermo and Jenkins Word Association Norms (1964) and in the Entwisle norms (1966b). In no cases were words included in the learning task if associations existed with other words in the same category.

A Table of First Associations was constructed from the data used in compiling the Table of Meaningfulness. Words were included in the table if they had been given as a first association more than once and a percentage associative-strength index computed (Appendix 11). No words were included in either of the categories of meaningfulness for which first associations existed.

From the above analysis, it can be noted that in no case, for any of the variables over which control was exercised, was a discrepancy of more than one item allowed. In the case of frequency, J-count means were equated to within an occurrence of 44 times per $4\frac{1}{2}$ million words or 10 times per million words. These parameters were set in order to allow for a maximum range of meaningfulness with minimum discrepancies between each of the other relevant variables.

Table II summarizes the control of relevant variables.

The 18 words included in the mixed-list learning task

Table II: Learning Task : Control of Relevant Variables:

Mixed List

High $\bar{m}$	1	2	3	4	5	6	7	8	9
farm	6.52	1	AA	700	f		C	c	0
class	4.96	1	AA	700	c	√	C	c	0
sport	5.63	1	A	319	s	√	M	a	0
clothing	7.74	2	A	400	c	√	M	c-g	0
west	6.07	1	AA	700	w		M	a	0
sugar	4.93	2	A	503	s		M	c-g	0
wool	4.85	1	A	235	w		M	c-g	0
hospital	6.96	3	A	220	h		C	c	0
chicken	6.56	2	A	290	ch	#	C	c	0
9	$\bar{X}$ 6.02	14	6A 3AA	$\bar{X}$ 452		3√ 1#	4C 5M	4c 3c-g 2a	0

Column 1 - meaningfulness ($\bar{m}$)
Column 2 - length (number of syllables)
Column 3 - frequency
Column 4 - J count
Column 5 - initial alphabetic structure
Column 6 - blends and digraphs
Column 7 - specificity
Column 8 - concrete-abstract dimension
Column 9 - inter-item associative strength

Table II - continued

Low $\bar{m}$	1	2	3	4	5	6	7	8	9
sword	3.33	1	A	390	s	√	C	c	0
committee	1.63	3	A	109	c		C	c	0
wine	2.07	1	A	293	w		M	c-g	0
commerce	1.33	2	A	277	c		M	c-g	0
possession	.41	3	A	310	p		C	c	0
charm	2.52	1	A	264	ch	#	M	a	0
freedom	2.52	2	A	333	f	√	M	a	0
strength	3.00	1	AA	700	s	√	M	a	0
heart	3.41	1	AA	1000	h		C	c	0
	$\bar{X}$		7A	$\bar{X}$		3√	4C	4c 2c-g	
9	2.25	15	2AA	408		1#	5M	3a	0

were arranged in five different random orders (Appendix 12) and mimeographed on white paper for use by subjects (Appendix 13).

Subjects

Subjects were 128 children, aged nine in the calendar year 1967, who were attending school in School District 63 (Saanich).

Experimental Design

The design used in this experiment was a two-factor analysis of variance with repeated measures on one factor (Winer, 1962, p. 298).

Subjects were randomly selected (Lindquist, 1956, p. 191) and randomly assigned to treatment. All subjects learned both high- and low-meaningfulness items through the use of a mixed list. Groups of subjects were tested immediately after studying the lists, at one hour, at three hours, and at 24 hours. Each subject was observed under both levels of factor A (meaningfulness) but only under one level of factor B (time of testing).

Three minutes were allowed for study, and three minutes for recall of items learned.

Instructions to each subject were identical (Appendix 14).

Winer's "strong word of warning" (p. 301) in connection with order or sequence effects, such as practice, fatigue, transfer of training, or preceding success or

failure, was adequately accounted for in this study through the use of a mixed list and the fact that no subject in the experiment was tested more than once.

In the analysis of the data, because the same experimental unit, a subject, was observed under more than one treatment condition, the assumption was made that errors were correlated (Winer, 1962, p. 299).

Hypotheses and Statistical Treatment of Data

The following hypotheses were formulated:

(1) Differences in levels of meaningfulness will differentially influence children's verbal learning.

(2) The differential influence of two levels of meaningfulness on children's verbal learning will be maintained over time.

(3) The time of testing will not affect the influence of meaningfulness on children's verbal learning.

These hypotheses were restated for acceptance or rejection:

(1) $H_0 : \sigma^2_A = 0$

(2) $H_0 : \sigma^2_B = 0$

(3) $H_0 : \sigma^2_{AB} = 0$

A summary of the analysis of variance, 2 X 4 factorial, with repeated measures on one factor (Winer, 1962, p. 304) is presented in Table III.

Table III: Summary Table : Analysis of Variance

(Raw Scores, Appendix 15):

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
A	92.64062	1	92.64062	118.77
B	153.17187	3	51.05728	23.10
AB	6.17188	3	2.05729	2.62
R	84.85937	31	2.73740	
AR	33.85937	31	1.09224	
BR	189.32812	93	2.03579	
ABR	63.32812	93	0.68095	
Total	623.35937	255		
Error A	.78			
Error B	2.21			

		df	F
Critical Values of F (Ferguson, 1966)	.01 - A	1, 124	6.84
	.01 - B	3, 124	3.94
	.05 - AB	3, 124	2.68

A graph of the learning curves is presented in Table IV.

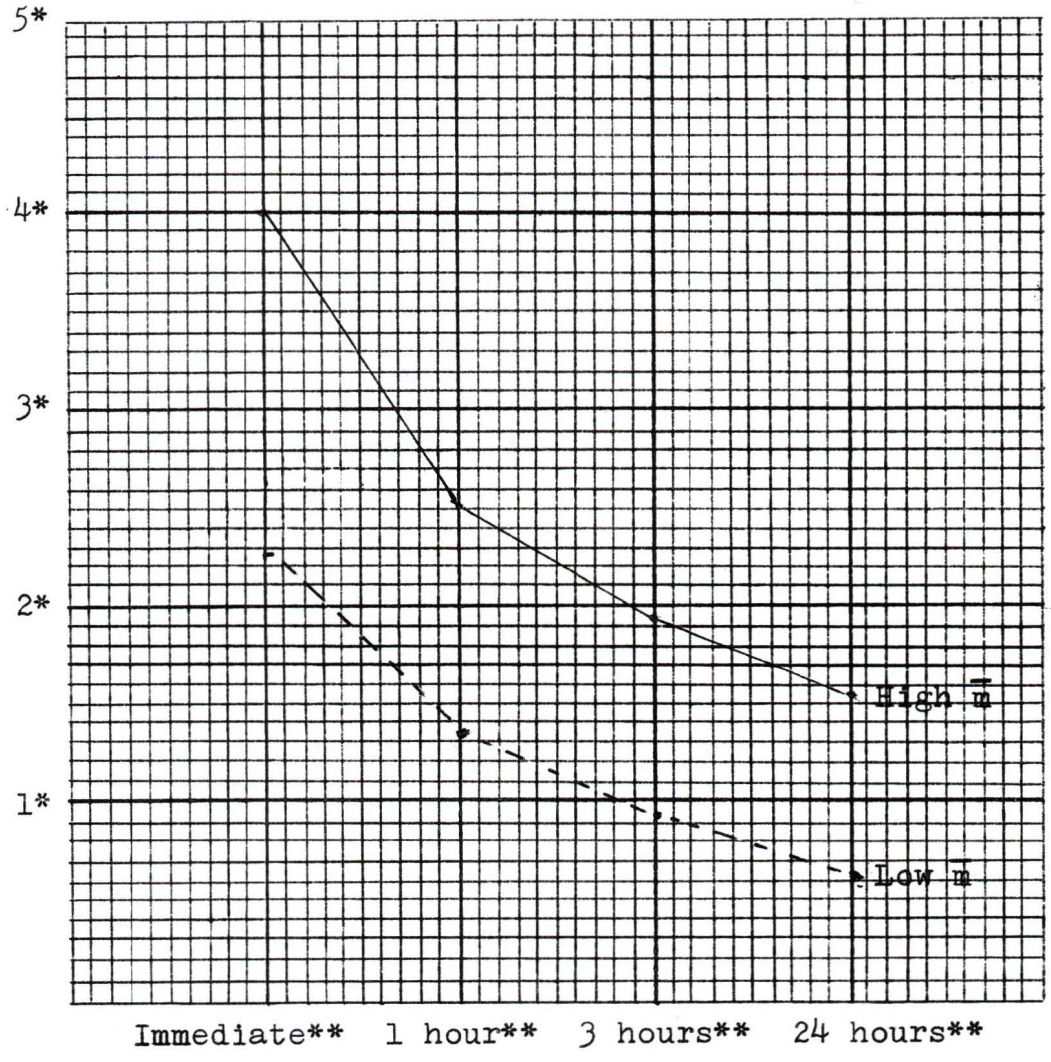
Interpretation of Results

Hypothesis 1. The F ratio for A factor (meaningfulness) was significantly different from zero beyond the .01 level of confidence and the hypothesis, $\sigma^2_A = 0$, therefore rejected. Differences in levels of meaningfulness were found to differentially influence children's verbal learning. An examination of the data (Table IV: Learning Curves) clearly reveals that the facilitating effect of meaningfulness in children's verbal learning was greater for high-meaningfulness verbal items than it was for low-meaningfulness verbal items.

Hypothesis 2. The F ratio for B factor (time of testing) was significantly different from zero beyond the .01 level of confidence and the hypothesis, $\sigma^2_B = 0$, therefore rejected. The differential influence of two levels of meaningfulness on children's verbal learning was maintained over time.

Hypothesis 3. The F ratio for AB factor (interaction) was not significantly different from zero at the .05 level of confidence, and the hypothesis, $\sigma^2_{AB} = 0$, not rejected. The time of testing does not interact with the variable of meaningfulness to produce a differential effect on the number of verbal items learned as measured by a test of free recall.

Table IV: Learning Curves (Data: Appendix 16)



*Mean No. of Items Retained.

**Testing Times

Discussion

As a result of the empirical evidence presented in this study, it is concluded that meaningfulness, when it is defined as the $\frac{\Sigma R}{N}$, and derived from samples of the population under consideration, exerts a facilitating effect on children's verbal learning. Further, the facilitation of meaningfulness on children's verbal learning holds up over time and is consistent irrespective of the time of testing.

It is of interest to note from the graph of the learning curve, that once learned, high and low-meaningfulness verbal items tend to follow parallel curves so far as retention is concerned. This lends empirical support to the hypotheses that meaningfulness measures may be more clearly related to acquisition than to retention (Vicory and Asher, 1966) and that the degree of learning is the critical variable involved in retention (Underwood and Keppel, 1963b).

In view of the paucity of empirical evidence on the function of the independent variable of meaningfulness on the dependent variable of retention in children's verbal learning, further experimentation in this area might well prove worthwhile.

V. Experiment II: Free Learning, Free Recall, Unmixed Lists

Introduction

In the first experiment reported in this study, the function of meaningfulness in children's verbal learning was examined. A mixed list was used as the learning task. Two questions emerged from this procedure:

(1) Do children, when they are presented with a mixed list of verbal items varying in degrees of meaningfulness, select those items to learn which are more meaningful to them and ignore those which are less meaningful?

(2) Would the facilitating effect of meaningfulness occur if the selection phenomenon between the two degrees of meaningfulness (high and low) was removed from the learning task?

It was to an examination of this latter question that a second experiment was directed.

Learning Task

In order to further examine the function of meaningfulness in free learning by children, two learning tasks were constructed. These were unmixed lists, each of which contained 14 verbal items. Range of meaningfulness for the high $\bar{m}$ list was 4.63 - 7.74 with a mean of 5.67. Range of meaningfulness for the low $\bar{m}$ list was .41 - 3.44 with a mean of 2.53.

Control of Relevant Variables

In addition to meaningfulness, experimental control was

exercised over the same seven variables as in the first experiment: length, frequency, form class, specificity, concrete-abstract dimension, initial alphabetic structure, and inter-item associative strength. As before, in no case was a discrepancy of more than one item allowed. With respect to frequency, the J count means were equated to within an occurrence of 58 times per 4½ million or 13 times per million words. As in the first experiment, these parameters were set in order to allow for a maximum range of meaningfulness with minimum discrepancies between each of the other relevant variables. Table V. summarizes the control of relevant variables for Experiment II.

Words were arranged in random order and mimeographed on white paper for use by subjects (Appendix 17).

Subjects

Subjects were 64 children, aged nine in the calendar year, 1967, randomly selected (Lindquist, 1956, p. 191) from pupils who were attending school in School District 63 (Saanich).

Experimental Design

Thirty-two subjects in each of two groups were randomly assigned to treatment. One group learned the high-meaningfulness list, one the low-meaningfulness list. Testing for recall of items learned was immediate.

Three minutes were allowed for study and three minutes for recall.

Table V: Learning Task : Control of Relevant Variables: Unmixed Lists

High $\bar{m}$	1	2	3	4	5	6	7	8	9
paper	4.63	2	AA	1000	p		M	c-g	0
farm	6.52	1	AA	700	f		C	c	0
class	4.96	1	AA	700	c	√	C	c	0
fashion	4.93	2	A	380	f		M	a	0
sport	5.63	1	A	319	s	√	M	a	0
beauty	4.93	2	AA	684	b		M	a	0
clothing	7.74	2	A	400	c	√	M	c-g	0
west	6.07	1	AA	700	w		M	a	0
meal	5.56	1	A	400	m		C	c	0
sugar	4.93	2	A	503	s		M	c-g	0
wool	4.85	1	A	235	w		M	c-g	0
hospital	6.96	3	A	220	h		C	c	0
chicken	6.56	2	A	290	ch	#	C	c	0
nose	5.11	1	AA	489	n		C	c	0
14	$\bar{X}$ 5.67	22	6AA 8A	$\bar{X}$ 501		3√ 1#	8M 6C	6c 4c-g 4a	0

Column 1 - meaningfulness
Column 2 - length
Column 3 - frequency
Column 4 - J count
Column 5 - initial alphabetic structure
Column 6 - blends (√) and digraphs (#)
Column 7 - specificity
Column 8 - concrete-abstract
Column 9 - inter-item associative strength

Table V: Learning Tasks : Control of Relevant Variables

Unmixed Lists

Low $\bar{m}$	1	2	3	4	5	6	7	8	9
faith	2.74	1	A	360	f		M	a	0
sword	3.33	1	A	390	s		C	c	0
committee	1.63	3	A	109	c		C	c	0
wine	2.07	1	A	293	w		M	c-g	0
commerce	1.33	2	A	277	c		M	c-g	0
possession	.41	3	A	310	p		C	c	0
charm	2.52	1	A	264	ch	#	M	a	0
freedom	2.52	2	A	333	f	√	M	a	0
wind	3.22	1	AA	1000	w		M	c-g	0
moment	2.78	2	AA	700	m		C	c-g	0
nation	3.07	2	AA	700	n		C	c	0
strength	3.00	1	AA	700	s	√	M	a	0
heart	3.41	1	AA	1000	h		C	c	0
branch	3.44	1	AA	495	b	√	C	c	0
14	$\bar{X}$ 2.53	22	6AA 8A	$\bar{X}$ 559		1# 3√	7M 7C	6c 4c-g 4a	0

Instructions to each subject were identical (Appendix 14).

A *t* test of the difference between means of items recalled for the randomly selected groups in a free-study, free-recall design using unmixed lists of high-and low-meaningfulness items was used.

Two basic assumptions underlying the use of a *t* test, those of normalcy of the population sampled and of the homogeneity of variance in the population sampled were met through the use of:

(a) randomly selected subjects

(b) random assignment of subjects to treatments

(c) use of equal-sized groups

(d) use of a relatively large sample (N = 64, 32 in each cell) (Hays, 1963, p. 322).

Hypothesis and Statistical Treatment of Data

In the first experiment, the data were conclusive in establishing the fact that high-meaningfulness verbal materials were learned with greater facility by children than were low-meaningfulness verbal materials. Directional hypotheses, therefore, were formulated in the second and subsequent experiments. It was hypothesized that high-meaningfulness material would be learned by children more readily than would low-meaningfulness material when a free-learning, free-recall, pure-list experimental paradigm was used. The hypothesis was restated for acceptance or rejection:

$$H_4 : \bar{X}_{high} \leq \bar{X}_{low}$$

A summary of the t-test data is presented in Table VI.

Interpretation of Results

Hypothesis 4. The t ratio for the difference between the means of high and low-meaningfulness items was significant beyond the .01 level of confidence. The hypothesis that the mean of high-meaningfulness items was equal to or less than the mean of low-meaningfulness items was therefore rejected. This result was interpreted as supporting the hypothesis that high-meaningfulness items would be learned by children more readily than would low-meaningfulness items in a free-learning, free-recall, pure-list experimental paradigm.

Discussion

The empirical data presented in the second experiment in this study confirm the evidence found in the first experiment, namely, that meaningfulness ($\frac{\Sigma R}{N}$) when derived from samples from the population under consideration, exerts a facilitating effect on children's verbal learning. Whether or not the list is mixed or pure does not significantly change the result.

It is of interest to note that, given a mixed list of 18 verbal items, nine in each category of meaningfulness, subjects retained 44% of the high $\bar{m}$ items and 25.3% of the low $\bar{m}$ items. Given pure lists of 14 verbal items in each

Table VI: Summary t-test Data: Free Learning, Free Recall, Unmixed Lists (Raw scores, Appendix 18)

Mean High $\bar{m}$	7.09		
Mean Low $\bar{m}$	3.81		
s^2_{high}	7.65	t	5.05
s^2_{low}	5.84		
s_d	.65		
Critical value of t - .01 (one-tailed) 62 df 2.39 (Fisher and Yates, 1953)			

category of meaningfulness, subjects retained 50.6% of the high $\bar{m}$ items and 27.2% of the low $\bar{m}$ items.

VI. Experiment III: Paired-Associates Learning

Introduction

When a free-learning, free-recall paradigm is used in experimental research in children's verbal learning, subjects learn high-meaningfulness items with greater facility than they do low-meaningfulness items. The question arises as to whether or not meaningfulness exerts a similar facilitating effect on children's verbal learning in a paired-associates paradigm. A third experiment was carried out to examine this question.

Learning Task

In order to examine the function of meaningfulness in paired-associates learning by children, two learning tasks were constructed, each consisting of seven pairs of verbal items. Both stimulus and response nouns were in the same category of meaningfulness in each task. Thus, an "high-high", "low-low" paradigm was used. Range of meaningfulness for the high $\bar{m}$ items was 4.63 - 7.74 with a mean of 5.67, and for the low $\bar{m}$ items, .41 - 3.44 with a mean of 2.53.

Control of Relevant Variables

Experimental control was exercised over the same seven variables as in Experiments I and II. Table V summarizes the control of relevant variables.

Words were randomly arranged in pairs (Appendix 19).

The order of the paired-associates nouns was randomly presented to subjects.

Subjects

Subjects were 48 children, aged nine in the calendar year, 1967, randomly selected (Lindquist, 1956, p. 191) from pupils who were attending school in School District 63 (Saanich).

Experimental Design

Twenty-four subjects in each of two groups were randomly assigned to treatment. One group learned the "high-high" meaningfulness pairs, one the "low-low" meaningfulness pairs.

The raw scores for each subject represent the number of trials needed to learn the seven pairs to criterion (one perfect performance). A maximum of ten trials was allowed. A detailed description of the procedure followed is included in Appendix 20.

A *t* test of the difference between the means of the trials-to-criterion scores was used.

The assumptions underlying the use of the *t* test were met as in Experiment II (page 46). The size of the sample, however, in the paired-associates experiment was 48, 24 in each cell.

Hypothesis and Statistical Treatment of Data

It was hypothesized that children would learn the high-meaningfulness pairs of items in a trials-to-criterion,

paired-associates, task more readily than they would learn the low-meaningfulness items. The hypothesis was restated for acceptance or rejection:

$$H_5 : \bar{X}_{high} \leq \bar{X}_{low}$$

A summary of the t-test data is presented in Table VII.

Interpretation of Results

Hypothesis 5. The t ratio for the difference between the means of the trials-to-criterion scores for high-and low-meaningfulness items was significant beyond the .01 level of confidence. The hypothesis that the mean of high meaningingfulness items was equal to or less than the mean of low-meaningfulness items was therefore rejected. The result was interpreted as supporting the hypothesis that high-meaningfulness items would be learned by children more readily than would low-meaningfulness items in a paired-associates, trials-to-criterion, verbal-learning task.

Discussion

The empirical data presented in the third experiment in this study confirm the evidence found in the free-learning, free-recall experiments, namely, that meaningfulness ($\frac{\Sigma R}{N}$), when derived from samples of the population under consideration, exerts a facilitating effect on children's verbal learning. Whether the verbal items are presented in a mixed list, pure lists, or paired-associates lists, does not change this conclusion.

Table VII. Summary of t-test Data: Paired-Associates Learning (Raw Scores, Appendix 21)

Mean Low $\bar{m}$	7.00		
Mean High $\bar{m}$	3.54		
s^2_{low}	5.58	t	6.26
s^2_{high}	1.75		
s_d	.55		
Critical value of t -	.01 (one-tailed)	46 df	2.42
(Fisher and Yates, 1953).			

VII. Experiment IV. Serial-Order Learning

Introduction

In each of the three experiments in this thesis, children learned high-meaningfulness verbal tasks with greater facility than they did low-meaningfulness tasks.

One remaining question was examined in a fourth experiment: Would meaningfulness exert a similar facilitating effect on learning if a serial-order paradigm was used?

Learning Task

In order to examine the function of meaningfulness in serial-order learning by children, two learning tasks were constructed, each containing nine verbal items. Range of meaningfulness for the high $\bar{m}$ items was 4.85 - 7.74 with a mean of 6.02, and for the low $\bar{m}$ items, .41 - 3.41 with a mean of 2.25.

Control of Relevant Variables

Experimental control was exercised over the same seven variables in addition to meaningfulness as in the first three experiments in this study. Table II summarizes the control of relevant variables.

Words were randomly arranged in serial order (Appendix 22) and typed on white paper for use by subjects.

Subjects

Subjects were 48 children, aged nine in the calendar year, 1967, randomly selected (Lindquist, 1956, p. 191) from

pupils who were attending school in School District 63 (Saanich).

Experimental Design

Twenty-four subjects in each of two groups were randomly assigned to treatment. One group learned the high-meaningfulness serial-order items, the other group the low-meaningfulness items.

The raw scores for each individual represent the number of trials needed to learn the nine items to criterion (one perfect performance). A maximum of ten trials was allowed. A detailed description of the procedure followed is included in Appendix 23.

A *t* test of the difference between the means of the trials-to-criterion scores was used in analyzing the data.

The assumptions underlying the use of the *t* test were met as in Experiment II (page 46). The size of the sample, however, in the serial order experiment was 48, 24 in each cell.

Hypothesis and Statistical Treatment of Data

It was hypothesized that children would learn the high-meaningfulness items in a trials-to-criterion, serial-order task more readily than they would learn low-meaningfulness items. The hypothesis was restated for acceptance or rejection:

$$H_6 : \bar{X}_{high} \leq \bar{X}_{low}$$

A summary of the *t*-test data is presented in Table 8.

Interpretation of Results

Hypothesis 6: The t ratio for the difference between the means of the trials-to-criterion scores for high-and low-meaningfulness items was significant beyond the .01 level of confidence. The hypothesis that the mean of high-meaningfulness items was equal to or less than the mean of low-meaningfulness items was therefore rejected. The result was interpreted as supporting the hypothesis that high-meaningfulness items would be learned by children more readily than would low-meaningfulness items in a serial-order, trials-to-criterion experiment.

Discussion

The empirical data presented in the fourth experiment in this study confirm the evidence found in the free-learning, free-recall experiments, and in the paired-assocates experiment, namely, that meaningfulness ($\frac{\Sigma R}{N}$) when derived from samples of the population under consideration, exerts a facilitating effect on children's verbal learning. Whether the verbal items are presented in a mixed list, pure lists, paired-associatees lists, or serial-order lists does not change this conclusion. In each of the four cases, children learned high-meaningfulness verbal tasks with greater facility than they did low-meaningfulness tasks.

Table VIII. Summary of t-test Data: Serial-Order Learning

(Raw Scores, Appendix 24)

Mean Low $\bar{m}$	8.00	
Mean High $\bar{m}$	5.08	
s^2_{low}	3.67	t 4.84
s^2_{high}	5.08	
s_d	.6032	
Critical value of t - (Fisher and Yates, 1953)	.01 (one-tailed) 46 df	2.42

VIII. Conclusion: Meaningfulness ($\bar{m}$) in Children's Verbal Learning

There is a relatively large amount of empirical evidence to support the hypothesis that meaningfulness exerts a facilitating effect on adult verbal learning in laboratory experimentation (pages 14 - 15). However, there appears to be very little evidence reported in the literature to justify generalizing this conclusion to children's verbal learning, and even less empirical research to indicate whether or not meaningfulness is a variable which has application to verbal learning in settings other than the university laboratory.

This study was designed to examine the function of meaningfulness in children's verbal learning. Subjects were examined in their normal school environment in every case. They were asked, however, to leave the classroom for an adjoining room (usually the library) in which testing could be carried out under uniform conditions for all subjects. In no cases were they asked to leave their schools for the required experimentation.

Four experimental paradigms were used: a free-learning, free-recall paradigm in which a mixed list of high-and low-meaningfulness items was used as the learning task, a free-learning, free-recall paradigm in which separate lists of high-and low-meaningfulness verbal items were used, a

paired-associates paradigm in which high-high- and low-low-meaningfulness items were paired and learned in a trials-to-criterion task, and a serial-order paradigm in which separate lists of high- and low-meaningfulness verbal items were used in a trials-to-criterion task.

In every case, meaningfulness was found to have a facilitating effect on children's verbal learning beyond the .01 level of confidence.

It might be argued that the indices of meaningfulness used in this study were association hierarchies, that the types of learning tasks involved only stimulus-response verbal learning, and that, with the possible exception of the first experiment, only short-term memory was involved.

These observations, however, in no way detract from their importance in the study of children's verbal learning. The empirical data presented in this study support the conclusion that the variable of meaningfulness ($\frac{\Sigma R}{N}$) is a relatively lawful construct. Words appear to be more or less meaningful to children as a function of their ability to verbalize associations evoked by a particular stimulus.

A descriptive, behavioristic, rationale is used to define meaningfulness in this study - given a stimulus, the subjects respond with both connotative and denotative ideas indicating the degree of meaningfulness of the verbal item. It would seem equally as valid, however, to suggest that the responses are descriptive of the cognitive structure of an

individual insofar as they indicate the subsumption of ideas into an inclusive concept already existing in the cognitive structure of the subject. Further, it does not seem illogical to suggest that the verbal responses represent for the subject at least a partial representation of the significate indicated by the stimulus.

One is tempted, therefore, to think in terms of a continuum rather than in terms of an "either-or" with respect to a theory of meaningfulness. It may well be that meaningfulness for children increases as a function of the number of associations made to a particular verbal item, that the associations are representational mediators of significates, at least in part, and that the cognitive structure of the individual changes as associative verbal concepts are subsumed under already exisiting ideas in cognitive structure.

Whatever the rationale one accepts by way of explanation of meaningfulness, there seems little doubt that the behavioral manifestation of $\bar{m}, (\frac{\Sigma R}{N})$, can be manipulated as an independent variable to influence children's verbal learning. Again, one is led to think in terms of a continuum insofar as learning is concerned. It is possible that learning is an hierarchical process involving signal learning, stimulus-response learning, chaining, verbal association, multiple discrimination, concept learning, principle learning, and problem solving (Gagné, 1965, p. 33). It would seem

important in considering this to examine with empirical precision each step in the hierarchy.

In an hierarchical concept of learning, such as Gagne's, no link in the chain is unimportant. Thus, researchers need to investigate empirically and precisely the early stages of the hierarchy before attempting to draw unwarranted conclusions about the complex aspects of learning such as concept development or problem solving. As DeCecco (1967, p. 139) notes, if one is patient enough not to demand answers to complex questions before he has found answers to simple ones, it is not impossible to expect that empirical examination of such ideas as Noble's concept of meaningfulness will result in better understanding of the more complex aspects of meaning.

Finally, as Melton (1963) argues, it seems logical to conclude that psychological studies of learning involving human, short-term memory will play an important role in advances toward a general, more comprehensive theory. Insofar as the present study is concerned, it was found that the facilitating effect of meaningfulness on children's verbal learning holds up under four different testing times: immediate, one hour, three hours and twenty-four hours.

The implications of the findings of this study for curriculum and instruction in elementary education are more provocative then definitive. Because meaningfulness ($\bar{m}$) facilitates children's verbal learning, one wonders what the

result would be if, for example, in beginning reading instruction teachers were to find out from children those concepts for which in fact meaningfulness could be demonstrated in terms of multiple associations and begin instruction from that point rather than from a set of prescribed materials presumably suitable for all children. Meaningfulness, as defined in this study, might be thought of as the basis of individual differences in children's verbal facility and, as such, the starting point for individualizing instruction in the language arts programme.

As a result of the empirical evidence presented in this study, it was concluded that meaningfulness ($\bar{m}$), when defined as $\frac{\Sigma R}{N}$ and derived from samples of the population under consideration, facilitated children's verbal learning. This conclusion would seem to warrant further investigation in the applied fields of curriculum development and instruction in elementary education.

IX. Literature Cited

Agrawal, K. G. Influence of age on meaningfulness. Journal of Psychological Researches, 1965, 9 (2), 74-76.

Anderson, N. S. Word associations to individual letters. Journal of Verbal Learning and Verbal Behavior, 1965, 4, 541-545.

Archer, E. J. Re-evaluation of the meaningfulness of all possible CVC trigrams. Psychological Monographs, General and Applied, 1960, 74 (10, Whole No. 497).

Ausubel, D. P. The psychology of meaningful verbal learning. New York: Grune & Stratton, 1963.

Avis, W. S., Drysdale, P. D., Gregg, R. J., & Scargill, M. H. Dictionary of Canadian English, the senior dictionary. Toronto: W. J. Gage Limited, 1967.

Badia, P., Rosenberg, B. G., & Langer, J. Representational value, meaningfulness, and pronunciability in serial learning. Psychological Reports, 1965, 16 (3, Pt. 1), 997-1000.

Battig, W. F. Interrelationships between measures of association and structural characteristics of nonsense shapes. Perceptual and Motor Skills, 1962, 14, 3-6.

Battig, W. F., & Spera, A. J. Rated association values of numbers from 0-100. Journal of Verbal Learning and Verbal Behavior, 1962, 1, 200-202.

Bloomer, R. H. Concepts of meaning and the reading and spelling difficulty of words. Journal of Educational Research, 1961, 54 (5), 178-182.

Bogartz, W., & Headrick, A. The length-difficulty law of serial learning: an empirical function and a theoretical derivation. Psychonomic Science, 1965, 3, 357-358.

Bousfield, W. A. The occurrence of clustering in the recall of randomly arranged associates. Journal of General Psychology, 1953, 49, 229-240.

Bousfield, W. A., Cohen, B. H., & Whitmarsh, G. A. Associative clustering in the recall of words of different taxonomic frequencies of occurrence. Psychological Reports, 1958, 4, 39-44.

Broerse, A. C., & Zwaan, E. J. The information value of initial letters in the identification of words. Journal of Verbal Learning and Verbal Behavior, 1966, 5 (5), 441-446.

Brown, R., & Berko, J. Word association and the acquisition of grammar. Child Development, 1960, 31, 1-14.

Carroll, J. B. The analysis of reading instruction: perspectives from psychology and linguistics. In Hilgard, E. R. (Ed.) Theories of Learning and Instruction: The Sixty-third Yearbook of the National Society for the Study of Education Part I. Chicago: The University of Chicago Press, 1964, 336-354.

Castaneda, A., Fahel, L. S., & Odom, R. Associative characteristics of 63 adjectives and their relation to verbal paired-associate learning in children. Child Development, 1961, 32, 297-304.

Catalano, J. cited in Epstein, W., Rock, I., & Zuckerman, C. B. Meaning and familiarity in associative learning. Psychological Monographs, General and Applied, 1960, 74 (4, Whole No. 491).

Cautela, J. R. The effect of S meaningfulness and R meaningfulness on R-S learning. Journal of Psychology, 1965, 61 (1), 123-126.

Cieutat, V. J. Association indices for 446 randomly selected English monosyllables, bisyllables, and trisyllables. Journal of Verbal Learning and Verbal Behavior, 1963, 2, 176-185.

Cochran, S. W., & Wickens, D. D. Supplementary report: rated association values of numbers from 0-100. Journal of Verbal Learning and Verbal Behavior, 1963, 2, 373-374.

Cooper, J. C., Jr., & Gaeth, J. H. Interactions of modality with age and with meaningfulness in verbal learning. Journal of Educational Psychology, 1967, 58 (1), 41-44.

Davis, G. A. Effects of list length and the number of response alternatives in a serially learned paired-associates task. The Journal of General Psychology, 1966, 75 (1), 29-33.

De Cecco, J. P. The psychology of language, thought, and instruction. Toronto: Holt, Rinehart and Winston, Inc., 1967.

Deese, J. Influence of inter-item associative strength upon immediate free recall. Psychological Reports, 1959, 5, 305-312.

Deese, J. From the isolated verbal unit to connected discourse. In Cofer, C. N. (Ed.) Verbal learning and verbal behavior: McGraw-Hill Book Company, Inc., 1961, 11-38.

Dowling, R. M., & Braun, H. W. Retention and meaningfulness of material. Journal of Experimental Psychology, 1957, 54 (3), 213-217.

Dukes, W. F., & Bastian, J. Recall of abstract and concrete words equated for meaningfulness. Journal of Verbal Learning and Verbal Behavior, 1966, 5 (5), 455-458.

Ekstrand, B. R., & Underwood, B. J. Free learning and recall as a function of unit-sequence and letter-sequence interference. Journal of Verbal Learning and Verbal Behavior, 1965, 4 (5), 390-396.

Entwisle, D. R. Form class and children's word associations. Journal of Verbal Learning and Verbal Behavior, 1966, 5, 558-565. (a)

Entwisle, D. R. Word associations of young children. Baltimore: The Johns Hopkins Press, 1966. (b)

Entwisle, D. R., Forsyth, D. F., & Muuss, R. The syntactic-paradigmatic shift in children's word associations. Journal of Verbal Learning and Verbal Behavior, 1964, 3, 19-29.

Epstein, W. Backward association as a function as meaningfulness. Journal of General Psychology, 1962, 67, 11-20.

Epstein, W. The effect of stimulus and response meaningfulness when response availability is equated. Journal of Verbal Learning and Verbal Behavior, 1963, 2, 242-249.

Epstein, W., & Platt, J. R. Free recall of paired associates as a function of meaningfulness. Journal of Verbal Learning and Verbal Behavior, 1964, 3, 269-273.

Epstein, W., Rock, I., & Zuckerman, C. B. Meaning and familiarity in associative learning. Psychological Monographs, General and Applied, 1960, 74 (4, Whole No. 491).

Ervin, S. M. Changes with age on the verbal determinants of word association. American Journal of Psychology, 1961, 74, 361-372.

Fisher, R. A., & Yates, F. Statistical tables for biological, agricultural and medical research. London: Oliver and Boyd, 1963.

Ferguson, G. A. Statistical analysis in psychology and education. (2nd ed.) Toronto: McGraw-Hill Book Company, 1966.

Gaeth, J. H. Verbal and nonverbal learning in children including those with hearing losses. Cooperative Research Project, No. 1001. Detroit: Wayne State University, 1964.

Gaeth, J. H., & Allen, D. V.. Association values for selected trigrams with children. Journal of Verbal Learning and Verbal Behavior, 1966, 5 (5), 473-477.

Gagné, R. M. The conditions of learning. Toronto: Holt, Rinehart, and Winston, Inc., 1965.

Garner, W. R., & Whitman, J. R. Form and amount of internal structure as factors in free-recall learning of nonsense words. Journal of Verbal Learning and Verbal Behavior, 1965, 4 (4), 257-266.

Gibson, E. J., Bishop, C. H., Schiff, W., & Smith, J. Comparison of meaningfulness and pronunciability as grouping principles in the perception and retention of verbal material. Journal of Experimental Psychology, 1964, 67, 173-182.

Glaze, J. A. The association value of non-sense syllables. Journal of Genetic Psychology, 1928, 35, 255-269.

Goldstein, A. G. Spatial orientation as a factor in eliciting associative responses to random shapes. Perceptual and Motor Skills, 1961, 12, 15-25.

Gorman, A. Recognition memory for nouns as a function of abstractness and frequency. Journal of Experimental Psychology, 1961 (1), 23-29.

Goss, A. E., & Nodine, C. F. Paired-associates learning. New York: Academic Press, 1965.

Greenfeld, N., & Prindle, A. Acquisition of a foreign language vocabulary as influenced by meaning ($\bar{m}$) and reinforcement. Psychological Reports, 1966, 19 (2), 585-586.

Hall, J. F. Relationships among a number of measures of meaningfulness. American Journal of Psychology, 1967, 80 (2), 291-293.

Hays, W. L. Statistics for psychologists. Toronto: Holt, Rinehart and Winston, 1963.

Heim, A. W., Watts, K. P., Bower, I. B., & Hawton, K.E. Learning and retention of word-pairs with varying degrees of association. Quarterly Journal of Experimental Psychology, 1966, 18 (3), 193-205.

Hilgard, E. R. Learning and the technology of instruction. In Hilgard, E. R., & Bower, G. H. Theories of learning (3rd ed.) New York: Appleton-Century-Crofts, 1966, 541-584.

Horowitz, L. M. Free recall and ordering of trigrams. Journal of Experimental Psychology, 1961, 62, 51-57.

Hull, C. L. The meaningfulness of 320 selected nonsense syllables. American Journal of Psychology, 1933, 45, 730-734.

Imae, K. & Umemoto, T. Meaningfulness of number as a variable in verbal learning. Psychologia An International Journal of Psychology in the Orient, 1966, 9 (3), 137-144.

Jenkins, J. J., & Russell, W. A. Systematic changes in word association norms. Journal of Abnormal and Social Psychology, 1960(3), 293-304.

Johnson, R. C. Meaningfulness of 80 English words. Psychological Reports, 1961, 9, 431.

Johnson, R. C. Reanalysis of 'Meaningfulness and verbal learning'. Psychological Review, 1962, 69, 233-238.

Johnson, R. C., Frincke, G., & Martin, L. Meaningfulness, frequency, and affective character of words as related to visual duration threshold. Canadian Journal of Psychology, 1961, 15, 199-204.

Johnson, R. C., Thomson, C. W., & Frincke, G. Word values, word frequency, and visual duration thresholds. Psychological Review, 1960, 67, 332-342.

Kent, G. H., & Rosanoff, A. J. A study of association in insanity. American Journal of Insanity, 1910, 67, 4-96.

Keppel, G. Word value and verbal learning. Journal of Verbal Learning and Verbal Behavior, 1963, 1 (5), 353-356.

Keppel, G. Verbal learning in children. Psychological Bulletin, 1964, 61 (1), 63-80.

Koen, F. Polarization, m, and emotionality in words. Journal of Verbal Learning and Verbal Behavior, 1962, 1 (3), 183-187.

Kothurkar, V. K. Effect of stimulus-response meaningfulness on paired-associate learning and retention. Journal of Experimental Psychology, 1963, 65, 305-308.

Krueger, W. C. F. The relative difficulty of nonsense syllables. Journal of Experimental Psychology, 1934, 17, 145-153.

Lindley, R. H. Association value, familiarity, and pronunciability ratings as predictors of serial verbal learning. Journal of Experimental Psychology, 1963, 65, 347-351.

Lindley, R. H. Words and pronunciation as coding aids. Psychonomic Science, 1966, 6 (8), 395-396.

Lindley, R. H., & Stone, W. G. Measures of meaningfulness and ease of free recall. Journal of Verbal Learning and Verbal Behavior, 1967, 6, 264-267.

Lindquist, E. F. Design and analysis of experiments in psychology and education. Boston: Houghton Mifflin Company, 1956.

Mandler, G. Associative frequency and associative prepotency as measures of response to nonsense syllables. American Journal of Psychology, 1955, 68, 662-665.

Mandler, G., & Campbell, E. H. Effect of variation in associative frequency of stimulus and response members on paired-associate learning. Journal of Experimental Psychology, 1957, 54, 269-273.

Martin, C. J., Cox, D. L., & Boersma, F. J. The role of associative strategies in the acquisition of P-A material: an alternate approach to meaningfulness. Psychonomic Science, 1965, 3, 463-464.

McCullers, J. C. Effects of associative strength, grade level, and interpair interval in verbal paired-associate learning. Child Development, 1961, 32, 773-778.

McNulty, J. A. Short-term retention as a function of method of measurement, recording time, and meaningfulness of the material. Canadian Journal of Psychology, 1965, 19 (3), 188-196.

Melton, A. Implications of short term memory for a general theory of memory. Journal of Verbal Learning and Verbal Behavior, 1963, 2 (1), 1-21.

Miller, G. A. The magical number seven, plus or minus two: some limits on our capacity for processing information. Psychological Review, 1956, 63, 81-97.

Miller, G. A. Free recall of redundant strings of letters. Journal of Experimental Psychology, 1958, 56, 485-491.

Nikkel, N., & Palermo, D. S. Effects of mediated associations in paired-associate learning of children. Journal of Experimental Child Psychology, 1965, 2, 92-102.

Noble, C. E. An analysis of meaning. Psychological Review, 1952, 59 (6), 421-430.

Noble, C. E. Measurement of association value (a), rated associations (a') and scaled meaningfulness (m') for the 2100 CVC combinations of the English alphabet. Psychological Reports, 1961 (8), 487-521.

Noble, C. E. Meaningfulness and familiarity. In Cofer, C. N., & Musgrave, B. (Ed.). Verbal behavior and learning: problems and processes. Toronto: McGraw-Hill Book Company, 1963, 76-119.

Noble, C. E., & Parker, C. V. C. The Montana scale of meaningfulness (m). Psychological Reports, 1960, 325-331.

Noble, C. E., Showell, F. A., & Jones, H. R. Serial CVC learning with varied m' but equal a values. Psychonomic Science, 1966, 4 (6), 217-218.

Noble, C. E., Stockwell, F. E., & Pryer, M. W. Meaningfulness (m') and association value (a) in paired-associate syllable learning. Psychological Reports, 1957, 3, 441-452.

Nodine, C. F. Stimulus durations and stimulus characteristics in paired-associates learning. Journal of Experimental Psychology, 1963, 66 (1), 100-106.

Osgood, C. E., Suci, G. J., & Tannenbaum, P. H. The measurement of meaning. Urbana: University of Illinois Press, 1965.

Paivio, A. Abstractness, imagery, and meaningfulness in paired-associate learning. Journal of Verbal Learning and Verbal Behavior, 1965, 4 (1), 32-38.

Paivio, A. Paired-associate learning and free recall of nouns as a function of concreteness, specificity, imagery and meaningfulness. Psychological Reports, 1967, 20, 239-245.

Paivio, A., & Yuille, J. C. Word abstractness and meaningfulness, and paired-associate learning in children. Journal of Experimental Child Psychology, 1966, 4 (1), 81-89.

Paivio, A., Yuille, J.C., & Smythe, P. C. Stimulus and response abstractness, imagery, and meaningfulness, and reported mediators in paired-associate learning. Canadian Journal of Psychology, 1966, 20 (4), 362-377.

Palermo, D. S., Flamer, G. B., & Jenkins, J. J. Association value of responses in the paired-associate learning of children and adults. Journal of Verbal Learning and Verbal Behavior, 1964, 3, 171-175.

Palermo, D. S., & Jenkins, J. J. Frequency of superordinate responses to a word association test as a function of age. Journal of Verbal Learning and Verbal Behavior, 1963, 1 (5), 378-383.

Palermo, D. S., & Jenkins, J. J. Paired-associate learning as a function of the strength of links in the associative chain. Journal of Verbal Learning and Verbal Behavior, 1964, 3, 406-412. (a)

Palermo, D. S., & Jenkins, J. J. Word association norms grade school through college. Minneapolis: University of Minnesota Press, 1964. (b)

Peixotto, H. E. The recognitive value of three hundred nonsense syllables. American Journal of Psychology, 1948, 61, 352-360.

Pollio, H. R., & Christy, E. G. Variation of inter-item associative strength and some measures of free recall. Psychological Reports, 1964, 15 (2), 527-534.

Postman, L. Extra-experimental interference and the retention of words. Journal of Experimental Psychology, 1961, 61, 97-110.

Postman, L. Norms of word association. New York: Academic Press, In Goss, A. E., & Nodine, C. F. Paired-associates learning. New York: Academic Press, 1965.

Postman, L., & Phillips, L. W. Studies in incidental learning: IX. A comparison of the methods of successive and single recalls. Journal of Experimental Psychology, 1961, 61, 236-241.

Rearden, J. J., & Gladstone, R. Age, meaningfulness and ability in single trial learning. Psychological Reports, 1966, 18 (1), 27-30.

Richardson, J., & Brown, B. Mediated transfer in paired-associate learning as a function of presentation rate and stimulus meaningfulness. Journal of Experimental Psychology, 1966, 72 (6), 820-828.

Riegel, K. F., & Riegel, R. M. Prediction of word-recognition thresholds on the basis of stimulus-parameters. Language and Speech, 1961, 4, 157-170.

Rosanoff, J. R., & Rosanoff, A. J. A study of association in children. Psychological Review, 1913, 20, 43-89.

Russell, W. A., & Jenkins, J. J. The complete Minnesota norms for responses to 100 words from the Kent-Rosanoff word association test. Technical report No. 11. Contract N8-ONR-66216, Office of Naval Research, and University of Minnesota, 1954, cited in Palermo, D. S., & Jenkins, J. J. Word association norms grade school through college. Minneapolis: University of Minnesota Press, 1964.

Ruth, R. A., & Nye, M. Appropriateness of published association norms for a Canadian sample. Unpublished paper delivered at the British Columbia Educational Research Council. Vancouver: 1967.

Saltz, E. Thorndike-Lorge frequency and $\bar{m}$ of stimuli as separate factors in paired-associates learning. Journal of Experimental Psychology, 1967, 73 (3), 473-478.

Schutte, W., & Hildebrand , N. Tachistoscopic recognition thresholds and meaningfulness. Psychonomic Science, 1966, 6 (2), 53-54.

Shapiro, S. S. Meaningfulness values for 52 CVC's for grade-school-aged children. Psychonomic Science, 1964, 1, 127-128. (a)

Shapiro, S. S. Word associations and meaningfulness values for grade-school-aged children. Psychological Reports, 1964, 15, 447-455. (b)

Simon, S., & Hess, J. L. Supplementary report: influence of inter-item associative strength upon immediate free recall in children. Psychological Reports, 1965, 16 (2) 451-455.

Simon, S., Lotsof, E. J., & Pease, H. E. Associative originality training in children. Paper presented at the Midwestern Psychological Association meetings, Chicago, 1963, cited in Simon, S., & Hess, J. L. Supplementary report: influence of inter-item associative strength upon immediate free recall in children. Psychological Reports, 1965, 16 (2), 451-455.

Skinner, B. F. Verbal behavior, New York: Appleton-Century-Crofts, Inc., 1957.

Spreen, O., Borkowski, J. G., & Gordon, A. M. Effects of abstractness, meaningfulness, and phonetic structure on auditory recognition of nouns. Journal of Speech and Hearing Research, 1966, 9 (4), 619-625.

Spreen, O., & Schulz, R. W. Parameters of abstraction, meaningfulness and pronunciability for 329 nouns. Journal of Verbal Learning and Verbal Behavior, 1966, 5 (5), 459-468.

Stageberg, N. C. An introduction to English grammar. Toronto: Holt, Rinehart and Winston, Inc., 1966.

Stoddard, G. D. An experiment in verbal learning. Journal of Educational Psychology, 1929, 20, 452-457.

Stroud, J. B. Experiments on learning in school situations. Psychological Bulletin, 1940, 37, 777-807.

Taylor, J. D. The meaningfulness of 320 words and paralogs. Unpublished PhD. Dissertation, Duke University, 1959, In Goss, A. E., & Nodine, C. F. Paired-Associates Learning. New York: Academic Press, 1965.

Thorndike, E. L., & Lorge, I. The teacher's word book of 30,000 words. New York: Bureau of Publications, Teachers' College, Columbia University, 1944.

Trapp, E. P., & Kausler, D. H. A revision of Hull's table of associative values for 320 selected nonsense-syllables. American Journal of Psychology, 1959, 72, 423-428.

Umemoto, T., & Imae, K. Association values and meaningfulness of numbers from 0-100. Japanese Journal of Psychology, 1965, 36, 14-16 cited in Imae, K., & Umemoto, T. Meaningfulness of number as a variable in verbal learning. Psychologia An International Journal of Psychology in the Orient, 1966, 9 (3), 137-144.

Underwood, B. J. Verbal learning in the educative processes. Harvard Educational Review, 1959, 29, 107-117.

Underwood, B. J. Articulation in verbal learning. Journal of Verbal Learning and Verbal Behavior, 1964, 3, 146-149.

Underwood, B. J., Ekstrand, B. R., & Keppel, G. Studies of distributed practice: XXIII. Variations in response-term interference. Journal of Experimental Psychology, 1964, 68 (2), 201-212.

Underwood, B. J., & Erlebacher, A. H. Studies of coding in verbal learning. Psychological Monographs: General and Applied, 1965, 79 (13, Whole No. 606).

Underwood, B. J., & Keppel, G. Coding processes in verbal learning. Journal of Verbal Learning and Verbal Behavior, 1963, 1 (4), 250-257. (a)

Underwood, B. J., & Keppel, G. Retention as a function of degree of learning and letter-sequence interference. Psychological Monographs: General and Applied, 1963, 77 (4, Whole No. 567). (b)

Underwood, B. J., & Postman, L. Extraexperimental sources of interference in forgetting. The Psychological Review, 1960, 67 (2), 73-95.

Underwood, B. J., & Richardson, J. The influence of meaningfulness, intralist similarity, and serial position on retention. Journal of Experimental Psychology, 1956, 52, 119-126.

Underwood, B. J., & Schulz, R. W. Meaningfulness and verbal learning. New York: J. B. Lippincott Company, 1960.

Vanderplas, J. M., & Garvin, E. A. The association value of random shapes. Journal of Experimental Psychology, 1959, 57, (3), 147-154.

Vicory, A. C., & Asher, J. J. A simplified associative-frequency measure of meaningfulness in verbal learning. Journal of Verbal Learning and Verbal Behavior, 1966, 5 (6), 507-513.

Waugh, N. C. Presentation time and free recall. Journal of Experimental Psychology, 1967, 73 (1), 39-44.

Weinberg, G. H., & Schumaker, J. A. Statistics an intuitive approach. Belmont, California: Wadsworth Publishing Company, Inc., 1965.

Winer, B. J. Statistical principles in experimental design. Toronto: McGraw-Hill Book Company, 1962.

Winnick, W. A., & Kressel, K. Tachistoscopic recognition thresholds, paired-associate learning, and free recall as a function of abstractness-concreteness and word frequency. Journal of Experimental Psychology, 1965, 70 (2), 163-168.

Witmer, L. R. The association value of three-place consonant syllables. Journal of Genetic Psychology, 1935, 47, 337-360.

Woodrow, H., & Lowell, F. Children's association frequency tables. The Psychological Monographs, 1916, 22 (5, Whole No. 97).

Yarmey, A. D., & Paivio, A. Further evidence on the effects of word abstractness and meaningfulness in paired-associate learning. Psychonomic Science, 1965, 2 (10), 307-308.

APPENDICES

Appendix 1

Verbal Learning: Terminology

The study of verbal learning, like most other disciplines, employs a specific vocabulary. The following standard terms and abbreviations are used in this study:

A and AA words. A words occur in the English language 50 to 100 times per million. AA words occur 100 times or over per million (Thorndike & Lorge, 1944, p. ix). According to Thorndike and Lorge, both A words and AA words should be taught for permanent knowledge in grade three (p. xi).

CCC. CCC is the standard abbreviation used for a trigram with a consonant-consonant-consonant structure. "LBJ" is an example.

CVC. CVC is the standard abbreviation used for a trigram with a consonant-vowel-consonant structure. "CAT" is an example.

CVCVC. A verbal unit with a consonant-vowel-consonant-vowel-consonant structure is commonly abbreviated as CVCVC.

Dissyllable. Noble (1952), in scaling for meaningfulness, used 96 two-syllable verbal units as stimuli. Some were words, some were not. These verbal units he called dissyllables. "GOJEY", "BODICE", and "KITCHEN" are examples.

Free learning. Perhaps the simplest verbal learning situation is free learning wherein subjects are given a series of words to learn and subsequently asked to recall

them in any order. Method of presentation of the stimulus varies according to the interests of the experimenter. Free learning appears to be a verbal learning situation common in educational practice.

Free recall. In a free recall paradigm, subjects are asked to recall in any order verbal units which they have studied.

G count. In the Thorndike-Lorge scale (1944), the G count is expressed as a numeral stating the number of times a word appears in English per million words.

J count. The J count is an index of Thorndike's and Lorge's analysis of 120 juvenile books. It provides an indication of the number of times a word appears, by actual count or by estimation, in four and one-half million words.

Mass and count nouns. The count noun class includes everything that is countable, such as "beetles", "books", "minutes". The mass noun class includes everything that is not countable, such as "steam", "music", and "milk". Many nouns can be mass nouns in one context and count nouns in another. "Beer" is an example. Where this is the case, Stageberg's general rule of thumb will be followed: count nouns are modified by "many", mass nouns by "much" (Stageberg, 1966, p. 280).

Mixed list. A mixed list is a list of verbal units purposely composed of items meeting criteria for more than one variable. A list containing both high and low-meaning-

fulness items is an example.

Paired-associates learning. A paired-associates paradigm uses verbal units which are presented in pairs to the subjects. Subsequently, subjects are given one of the units and asked to recall the other which was presented with it in the learning task.

Paradigmatic responses. Responses which can be considered replacement words, usually of the same form class as the stimulus, are classified as paradigmatic. An example is the response, "come" to the stimulus, "go".

Paralogs. Taylor (1959) designated verbal items with a CVCVC structure paralogs.

Phoneme. Stageberg (1966) defines a phoneme as a speech sound that signals a difference in meaning. By this definition, it is possible for a single letter to be classified as a phoneme providing the difference in meaning between two words is a function of the sound difference of the letters. Consider, for example, the words "dime" and "dine" or "class" and "glass".

Serial-order learning. In a serial order paradigm, the subject is presented with a list of verbal items to learn. When he is asked for recall, the subject must remember the items in order of presentation.

Superordinate responses. These responses are usually considered to be abstractions. However, superordinate responses were somewhat differently defined by Jenkins and

Russell (1960) and their behavioral definition was subsequently used by Palermo and Jenkins (1963).

A written test was given to 29 subjects which consisted of a set of 100 sentences in the form of "_____ is a member of the class _____". Each sentence began with one of the Kent-Rosanoff (1910) stimulus words and each subject completed the sentence with a single response. A superordinate response was defined as any sentence completion that was given by fifteen or more of the subjects.

Syntactic response. A response which normally follows the stimulus word in a sentence is termed syntactic. The response "home" to the stimulus "go" is an example.

Appendix 2

Subjects

I.	Table of Meaningfulness	135	135
II.	Table of Meaningfulness:		
	Cross validation	204	
		339	
III.	Experiment 1:		
	Free learning, free recall, mixed list		
	4 groups, each of N = 32		128
IV.	Experiment 2:		
	Free learning, free recall, unmixed list		
	2 groups, each of N = 32		64
V.	Experiment 3: Paired-associates paradigm		
	2 groups, each of N = 24		48
VI.	Experiment IV: Serial order paradigm		
	2 groups, each of N = 24		48
	Total number of subjects used once		423
	Cross validation group		204
	Grand total		627

Note: No subject in the four experiments was used more than once.

Appendix 2

Subjects: Schools Used

I. Table of Meaningfulness

School District # 61 (Greater Victoria)

Beacon Hill	North Ward
Cedar Hill	Quadra Primary
North Ridge	

N = 135

II. Cross Validation group

School District # 63 (Saanich)

Beaver Lake	Keating
Brentwood	Lochside
Cordova Bay	Saanichton
Elk Lake	Sidney

N = 204

III. Experiments 1 - 4

Beaver Lake	McTavish Road
Brentwood	Prospect Lake
Cordova Bay	Royal Oak
Deep Cove	Saanichton
Durrance Road	Sansbury
Keating	Sidney
Lochside	

N = 288

Total	423
Cross validation group	204
Grand total	627

Appendix 3

Randomly Selected Mass and Count Nouns

(Thorndike and Lorge, 1944)

A		AA	
Mass	Count	Mass	Count
wine	maid	news	finger
quality	settlement	joy	inch
sport	league	music	building
freedom	accident	height	class
content	coin	food	farm
gas	committee	paper	arm
faith	passenger	strength	mile
shame	breakfast	wood	bill
friendship	prison	sugar	enemy
courage	sword	ice	lady
commerce	principal	sky	heart
glory	slave	grass	mouth
wealth	trail	spirit	nation
fun	deed	salt	mother
property	meal	pleasure	season
clothing	hospital	beauty	woman
justice	student	future	nose
charm	pupil	weather	dollar
understanding	chicken	peace	house
concern	teeth	wind	baby
wool	stage	west	office
fashion	professor	history	job
virtue	nut	oil	friend
darkness	victory	meat	island
memory	pan	gold	town
metal	temple	truth	moment
treasure	minister	soil	eye
cream	pattern	shade	room
defence	possession	material	branch
style	factory	outside	world

Appendix 4

Sample Data Sheet

FUTURE

future _____
future _____
future _____
future _____
future _____
future _____
future _____
future _____
future _____
future _____
future _____

DOLLAR

dollar _____
dollar _____
dollar _____
dollar _____
dollar _____
dollar _____
dollar _____
dollar _____
dollar _____
dollar _____
dollar _____

PAN

pan _____
pan _____
pan _____
pan _____
pan _____
pan _____
pan _____
pan _____
pan _____
pan _____
pan _____

FARM

farm _____
farm _____
farm _____
farm _____
farm _____
farm _____
farm _____
farm _____
farm _____
farm _____
farm _____

Appendix 5

Randomly Arranged Order of Items on Data Sheets

lady	cream	faith	arm
island	shame	friendship	bill
truth	height	sport	nation
office	wealth	content	sugar
accident	soil	town	strength
committee	sky	friend	league
breakfast	paper	joy	slave
metal	peace	meat	chicken
principal	wind	inch	property
deed	ice	job	understanding
hospital	season	heart	wool
room	teeth	moment	fashion
west	wine	charm	darkness
commerce	branch	gold	grass
professor	eye	material	beauty
minister	quality	baby	history
mouth	meal	coin	house
shade	student	maid	justice
weather	enemy	defence	wood
courage	oil	nut	news
fun	pleasure	pan	music
glory	freedom	dollar	temple
clothing	spirit	future	salt
world	virtue	farm	nose
class	memory	sword	
building	prison	gas	
outside	victory	possession	
style	trail	factory	
pattern	treasure	finger	
concern	stage	mile	
pupil	settlement	mother	
food	passenger	woman	

Appendix 6

Instructions to Teachers

TO THE TEACHER:

Thank you for your help in this research project.

It is important in any research study that data be gathered objectively. No record of your class's responses as a unit will be kept. All data will be pooled. Therefore, it is not necessary to have your children's names on responses unless you wish.

The following points, however, should be carefully noted and adhered to in order that the data will be valid:

(1) Please go over instructions carefully with the children in order to be sure they understand exactly what is required.

(2) Read each key word aloud when you come to it. Repeat it once. For example:

"The next key word is 'dog'. 'Dog'. Are you ready? Go."

(3) From the second you say "Go" give the children exactly one minute to record answers. Please use a stop watch if you have one. If not, use a watch with a second hand. THIS TIME LIMIT IS EXTREMELY IMPORTANT. If it is not strictly followed, results will be invalidated. Say "Stop" exactly 60 seconds after you have said "Go".

(4) Proceed to the next key word. Follow the same routine exactly.

(5) It does not matter how many words your class completes at each sitting. The important thing is that the children not be tired or bored. This initial gathering of data can be tedious unless it is carefully handled and spaced by you, the teacher. Please use your own judgment and knowledge of your class to decide on the length of each session.

(6) One suggested procedure might be to give the class one sheet at 9 a.m., one at 10:45 a.m. and one at 1 p.m. After the first sheet has been completed and the children familiar with the routine, each sheet should take only about five minutes to administer.

(7) It is important that all data be gathered in June. As soon as your class has completed the data sheets, please give all material to your principal. It is also important that no data sheets be lost. Your cooperation in carefully

keeping all data sheets is very much appreciated.

(8) The sheets do not have to be administered in any particular order.

Should you have any questions or problems, please contact me through your principal.

Once again, thank you very much for your help in gathering data for this research project. Your cooperation is very much appreciated.

Appendix 6

Instructions to Teachers[1]

SESSION 1 - DEMONSTRATION BY EXPERIMENTER (Teachers observe)

INSTRUCTIONS TO BE READ TO THE PUPILS:

This is an exercise to see how many words you can think of and write in a short time.

I will say a key word and you will see it on your paper.

After I have said the key word twice, I will say, "Go". You are to write as many words as you can think of when you see and hear the key word. For example, think of the word, "DOG". Some words which you might think of when you see and hear the word "DOG" are:

brown	puppy
paw	ears
bark	growl
run	hair

We will do one key word at a time. Do not go on to the next key word until I tell you to. Remember, think of only one key word at a time.

You do not need to fill all the spaces. You may write as many words as you wish on a line. I will tell you when to stop. Here is a sample:

Experimenter:

Use the green sheet with four examples. "The first word is DOG. DOG. Are you ready? Go."

Go over the responses orally with the children.

Have the pupils complete the remaining three words in the required manner. (SCHOOL, BOOK, RING) Allow exactly 60 seconds for the responses for each word. Briefly discuss responses with the children.

SESSION 2 - PRACTICE SESSION BY THE TEACHER

(CAT, EYE, TREE, STOVE)	Use the yellow sheet with four examples Complete each key word in the required manner. Briefly discuss responses with the children.

[1]Adapted from Noble, 1952.

Appendix 7

Marking Criteria (Adapted from Noble, 1952)

The method of recording S's responses was sufficiently objective to require very little evaluation on E's part. However, in terms of the analysis of meaningfulness being considered, certain objective criteria were made for unacceptable responses:

1. Illegible responses: $S_x \longrightarrow ?$
2. Perseverated responses: $S_x \longrightarrow R_1$ $\quad (S_1) \longrightarrow R_1$ $\quad (S_1) \longrightarrow \ldots$
3. Failure of set:

This last class of unacceptable responses was classified into free or tangential associations such as:

SNOW	white
	black

and clang or alliterative responses, such as:

MOTHER	good
	hood
	should
	could

In each case, one credit was given for the first response.

Finally, a general rule of giving the subject the benefit of the doubt was followed.

In marking young children's responses, E's made the following clarifications:

Spelling was not counted if the intention of the subject was clear.

Chained responses such as "on the chair" were given one credit.

Appendix 8

Comparative Table of Meaningfulness:

Arrangement of Words on Data Sheets

virtue	shame
gas	soil
mother	clothing
wealth	material
factory	stage
wood	commerce
victory	farm
house	breakfast
freedom	room
lady	salt
job	concern
finger	weather
teeth	passenger
peace	possession
chicken	food
wine	committee
world	future
oil	office
charm	paper
pattern	content
town	height
maid	hospital
quality	history
island	deed

Appendix 9

Comparative Table of Meaningfulness

Victoria		Saanich	
house	8.41	farm	7.57
clothing	7.74	weather	7.47
world	7.67	food	7.02
breakfast	7.26	world	6.18
weather	7.11	house	6.16
hospital	6.96	chicken	6.02
lady	6.96	breakfast	6.00
island	6.93	clothing	5.88
room	6.93	mother	5.55
chicken	6.56	town	5.43
farm	6.52	wood	5.29
food	6.52	room	5.24
office	6.37	hospital	5.18
town	6.33	lady	5.16
mother	6.26	paper	4.94
wood	6.26	teeth	4.55
paper	4.63	passenger	4.53
finger	4.59	stage	4.45
stage	4.56	finger	4.41
teeth	4.52	island	4.41
passenger	4.44	oil	4.35
oil	4.37	office	4.33
salt	4.37	soil	4.27
maid	4.33	gas	4.27
deed	4.30	material	4.20
gas	4.19	factory	4.16
pattern	4.19	job	4.10
job	4.07	salt	4.00
factory	4.07	pattern	3.69
soil	4.07	maid	3.57
history	4.04	height	3.53
material	4.00	history	3.33
height	2.59	deed	3.25
freedom	2.52	wine	3.18
charm	2.52	charm	2.71
shame	2.41	peace	2.08
wine	2.07	shame	2.06
victory	1.96	future	2.04
peace	1.93	wealth	2.02
future	1.78	quality	1.75
committee	1.63	freedom	1.73
commerce	1.33	committee	1.57
virtue	1.11	content	1.35
wealth	1.04	victory	1.02
quality	.96	concern	.94
content	.93	possession	.90
concern	.93	virtue	.78
possession	.41	commerce	.76

Appendix 10

Data for Correlation Coefficient (Pearson Product Moment) between two Measures of Meaningfulness for 48 Words

	x	y		x	y
house	8.41	6.16	deed	4.30	3.25
clothing	7.74	5.88	gas	4.19	4.27
world	7.67	6.18	pattern	4.19	3.69
breakfast	7.26	6.00	job	4.07	4.10
weather	7.11	7.47	factory	4.07	4.16
hospital	6.96	5.18	soil	4.07	4.27
lady	6.96	5.16	history	4.04	3.33
island	6.93	4.41	material	4.00	4.20
room	6.93	5.24	height	2.59	3.53
chicken	6.56	6.02	freedom	2.52	1.73
farm	6.52	7.57	charm	2.52	2.71
food	6.52	7.02	shame	2.41	2.06
office	6.37	4.33	wine	2.07	3.18
town	6.33	5.43	victory	1.96	1.02
mother	6.26	5.55	peace	1.93	2.08
wood	6.26	5.29	future	1.78	2.04
paper	4.63	4.94	committee	1.63	1.57
finger	4.59	4.41	commerce	1.33	.76
stage	4.56	4.45	virtue	1.11	.78
teeth	4.52	4.55	wealth	1.04	2.02
passenger	4.44	4.53	quality	.96	1.75
oil	4.37	4.35	content	.93	1.35
salt	4.37	4.00	concern	.93	.94
maid	4.33	3.57	possession	.41	.90

Σx 205.65 Σy 187.38

Σx^2 1118.5323 Σy^2 889.7492

Σxy 981.4132

$\underline{r}$ = .9213

Appendix 11

Table of First Associations (%)

High $\bar{m}$

Stimulus	Response		Stimulus	Response	
beauty	pretty	19%	meal	eat	22%
	beautiful	15%		good	11%
	lovely	11%		supper	11%
				food	7%
				eggs	7%
chicken	meat	11%		milk	7%
	legs	7%		breakfast	7%
	scared	7%			
			nose	eyes	15%
class	children	19%		sniffing	11%
	desk	19%		smell	11%
	books	15%		funny	7%
	room	7%		face	7%
				long	7%
				blood	7%
clothing	dress	22%			
	pants	22%			
	shirt	19%	paper	white	11%
	socks	7%		brown	11%
	shoes	7%		draw	11%
	hat	7%		black	7%
				wood	7%
				writing	7%
farm	cows	30%			
	animals	11%			
	wheat	11%	sport	baseball	33%
	horse	7%		run(ning)	15%
	pig	7%		soccer	11%
				fishing	11%
				fun	7%
fashion	model	11%		basketball	7%
	old	11%		hockey	7%
	new	11%			
	girl	7%			

Appendix 11

Table of First Associations

Stimulus	Response		Stimulus	Response	
hospital	sick	22%	sugar	sweet	33%
	patient	15%		salt	15%
	bed	11%		lump	11%
	nurse	11%		tea	11%
	people	11%		cane	7%
	doctor	7%			
west	cowboy(s)	19%	wool	sheep	11%
	east	15%		lamb	11%
	direction	11%		string	7%
	south	11%		cotton	7%
	wild	7%		fuzzy	7%
	north	7%		furry	7%
				sweater	7%

Appendix 11

Table of First Associations

Low $\bar{m}$

Stimulus	Response		Stimulus	Response	
branch	tree(s)	30%	moment	minute	26%
	long	15%		wait	22%
	brown	11%		one	7%
	leaf(ves)	11%		second	7%
	stick	7%		stop	7%
	broken	7%			
			nation	country	19%
charm	luck(y)	22%		army	19%
	gold	7%		Canada(ian)	15%
				united	11%
commerce	bank	19%			
	wise	7%	possession	own	15%
committee	place	7%	strength	muscle	30%
	job	7%		strong	30%
	club	7%		big	11%
faith	trust	11%	wind	blow(ing)	48%
	Jesus	7%		cold	15%
	brave	7%		storm	7%
	church	7%			
			wine	drink(ing)	26%
freedom	happy	22%		water	11%
	gay	7%			
			sword	knife	22%
heart	red	11%		cut	15%
	blood	11%		kill	15%
	beat	7%		fight	7%
	lungs	7%			
	kind	7%			
	love	7%			
	valentine	7%			

Appendix 12

Learning Task:

Random Arrangement of Words

class	(h)[1]	west	(h)	wine	(l)
strength	(l)[2]	commerce	(l)	farm	(h)
committee	(l)	chicken	(h)	west	(h)
farm	(h)	strength	(l)	freedom	(l)
clothing	(h)	clothing	(h)	hospital	(h)
sport	(h)	wine	(l)	heart	(l)
sugar	(h)	heart	(l)	sugar	(h)
heart	(l)	sugar	(h)	charm	(l)
commerce	(l)	wool	(h)	sport	(h)
wine	(l)	possession	(l)	chicken	(h)
chicken	(h)	sword	(l)	class	(h)
possession	(l)	committee	(l)	strength	(l)
west	(h)	freedom	(l)	sword	(l)
sword	(l)	charm	(l)	committee	(l)
freedom	(l)	hospital	(h)	possession	(l)
wool	(h)	class	(h)	clothing	(h)
hospital	(h)	sport	(h)	commerce	(l)
charm	(l)	farm	(h)	wool	(h)

---

[1] (h) - high meaningfulness

[2] (l) - low meaningfulness

Appendix 12

Learning Task:

Random Arrangement of Words

hospital	(h)	freedom	(l)
commerce	(l)	wool	(h)
heart	(l)	farm	(h)
freedom	(l)	class	(h)
wool	(h)	wine	(l)
possession	(l)	clothing	(h)
west	(h)	chicken	(h)
class	(h)	hospital	(h)
strength	(l)	heart	(l)
committee	(l)	sword	(l)
clothing	(h)	charm	(l)
wine	(l)	strength	(l)
chicken	(h)	sport	(h)
farm	(h)	commerce	(l)
sword	(l)	west	(h)
sugar	(h)	possession	(l)
charm	(l)	sugar	(h)
sport	(h)	committee	(l)

Appendix 13

Sample Learning Task as Presented to Subjects

(Mixed List)

west

commerce

chicken

strength

clothing

wine

heart

sugar

wool

possession

sword

committee

freedom

charm

hospital

class

sport

farm

Appendix 14

Procedure: Free Learning, Free Recall, Mixed List

(1) The examiner spoke to all subjects in the classroom setting telling them she would be calling them out in small groups or individually to do some work with her. This was not an unusual procedure for these subjects insofar as they knew the examiner and were accustomed to her visiting the classroom and working with small groups.

(2) On entering the examining room, subjects were given a piece of foolscap on which they were asked to write their names and school. Learning task was distributed face down. Groups averaged 6 in number.

(3) Examiner said:

"This is an exercise using words. You have been given a list of words which you are to study for a few minutes. When the time for studying is up, I will tell you what to do. All you are to do now is to study the words on the page."

"Are you ready? Turn your paper over and go ahead."

(4) At the end of a three minute study period exactly, learning task papers were immediately collected. Subjects were then told:

"Now I would like you to write on your papers all the words you can remember which you have just been studying.

Are you ready? Go ahead."

or

"Now I would like you to go back to your classroom. I will call you again later. Right now, I would like to see some other boys and girls. Thank you."

(5) When the subjects were called back to the examining room, they were given the foolscap on which their names had been written. Examiner said:

"Now I would like you to write on your papers all the words you can remember which you studied

when you were here before. Are you ready? Go ahead."

(6) At the end of a three minute recall period exactly, in each case papers were collected and subjects thanked for their cooperation.

Appendix 15

Analysis of Variance Data: Raw Scores

Levels of Factors: A 2 (Repeated measure: meaningfulness)
B 4 (Time of testing)
R 32 (Replications: number of subjects in each cell)

Immediate		1 Hour		3 Hours		24 Hours	
High	Low	High	Low	High	Low	High	Low
1.0	1.0	1.0	1.0	1.0	0.0	1.0	0.0
4.0	3.0	3.0	2.0	1.0	2.0	0.0	1.0
3.0	3.0	3.0	2.0	3.0	2.0	2.0	0.0
5.0	4.0	2.0	2.0	4.0	2.0	0.0	1.0
3.0	1.0	2.0	1.0	1.0	0.0	3.0	0.0
3.0	2.0	2.0	1.0	3.0	1.0	1.0	1.0
2.0	0.0	0.0	0.0	2.0	2.0	1.0	0.0
4.0	3.0	2.0	0.0	3.0	1.0	1.0	0.0
2.0	1.0	1.0	2.0	1.0	0.0	1.0	0.0
5.0	3.0	2.0	1.0	2.0	2.0	2.0	3.0
6.0	2.0	2.0	2.0	2.0	0.0	1.0	0.0
6.0	4.0	2.0	2.0	0.0	0.0	1.0	0.0
4.0	2.0	3.0	0.0	2.0	1.0	2.0	0.0
4.0	1.0	2.0	2.0	2.0	0.0	2.0	0.0
5.0	3.0	2.0	0.0	0.0	0.0	0.0	2.0
3.0	2.0	1.0	1.0	2.0	2.0	1.0	1.0
4.0	3.0	3.0	2.0	1.0	1.0	1.0	1.0
4.0	3.0	3.0	0.0	0.0	0.0	3.0	0.0
3.0	2.0	2.0	2.0	2.0	0.0	0.0	0.0
5.0	4.0	5.0	4.0	1.0	0.0	0.0	0.0
2.0	3.0	6.0	3.0	1.0	1.0	2.0	0.0
2.0	0.0	6.0	3.0	3.0	1.0	1.0	1.0
3.0	2.0	1.0	1.0	3.0	1.0	2.0	2.0
5.0	0.0	4.0	3.0	3.0	3.0	1.0	0.0
8.0	4.0	5.0	2.0	3.0	0.0	3.0	1.0
4.0	3.0	4.0	2.0	4.0	2.0	6.0	1.0
4.0	1.0	2.0	2.0	1.0	1.0	2.0	2.0
6.0	3.0	3.0	0.0	1.0	0.0	2.0	2.0
4.0	0.0	2.0	0.0	2.0	0.0	2.0	0.0
7.0	5.0	2.0	0.0	4.0	3.0	2.0	0.0
5.0	3.0	1.0	0.0	2.0	0.0	2.0	1.0
2.0	2.0	1.0	0.0	2.0	1.0	2.0	1.0

Appendix 16

Experiment I.

Mean Number of Items Retained

High $\bar{m}$		Total	Mean
	Immediate	128	4.00
	1 Hour	80	2.50
	3 Hours	62	1.94
	24 Hours	50	1.56
Low $\bar{m}$			
	Immediate	73	2.28
	1 Hour	43	1.34
	3 Hours	29	.91
	24 Hours	21	.66

Appendix 17

Sample Learning Tasks:

Unmixed Lists

(1) high meaningfulness

(2) low meaningfulness

paper

farm

class

fashion

sport

beauty

clothing

west

meal

sugar

wool

hospital

chicken

nose

faith

sword

committee

wine

commerce

possession

charm

freedom

wind

moment

nation

strength

heart

branch

Appendix 18

t-test Data: Raw Scores: Free Learning, Free Recall, Unmixed List

x	y
High $\bar{m}$	Low $\bar{m}$
5.0	0.0
11.0	4.0
10.0	2.0
11.0	3.0
6.0	6.0
8.0	4.0
8.0	3.0
14.0	8.0
9.0	6.0
9.0	4.0
9.0	6.0
5.0	3.0
3.0	3.0
5.0	4.0
11.0	0.0
7.0	7.0
6.0	4.0
5.0	3.0
9.0	7.0
4.0	4.0
6.0	4.0
8.0	1.0
5.0	4.0
7.0	8.0
9.0	10.0
11.0	3.0
3.0	1.0
6.0	4.0
3.0	1.0
4.0	3.0
6.0	0.0
4.0	2.0
Σ_x 227.00	Σ_y 122.00
$\bar{X}_x$ 7.09	$\bar{X}_y$ 3.81
s^2_x 7.65	s^2_y 5.84
s_d .65	
t 5.05	

(Weinberg and Schumaker, 1965, p. 207)

Appendix 19

Paired-Associates Tasks

High meaningfulness

beauty	-	sport
clothing	-	farm
paper	-	class
hospital	-	nose
meal	-	west
chicken	-	sugar
fashion	-	wool

Low meaningfulness

charm	-	moment
faith	-	wind
commerce	-	possession
nation	-	strength
branch	-	committee
heart	-	sword
wine	-	freedom

Appendix 20

Experiment III: Paired-Associates Learning: Procedure

(1) The examiner spoke to all children in the classroom setting telling them that she would be calling them out in small groups or individually to do some work with her. (This was not an unusual procedure for these children in that they knew the examiner and were accustomed to her visiting the classroom and working with small groups.)

Children were told that everyone would have a turn but that they were being asked to come out individually or in small groups so as not to disturb the other children in the class.

(2) On entering the room, subjects were asked to be seated next to the examiner.

(3) Examiner said: "This is an exercise with words. I have some words on cards (3" by 8"). I will put them down in front of you in pairs. I will read them to you; then you can read them to me. (Training thus involves two trials with the subject using oral, aural, and visual modalities.)

"boy - girl"
"cat - dog"

You read them to me. Now let's see if you can remember which words go together.

"boy - ____"
"cat - ____"

Good. (Note: one positive reinforcement)

Now let's begin."

Pairs of words were presented in random order. Raw scores represent the number of trials required to reach criterion (one perfect recitation) to a maximum of ten trials.

Appendix 21

t-test Data: Raw Scores : Paired-Associates Learning

x Low m	y High m
10.0	4.0
8.0	4.0
10.0	3.0
10.0	1.0
4.0	3.0
10.0	4.0
7.0	3.0
7.0	6.0
5.0	6.0
8.0	5.0
3.0	4.0
6.0	4.0
3.0	3.0
6.0	4.0
6.0	2.0
9.0	6.0
4.0	3.0
5.0	3.0
10.0	1.0
8.0	4.0
5.0	4.0
5.0	2.0
10.0	3.0
9.0	3.0

Σ_x	168	Σ_y	85
$\bar{X}_x$	7	$\bar{X}_y$	3.54
s^2_x	5.58	s^2_y	1.75

s_d .55

t 6.26

(Weinberg and Schumaker, 1965, p. 207)

Appendix 22

Sample Serial-Order Tasks

(1) High meaningfulness

(2) Low meaningfulness

sugar

hospital

farm

wool

chicken

class

sport

clothing

west

commerce

sword

wine

heart

strength

committee

possession

charm

freedom

Appendix 23

Experiment IV: Serial-Order Learning: Procedure

(1) The examiner spoke to all children in the classroom telling them she would be calling them out in small groups or individually to do some work with her. (This was not an unusual procedure for these children in that they knew the examiner and were accustomed to her visiting the classroom and working with small groups.)

Children were told that everyone would have a turn but that they were being asked to come out individually or in small groups so as not to disturb the other children in the class.

(2) On entering the room, subjects were asked to be seated next to the examiner.

(3) Examiner said: "This is an exercise with words. I have here a list of words. I will read them to you, then you can read them to me. After you have read them to me, we will turn the paper over and see if you can remember them in the proper order. Are you ready?"

Words were then read to the subject at approximately two second intervals. Subjects then read the words. (Training thus consisted of two trials with the subject using oral, aural, and visual modalities.)

At the conclusion of the learning trials, paper was removed from in front of the subject and the subject asked to repeat the words in order.

The rawscores represent the number of trials required to reach criterion (one perfect performance). A maximum of ten trials was allowed.

Appendix 24

t-test Data: Raw Scores : Serial-Order Learning

x Low m̄	y High m̄
9.0	7.0
8.0	3.0
6.0	9.0
10.0	7.0
9.0	5.0
7.0	6.0
7.0	6.0
6.0	5.0
10.0	7.0
4.0	9.0
10.0	3.0
9.0	5.0
7.0	9.0
9.0	6.0
4.0	5.0
10.0	7.0
5.0	3.0
10.0	2.0
10.0	4.0
9.0	1.0
10.0	2.0
7.0	5.0
7.0	3.0
9.0	3.0

Σ_x	192	Σ_y	122
$\bar{X}_x$	8	$\bar{X}_y$	5.08
s^2_x	3.67	s^2_y	5.08

s_d .60

$\underline{t}$ 4.84

(Weinberg and Schumaker, 1965, p 207)

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