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Numerous research projects have revealed that an "isolated" or distinct item in a homogeneous list is recalled more readily than its non-isolated counterparts. This isolation phenomenon was first investigated by von Restorff and has since become known as the von Restorff effect. Until recently, the research projects were conducted using visual stimuli. However, Arbogast has shown that the von Restorff effect also exists for auditory stimuli. The purpose of this study was to investigate the possibility of a von Restorff effect for voice inflection which involves a subtle usage of auditory stimuli.

In this study eighty subjects learned the order of a nine-item serial list by the anticipation method to a criterion of two perfect trials. The list consisted of five-letter nouns that occur with equal frequency in English usage. The selected words occur more than fifty but less than one hundred times per one million written words. The subjects for this experiment were forty males and forty females enrolled in Introductory Psychology at Emporia State University. The subjects

were divided into male control and experimental groups and female control and experimental groups with each group consisting of twenty subjects. The control subjects listened to the serial list items which were taped in a female voice at a sound intensity level of less than seventy decibels. The same taped list at the same sound intensity level was presented to the experimental subjects except that the number six serial item was vocally inflected to a level of seventy-five decibels. Statistical significance was evaluated through the use of a 2 x 2 fixed effects analysis of variance.

The statistical analysis for serial position six indicated that there was not a significant difference in mean number of errors between the isolated and non-isolated conditions at the .05 level of probability. The data also failed to indicate a significant difference between males and females. However, there was a significant difference between the mean number of errors at the .05 level of probability between the experimental and control groups at serial position three. There were no significant differences between males and females, and there was no significant interaction effect at the .05 level of probability for position three. Also, there were no significant differences demonstrated at the remaining seven serial positions. The results of this study failed to reveal that a significant von Restorff effect occurs when voice inflection is employed in a serial learning task.

VOICE INFLECTION AND THE AUDITORY VON RESTORFF EFFECT

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the Department of Psychology

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Lela Scheckel

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Chapter 1

INTRODUCTION

The theoretical background of the visual and auditory von Restorff effect are discussed in this chapter. The statement of the problem, statement of the hypotheses, purpose of the study and its significance, definition of terms, and limitations of the study are also included.

THEORETICAL FORMULATION

While studying factors that interfere with memory, von Restorff in 1933 discovered that an "isolated" or distinct item in a homogeneous list is recalled more readily than its non-isolated counterparts. In her initial studies, von Restorff, as noted by Koffka, presented her subjects with a series of ten items to learn.[1] On the first day, the subjects were presented a list containing ten different items. On the second and third days, various groups of subjects learned lists of either nine numbers and one syllable, or nine syllables and one number. Compared to the average recall of all the similar terms, the isolated items showed higher recall scores. This isolation phenomenon was first investigated by von Restorff; consequently, it has become known as the von Restorff effect.

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[1]Kurt Koffka, Principles of Gestalt Psychology (New York: Harcourt and Brace, 1935), pp. 481-492.

Although numerous researchers have attempted to explain the von Restorff effect (e.g., Gibson,[2] Newman and Saltz,[3] and Green[4]), the original findings were interpreted according to Gestalt principles.[5] Von Restorff concluded that during a serial learning task each item in a list forms a neural trace. The isolated item forms a trace which retains its individuality whereas the homogeneous items become part of a larger trace system and lose their uniqueness. Subsequently, the non-isolated terms form an aggregation based on similarity. The aggregation of non-isolated items provides a background against which the trace of the isolated item can stand out. By linking the memory trace theory with the perceptual organization theory, von Restorff further concluded that the trace of the isolated item stands out as a "figure" against the aggregated homogeneous traces, the "ground."

Since its initial discovery, the von Restorff effect has been studied in a variety of experiments using serial learning tasks, paired-associate learning tasks, free recall, and immediate memory tasks.[6] All of these research projects were conducted using visual stimuli. Recently, however, Arbogast has shown that the von Restorff effect also

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[2]Eleanor J. Gibson, "Intra-list Generalization as a Factor in Verbal Learning," Journal of Experimental Psychology, 30 (1942), pp. 185-200.

[3]S. E. Newman and E. Saltz, "Isolation Effects: Stimulus and Response Generalization as Explanatory Concepts," Journal of Experimental Psychology, 55 (1958), pp. 467-472.

[4]R. T. Green, "Surprise as a Factor in the von Restorff Effect," Journal of Experimental Psychology, 52 (1956), pp. 340-344.

[5]Koffka, loc. cit.

[6]William P. Wallace, "Review of the Historical, Empirical, and Theoretical Status of the von Restorff Phenomenon," Psychological Bulletin, 63 (1965), pp. 410-424.

exists for auditory stimuli.[7] In his experiment the control groups learned a nine word serial list which was presented on a tape in a male voice. The same serial list for the experimental groups was taped in the same male voice except for the sixth word which was taped in a female voice. The significant isolation effect obtained in Arbogast's study prompted further research in closely related areas. An investigation into the possibility of a von Restorff effect for voice inflection was one such area.

THE PROBLEM

Extensive research has revealed that isolating an item against a homogeneous background facilitates the learning of that isolated item. This isolation effect has proved to be a pervasive factor with both visual and auditory stimuli in serial learning tasks. The present researcher attempted to further knowledge in this area by investigating the possibility of a von Restorff effect for voice inflection. A second factor which was investigated was the possibility of a significant difference in learning between the males and females since the serial learning task was presented by a taped female voice.

Statement of the Problem

Can the von Restorff effect be demonstrated in a serial learning task with the use of voice inflection?

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[7]Robert Arbogast, "Investigation into the Possibility of an Auditory von Restorff Effect" (unpublished thesis, Emporia Kansas State College, 1976).

Is there a significant difference in learning between males and females when the serial learning task is presented by a taped female voice?

Statement of the Hypotheses
(Null form)

The von Restorff effect cannot be demonstrated in a serial learning task when voice inflection is used.

There is no significant difference in learning between males and females when the serial learning task is presented by a taped female voice.

Purpose of the Study

This study was conducted to discover if the von Restorff effect could be demonstrated in a serial learning task when voice inflection was used to isolate an item. In a prior experiment Arbogast demonstrated that an auditory von Restorff effect does exist.[8] His conclusions prompted this follow-up study which involved a more subtle usage of auditory stimuli. The item in the serial list was made more distinct by inflecting the voice rather than by changing the gender of the voice.

Significance of the Study

The demonstration of a von Restorff isolation effect for voice inflection could greatly aid educators, psychotherapists, the advertising medium and any field in which material is presented in an auditory manner. Teachers of both "normal" and special education classes could employ this technique to facilitate student learning. Psychotherapists

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[8] Arbogast, loc. cit.

could exert more control over their voice level during therapy sessions. Most psychotherapists recognize that the raising or lowering of the voice gives the patient clues about therapist attitude. Members of the advertising industry could employ the scientifically controlled usage of voice inflection to increase the sale of their products and influence public opinion. Although some members of these fields currently utilize voice inflection to make certain material more distinct, they lack empirical evidence to show that learning is facilitated. Finally, the major significance of this study would be the stimulation of further research on the von Restorff effect.

DEFINITION OF TERMS

Serial Learning

Serial learning involves learning to make certain responses in an exact prescribed order. In serial memorizing, a set of words must be recalled in the order of first presentation.[9]

Isolated Item

An isolated item is the single item in a serial learning task which receives emphasis, e.g., printing one of the items in a distinctive type face.[10]

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[9]Horace B. English and Ava Champney English, A Comprehensive Dictionary of Psychological and Psychoanalytical Terms (New York: David McKay, 1958).

[10]Ibid.

Homogeneous Items

Homogeneous items are items which show sameness or marked likeness in the quality or attribute under consideration.[11]

Intrusion Error

In serial memory experiments, an intrusion error involves substituting a response that was not in the original list, or making a response from the original list but in the wrong place.[12]

Voice Inflection

Voice inflection is a change in speaking or modulation of the voice.[13]

LIMITATIONS OF THE STUDY

This study was limited to the measurement of the effects of voice inflection on learning facilitation in a serial learning task. The subjects were a sample of eighty students enrolled in Introductory Psychology at Emporia State University. Since subjects were selected to participate in the experiment on the basis of availability, no control over number of years in college or age was exercised. Also, since college students are assumed to be more intelligent than the average population, learning of the serial list might have been influenced by subject selection. Although the use of college students as subjects in a learning experiment was justifiable, future studies might utilize younger age groups when exploring the auditory von Restorff effect.

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[11] Ibid. [12] Ibid. [13] Ibid.

Chapter 2

REVIEW OF RELATED LITERATURE

The material presented in this chapter is a review of pertinent literature about the von Restorff phenomenon. The historical background, properties and characteristics, and interpretations for the von Restorff effect are discussed.

HISTORICAL BACKGROUND

The von Restorff isolation effect was initially discovered by Hedwig von Restorff in 1933.[14] Following a series of experiments in which she used paired-associate and free recall methods, von Restorff concluded that an isolated item in a learning task will be learned quickly as compared with non-isolated terms. In other words, when an isolated item is placed against a homogeneous background, the learning of the isolated item will be facilitated. In her experiments, each subject was presented a list containing ten items. After the list had been mastered, the subject was given a meaningful text to memorize. Each subject was tested on three separate days. On the first day the subjects were presented lists containing ten different items. On the second day the subjects were divided into two groups. One group learned a list containing nine numbers and one syllable while the second group

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[14] Koffka, loc. cit.

learned a list with nine syllables and one number. On the third day the subjects received the opposite list from the previous day. Compared to the average recall of the homogeneous items, the isolated terms had higher recall scores.

Numerous researchers have confirmed the original von Restorff findings and have used a variety of methods to produce isolation.[15] One method of achieving isolation has been to change the outer physical properties or characteristics of a single item (e.g., printing the isolated item in red while the remaining items in the list are printed in black). Isolation has also been produced by inserting a different type of item within a list of similar type items (e.g., placing a single number within a list of nonsense syllables). A third way isolation has been produced is by changing the structural organization within a list. The structural organization method was developed by Siegel in 1943 and involves the use of two element types and an equivalent number of items from each type.[16] Isolation is manipulated in a list by inserting an item of one type within several items of the opposite type.

Prior to the von Restorff isolation discovery, several investigators, as reported by Wallace, had studied vividness.[17] Vividness refers to isolating an item by making it more vivid than the remaining items in a list. The influence of vividness upon learning and making associations was being investigated. However, many of the researchers prior to

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[15]Wallace, loc. cit.

[16]P. S. Siegel, "Structure Effects Within a Memory Series," Journal of Experimental Psychology, 33 (1943), pp. 311-316.

[17]Wallace, loc. cit.

von Restorff failed to utilize statistical evaluation and were more concerned with describing the isolation effect than exploring why isolation of an item facilitates learning.

The first experimenter to explore vividness was Calkins.[18] She produced vividness by varying the size, color and number of digits for numerals in her list. She also studied the significance of recency, frequency and primacy as possible conditions influencing learning. Frequency refers to the number of times the same item appears in a list. A frequent item would appear two or more times within the same list. Primacy and recency are terms indicating the first and last items of a list. As predicted, all four conditions produced better recall in her subjects, but frequency and vividness showed the greatest influence upon learning.

Frequency, recency, primacy and vividness were also seen as factors influencing recall in two separate but similar experiments conducted by Lamb and Waterman as reported by Welch.[19] Better learning occurred under all four conditions, but vividness was the least influential factor. Vividness in this study was produced by placing a color next to a nonsense syllable.

Accepting as a basic premise that vividness does influence recall, Jersild decided to vary the degree and form of vividness.[20] Two hundred fifty-three college students served as subjects and were

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[18] M. Calkins, "Association: An Essay Analytic and Experimental," Psychological Review Monograph Supplement, No. 2 (1896), cited by Wallace, op. cit., p. 411.

[19] G. B. Welch and C. Burnett, "Is Primacy a Factor in Association Formation," American Journal of Psychology, 35 (1924), pp. 396-401.

[20] A. Jersild, "Primacy, Recency, Frequency, and Vividness," Journal of Experimental Psychology, 12 (1929), pp. 58-70.

presented a narrative containing seventy statements. After being exposed to the narrative, the subjects were tested for recall by having them write down as many sentences as they could remember. The material was presented in ten different arrangements to ten groups of subjects. Sentence vividness was produced by six methods: pausing, speaking a sentence slowly, banging a fist before speaking, making gestures during a sentence, increasing voice loudness for a sentence and prefacing sentences with emphatic commands like "now get this!" All of the previously mentioned vividness devices aided recall except for speaking a sentence slowly. Learning was influenced most when a sentence was preceded or followed by an emphatic statement.

In the previously mentioned studies, the subjects were encouraged to recall the list items in any order and then the isolated item recall was compared with the average recall for the homogeneous items. Van Buskirk in 1932 stated that free recall of list items did not account for ordinal position effects.[21] He suggested that an isolated item in an experimental list should be compared with an item in the same ordinal position in a control list.

Utilizing his new technique, Van Buskirk conducted an experiment on vividness in which the last item learned by a subject during a previous trial was made vivid for the next experiment. The vivid item was a large red syllable on a green background while the non-vivid items were smaller black syllables on a white background. The material was presented visually to 102 university and high school students. Each

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[21]W. L. Van Buskirk, "An Experimental Study of Vividness in Learning and Retention," Journal of Experimental Psychology, 15 (1932), pp. 563-573.

subject was shown three series of nine nonsense syllables. After each presentation of a series, free recall of the list was encouraged until one perfect recitation of the list could be made. After the initial list of syllables had been mastered by a subject, Van Buskirk selected the last syllable learned and made it vivid in the second series. The third list of syllables, the relearning series, was presented either a week or two weeks later. During relearning trials, a black syllable on white ground was substituted for the red, vivid syllable in the second series. In all instances the vivid syllable was recalled more frequently on the average than the same position syllable in a control list.

A final study on vividness was conducted by Jones and Jones in 1942.[22] This study resembled the von Restorff experiments in that concentration was placed on isolation and learning facilitation. Vividness was produced by placing a vivid red syllable in a list of ten nonsense syllables typed in black. Jones and Jones predicted that the vivid item would be learned more readily than the non-vivid items, and that a reorganized learning pattern for the list would occur. Forty college students learned the list to one perfect recitation by the anticipation method and then were interviewed by the experimenter. Subjects who mentioned that they had noticed the red syllable showed no facilitated learning as compared with subjects who did not notice the vivid syllable. Secondly, few subjects admitted to using the vivid syllable as an anchor point for reorganization of learning. In summarizing the results of

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[22]F. N. Jones and M. H. Jones, "Vividness as a Factor in Learning Lists of Nonsense Syllables," American Journal of Psychology, 55 (1942), pp. 96-101.

their experiment, Jones and Jones concluded that the vivid syllable was learned more readily than the same position syllable in a control list. However, the emphasized syllable did not produce a reorganization of learning which might have caused the list to be learned better.

The vividness studies were gradually replaced by studies concerned with the von Restorff isolation effect. Emphasis was shifted from describing the isolation effect to concentrating on why isolation facilitates learning.

PROPERTIES AND CHARACTERISTICS OF THE ISOLATION PHENOMENON

Influence of Isolation on Learning a List of Items

After von Restorff demonstrated that isolated items are learned quickly as compared with homogeneous items, researchers began to study the influence of isolation on learning a list of items. They theorized that the list containing the isolated item would be learned quickly as compared with a control list where the item was not isolated.

Young and Supa, while working on memory span, found that item isolation facilitated the learning of the entire list.[23] The subjects in their experiment were thirty-four college students who learned lists containing two types of items, words and digits. The subjects in the experimental group learned series in which the last three elements were different (isolated) from the items which began the list. The control subjects learned lists containing one type of item. After analyzing their data, Young and Supa reported a longer retention span for

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[23]C. W. Young and M. Supa, "Mnemic Inhibition as a Factor in the Limitation of the Memory Span," American Journal of Psychology, 54 (1941), pp. 546-552.

subjects who learned the series with two dissimilar types of material.

Further research about isolation and total list learning was conducted by Smith,[24] and Smith and Stearns.[25] In the latter experiment forty subjects learned both an isolated and homogeneous list for five days. The isolated list consisted of thirteen adjectives with the eighth item typed in red. The homogeneous list contained thirteen homogeneous adjectives typed in black. The subjects were separated into two equal groups with half of the participants learning the isolated list first each day and the other half learning the homogeneous list first. After the five days of experimentation, the first lists learned daily were compared. The results indicated that the isolated list was learned slightly faster than the crowded list. However, this slight advantage was not noted for the lists learned second in the daily sessions. Smith and Stearns concluded that the increased recall for the isolated eighth item caused total list recall to be decreased.

Item isolation was shown to be detrimental to total list learning in a third experiment by Smith in 1949.[26] By using 165 subjects and varying the position of the isolated term, Smith showed that a single isolated item in a list had no effect on facilitating learning for the entire list. He concluded that the learning of the isolated item

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[24]M. H. Smith, Jr., "Spread of the Isolation Effect in Serial Learning," American Psychologist, 3 (1948), p. 235.

[25]M. H. Smith, Jr. and Ellen G. Stearns, "The Influence of Isolation on the Learning of Surrounding Materials," American Journal of Psychology, 62 (1949), pp. 369-381.

[26]M. H. Smith, Jr., "The Influence of Isolation on Immediate Memory," American Journal of Psychology, 62 (1949), pp. 405-411.

interfered with learning the total list and thus was obtained at the expense of the other list items. Similar conclusions were drawn by Newman and Saltz,[27] Jensen,[28] Roberts,[29] and Steil and Hynum.[30]

The Isolation Effect and Long-Term Retention

Several investigators have demonstrated that an isolated item is retained better over a period of time than its homogeneous counterparts (e.g., Jones and Jones[31] and Kothurkar[32]). This aspect of the von Restorff phenomenon was initially described by Van Buskirk in his study on the effects of vividness in learning and the effect of isolation over different time intervals.[33] Van Buskirk showed that vividness was significant in both learning and retention over one and two week intervals.

In a similar manner, Buxton and Newman demonstrated that the isolated material showed little forgetting during the two days following

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[27]Newman and Saltz, loc. cit.

[28]A. R. Jensen, "The von Restorff Isolation Effect With Minimal Response Learning," Journal of Experimental Psychology, 64 (1962), pp. 123-125.

[29]W. A. Roberts, "A Further Test of the Effect of Isolation in Serial Learning," American Journal of Psychology, 75 (1962), pp. 134-149.

[30]Peter Steil and Leslie Hynum, "The von Restorff Isolation Effect Employing One and Three Isolates," Psychological Reports, 27 (1970), pp. 963-966.

[31]Jones and Jones, loc. cit.

[32]V. K. Kothurkar, "Learning and Retention of an Isolated Number on the Background of Meaningful Material," Indian Journal of Psychology, 31 (1956), pp. 59-62.

[33]Van Buskirk, loc. cit.

their first experiment while the crowded material was forgotten immediately.[34] Using a delayed time interval of twenty minutes, Postman and Phillips also demonstrated slight evidence for better retention of isolated items.[35]

Contrary to the preceding findings, Newman did not find long-term retention for isolated material.[36] In his experiment twenty-one subjects were presented a single list consisting of eight nonsense syllables. Next, the subjects were presented with three similar lists in quick succession. Newman intended that the single list would represent an isolated element and that the triple lists would be the crowded element. The subjects were then given delayed relearning tests after one, twenty-four and forty-eight hours. Unexpectedly, the percentage savings score for the crowded lists did not differ significantly after the three time intervals while the isolated list had shown a rapid decline. However, the recall score for the isolated list was still higher than the average crowded list recall after the forty-eight hour period.

Similar results were reported by Saul and Osgood who measured retention by providing for an immediate recall to measure original learning and two delayed recalls after one and twenty-four hours to

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[34]C. E. Buxton and E. B. Newman, "The Forgetting of 'Crowded' and 'Isolated' Materials," Journal of Experimental Psychology, 26 (1940), pp. 180-198.

[35]L. Postman and Laura W. Phillips, "Studies in Incidental Learning: I. The Effect of Crowding and Isolation," Journal of Experimental Psychology, 48 (1954), pp. 48-56.

[36]E. B. Newman, "Effect of Crowding Material on Curves of Forgetting," American Journal of Psychology, 52 (1939), pp. 601-609.

measure retention.[37] No evidence for better retention of isolated material was cited. Using a similar method and a fifty minute delay interval, Green also failed to show that isolation enhances retention.[38] Instead he found that the delayed recall caused the homogeneous items to be recalled better than the isolated terms.

A major flaw with the preceding studies is that they failed to control for degree of learning.[39] Since degree of learning exerts an influence on the level of retention, some variables utilized in the long-term retention studies were confounded. Immediate recall tests have repeatedly shown that an isolated item is learned quickly as compared with the corresponding control item. Since isolated items are learned to a superior degree, a comparison of retention for isolated and control items is not appropriate.

Spread of the Isolation Effect in Serial Learning

A third factor receiving extensive research is the spread of the isolation effect in serial learning. Several studies have reported that isolating an item in a serial list facilitates the learning of the adjacent items. For example, Jones and Jones isolated the seventh syllable of a ten syllable experimental list by typing the syllable in red.[40]

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[37]E. V. Saul and C. E. Osgood, "Perceptual Organization of Materials as a Factor Influencing Ease of Learning and Degree of Retention," Journal of Experimental Psychology, 40 (1950), pp. 372-379.

[38]Green, loc. cit.

[39]B. J. Underwood, "Degree of Learning and the Measurement of Forgetting," Journal of Verbal Learning and Verbal Behavior, 3 (1964), pp. 112-129.

[40]Jones and Jones, loc. cit.

Their control list consisted of ten syllables typed in black. As predicted, the isolated seventh item was learned quickly as compared with its control counterpart. However, the sixth and eighth syllables on the experimental list also showed a slight learning advantage as compared with the same position syllables in the control list.

Similar findings were reported by Smith in 1948.[41] In the experiment forty subjects were required to learn two separate lists. The homogeneous list consisted of thirteen adjectives typed in black on a white sheet while the isolated list had the eighth syllable typed in red. Isolation of the eighth item appeared to cause a redistribution for order of learning since the items immediately adjacent to the isolated syllable were also learned quickly as compared with their control counterparts. In a follow-up study the next year Smith failed to find evidence for the spread of the isolation effect.[42] However, a third study conducted jointly by Smith and Stearns found a slight but not significant advantage for the item following the isolated term.[43]

A learning advantage for items adjacent to the isolated term was not found by Jenkins and Postman.[44] They manipulated isolation by placing a three-letter noun in a list of twelve low associated nonsense syllables. To account for possible serial position effects, isolated

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[41]Smith, "Spread of the Isolation Effect in Serial Learning," p. 235.

[42]Smith, "The Influence of Isolation on Immediate Memory," pp. 405-411.

[43]Smith and Stearns, loc. cit.

[44]W. O. Jenkins and L. Postman, "Isolation and Spread of Effect in Serial Learning," American Journal of Psychology, 61 (1948), pp. 214-221.

terms were placed in the third, sixth and ninth positions. In accord with previous studies, the isolated items were learned quickly as compared with their control counterparts. However, when the item following the isolated term was compared with its critical counterpart in the control list, the control item showed significantly higher recall. The control group also performed better on the item preceding the isolated term. Puzzled by their results, Jenkins and Postman suggested that the isolated item received extra rehearsal time since it attracted subject attention. Consequently, the surrounding items received less practice time and lower results.

Similar findings were reported by Tatuno who placed an isolated term, or two identical terms into a series of letters or digits in order to investigate the spread of effect.[45] An analysis of the recall scores revealed facilitated learning for the isolated items and inhibited learning for the adjacent terms.

Other researchers who were interested in the spread of effect began to investigate the possibility that the isolated item served as a stimulus. These studies were concerned with checking on the performance for the term following the isolated item. For example, Jensen had forty subjects learn the serial order of nine geometric shapes by the anticipation method.[46] He was interested in knowing if the isolation phenomenon would be present in both the serial and response learning phases of a task when response learning was minimized. To achieve minimal response

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[45]T. Tatuno, "On the Effect of the Isolated Term and the Identical Term in Serial Learning," Japanese Psychological Research, 3 (1961), pp. 17-27.

[46]Jensen, loc. cit.

learning, Jensen created a condition whereby the subject made the same response in both the isolated and non-isolated conditions. He placed the words "Blue Circle" in the sixth position of the experimental list. Then, he placed a geometric blue circle in the sixth position for the control list. Jensen's findings revealed a significant isolation effect for the experimental subjects at position six. However, position seven had an increased number of errors. Isolation did not facilitate learning for the following item. In summarizing the results of his experiment, Jensen suggested that isolation caused a reorganized learning pattern. Similar conclusions were reported by Roberts when he also failed to find a difference in learning speed for the item following the isolated term.[47]

In summary, the issue about the spread of the isolation effect remains controversial. When isolation is manipulated by changing the color of the isolated term, then some learning enhancement for surrounding terms is evident. However, when isolation is produced by inserting a different kind of material into the list, the adjacent terms do not appear to be facilitated in learning.

Stimulus Versus Response Isolation

In a series of three experiments involving paired-associate learning, Kimble and Dufort demonstrated that isolated pairs were learned faster than control pairs when isolation was among stimulus items, but not when isolation was among the responses.[48] Twenty-eight

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[47]Roberts, loc. cit.

[48]G. A. Kimble and R. H. Dufort, "Meaningfulness and Isolation as Factors in Verbal Learning," Journal of Experimental Psychology, 50 (1955), pp. 361-368.

college students served as subjects for the experiment and were presented lists containing ten pairs of meaningful words. One group received a list with two paralogs embedded among the stimuli. The second group received lists with two paralogs among the response items. An analysis of the data revealed that the isolated paralogs among the responses were learned slower than the average of the massed pairs while the paralogs among stimuli were learned faster. An evaluation of this study by Underwood and Schulz revealed confounding variables. Isolation and meaningfulness were confounded since changes in response meaningfulness, as caused by the paralog insertion, influence performance more than changes in stimulus meaningfulness.[49]

A follow-up study without confounding variables was conducted by Nachmias, Gleitman, and McKenna who used three kinds of material.[50] Two-place numbers, nonsense syllables, and five-letter adjectives were utilized on the twelve paired-associate lists which were presented to sixty introductory psychology students. On some lists seven of the stimulus items were of the same material type while two stimulus items were of another material type. The nine responses for this list were of identical material type. Response isolation was achieved in a similar manner; two isolated terms were placed among the responses. The results obtained revealed a significant isolation effect for the isolated items, but no main effect or interaction for stimulus versus response

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[49]B. J. Underwood and R. W. Schulz, Meaningfulness and Verbal Learning (New York: Lippincott, 1960), pp. 267-271.

[50]J. Machmias, H. Gleitman, and V. McKenna, "The Effect of Isolation of Stimuli and Responses in Paired Associates," American Journal of Psychology, 74 (1961), pp. 452-456.

isolation. Isolation was equally effective among the stimulus and response terms.

Newman conducted a study in this area and compared stimulus and response isolation as produced by color and meaningfulness.[51] Stimulus and response items were isolated by typing them in red or varying their meaningfulness. For example, a low meaningful item was placed among fourteen pairs of high meaningful dissyllables. Each subject was then allowed fifteen study-recall trials. A comparison of learning performance revealed facilitated learning for stimulus items under both isolation conditions. Response isolation produced increased performance only under the color condition.

Newman's findings were explained by Horowitz using a two stage theory of paired-associate learning.[52] While studying the effect of intra-list similarity on associative learning, Horowitz found that associative learning is increased whenever the stimulus or response of a pair is made distinct. He also discovered that intra-list similarity depends on the nature of the subject's task. If a stimulus item is isolated, then learning will be facilitated since only associative learning is involved. However, response learning requires both associative and response learning which makes meaningfulness of items important. Any advantage which the response item obtains due to its isolation is offset when it takes on a low meaningful value.

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[51] S. E. Newman, "Paired Associate Learning as a Function of Stimulus Term and Response Term Isolation," (paper read at Psychonomics meeting, St. Louis, August 30, 1962).

[52] L. M. Horowitz, "Associative Matching and Intralist Similarity," Psychological Reports, 10 (1962), pp. 751-757.

The stimulus versus response isolation effect has also been studied in serial learning experiments (e.g., Kimble and Dufort,[53] Saltz and Newman,[54] and Jensen[55]). These researchers, along with Roberts, have consistently shown a von Restorff isolation effect for the response term, but not as a function of stimulus isolation.[56] For his experiment Roberts constructed four serial lists containing fifteen meaningful words and paralogs. Response comparisons were made by comparing the isolated paralogs in the fifth, eighth and eleventh positions with control items in a homogeneous list. Stimulus comparisons were made by measuring learning facilitation on the items following the isolated terms. As previously noted, Roberts could only find an isolation effect for the response terms. However, in criticizing his own research, he suggested that the degree of isolation and meaningfulness had been confounded.

A single experiment which found an isolation effect for the stimulus term was conducted by Newman and Saltz.[57] The experiment utilized a one-tailed test, and the results were of borderline significance.

In summarizing stimulus versus response isolation for paired-associate studies, conclusive results can be drawn. The studies suggest a learning ease for the stimulus term. The studies including serial

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[53]Kimble and Dufort, loc. cit.

[54]E. Saltz and S. E. Newman, "The von Restorff Isolation Effect: Test of the Intralist Association Assumption," Journal of Experimental Psychology, 58 (1959), pp. 445-451.

[55]Jensen, loc. cit.

[56]Roberts, loc. cit.

[57]Newman and Saltz, loc. cit.

learning tasks are inconclusive, however, since there has been some difficulty in identifying the stimulus term.

Degrees of Isolation and Ease of Learning

Several researchers have investigated the possibility of varying the degree of isolation and thus increasing learning facilitation (e.g., Moore,[58] Saltz and Newman,[59] and Ericksen[60]). The degree of isolation has been manipulated by either changing the number of isolated elements or increasing the difference between the isolated item and other items in the list.

Varying the degree of isolation first occurred in the von Restorff experiments as reported by Koffka.[61] In a later experiment von Restorff presented her subjects with lists containing eight pairs of items; four pairs were of the same material type while the remaining four pairs were of different materials. The isolated pairs were recalled significantly better than the repeated pairs. Next, von Restorff varied the degree of isolation by presenting each subject with a list containing six pairs of the same material type and two distinct pairs. The experimental results indicated an even more enhanced recall for the isolated terms. Von Restorff suggested that there is a direct relationship between the degree of isolation and speed of learning.

[58]M. E. Moore, "Isolation as a Factor in Immediate Recall," American Journal of Psychology, 72 (1959), pp. 626-628.

[59]Saltz and Newman, loc. cit.

[60]R. L. Ericksen, "Relational Isolation as a Means of Producing the von Restorff Effect in Paired Associate Learning," Journal of Experimental Psychology, 66 (1963), pp. 111-119.

[61]Koffka, loc. cit.

Whereas von Restorff increased isolation degree, Pillsbury and Raush decreased the degree of isolation by including three rather than one isolated items for each list of eight or sixteen terms.[62] Although isolation facilitated learning, the isolation advantage was gradually reduced as the number of isolates increased.

Further evidence for the relationship between degree of isolation and speed of learning was reported by Kimble and Dufort.[63] They placed a nonsense term in the middle of a list of meaningful words and then varied the degree of meaningfulness for the nonsense syllable. Kimble and Dufort predicted that learning speed would vary inversely with the degree of meaningfulness. In other words, the least meaningful item should be learned the quickest. Eighty subjects participated in the experiment and were divided into four groups. Each group of subjects learned a thirteen-item list with the middle item being one of four degrees of meaningfulness. As predicted, the least meaningful word was learned first.

The most recent experiment in this area was conducted by Gumenik and Levitt in 1968.[64] In their experiment the critical item was projected on a screen in one of four sizes while all other items on the list were of a designated size. Again, speed of learning was directly related to the degree of isolation.

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[62]W. B. Pillsbury and H. L. Raush, "An Extension of the Kohler-Restorff Inhibition Phenomenon," American Journal of Psychology, 56 (1943), pp. 293-298.

[63]Kimble and Dufort, loc. cit.

[64]W. E. Gumenik and J. Levitt, "The von Restorff Effect as a Function of Difference of the Isolated Item," American Journal of Psychology, 81 (1968), pp. 247-252.

Background Meaningfulness

Several studies have investigated the possibility that background meaningfulness influences the von Restorff effect. Kothurkar compared learning for an isolated number placed against a background of nonsense syllables, or a second background of meaningful prose.[65] A larger advantage in free recall was found for the isolated numbers placed against a background of nonsense syllables. Kothurkar concluded that the magnitude of the von Restorff effect varied as a function of the meaningfulness of the background stimuli.

Rosen, Richardson, and Saltz compared the serial learning effects of an item typed in red among eight similar items of either high or low meaningfulness.[66] Isolation again demonstrated a greater relative effect in the low meaningful list as compared with the high meaningful list. The researchers concluded that facilitated learning occurred in the low meaningful list because isolation produced differentiation among the list items. In the high meaningful list the eight terms were already differentiated so the isolated item had a lesser effect. A similar study by Samuels found the same results.[67]

Incidental Learning

Several studies have focused on the von Restorff effect for incidental learning situations. Koyanagi, as cited in Wallace, compared

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[65]Kothurkar, loc. cit.

[66]H. Rosen, D. H. Richardson and E. Saltz, "Supplementary Report: Meaningfulness as a Differentiation Variable in the von Restorff effect," Journal of Experimental Psychology, 64 (1962), pp. 327-328.

[67]Samuels, loc. cit.

incidental and intentional learning in an experiment where isolation was produced by changes in color, material type, and structure.[68] The structural change lists involved a before and after condition. In the before condition the fifth item was preceded and followed by four items of a different material type. The last eight list items were of the same material as the isolated term. For the after condition, the isolated item was placed in position thirteen and was surrounded on both sides by four items of different material. The first eight items for this list were of the same material as the isolated term. The major difference between these two conditions concerns the appearance of different materials. In the before condition the isolated item represented the first appearance for a different material type. The isolated item had previously appeared in a massed context for the after condition. The control group was given a list in which the two material types alternated.

The results of Koyanagi's experiment indicated that a significant isolation effect was produced by intentional learners in all groups except the structural-after condition and the isolation-by-color condition. The incidental learners fared more poorly. A significant isolation effect was only observable in the isolation-by-material condition. Koyanagi concluded that an isolation effect does not occur when the isolated type of material was previously presented in a massed context. Similar findings were reported by Saul and Osgood,[69] and Saltzman and

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[68]K. Koyanagi, "Studies in Incidental Learning: II. Intraserial Interference," Tohoku Psychologica Folia, 15 (1957), pp. 1-12, cited by Wallace, op. cit., pp. 416-417.

[69]Saul and Osgood, loc. cit.

Carterette.[70] However, an isolation effect for the after-condition was noted by Siegel[71] and Postman and Phillips.[72]

In agreement with Koyanagi's results are the consistent failures to find an isolation effect for incidental learners and structural isolation (e.g., Postman and Phillips,[73] Koyanagi,[74] and Saltzman and Carterette[75]). The status accorded to incidental learning was further denoted when Gleitman and Gillett failed to find a significant isolation effect for material type changes.[76]

Apparently, intent to learn on the part of the subject determines whether an isolation effect will be obtained. An isolation effect for incidental learners was not found until isolation was produced by changing the material type. After reviewing the incidental learning studies, Mechanic suggested that item isolation increases the probability that the subject will make a differentiating response.[77] The differential response to the verbal units should facilitate learning.

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[70]I. J. Saltzman and T. Carterette, "Incidental and Intentional Learning of Isolated and Crowded Items," American Journal of Psychology, 72 (1959), pp. 230-235.

[71]Siegel, loc. cit. [72]Postman and Phillips, loc. cit.

[73]Ibid.

[74]K. Koyanagi, "Studies in Incidental Learning: I. Intention of Learning and the Isolation Effect," Japanese Journal of Psychology, 27 (1957), pp. 270-278.

[75]Saltzman and Carterette, loc. cit.

[76]H. Gleitman and E. Gillett, "The Effect of Intention Upon Learning," Journal of General Psychology, 57 (1957), pp. 137-149.

[77]A. Mechanic, "The Responses Involved in the Rote Learning of Verbal Materials," Journal of Verbal Learning and Verbal Behavior, 3 (1964), pp. 30-36.

Wallace noted, however, that making a differentiating response does not occur simultaneously with item isolation.[78] Consequently, the incidental learners may make a differentiating response to isolation and not to the item.

Auditory von Restorff Effect

Recently, Arbogast demonstrated the existence of the auditory von Restorff effect.[79] Previous researchers had been concerned with studying properties of the isolation effect by utilizing visual stimuli. Jersild conducted the only other experiment in which material was presented verbally.[80] However, his experiment involved only a single trial and free recall of the list. Jersild also failed to account for ordinal position effects. Consequently, Arbogast concluded that the auditory von Restorff effect had not been adequately demonstrated.

In his experiment Arbogast utilized a serial learning task which consisted of nine three-letter nouns.[81] The subjects for his experiment were sixty Introductory Psychology students attending Emporia Kansas State College. An equivalent number of males and females were placed in the experimental and control groups. The subjects in the control groups listened to the serial list taped in a male voice. The experimental groups listened to the same taped serial list except that the number six serial position was taped in a female voice. An analysis of the data revealed that a significant von Restorff effect does occur when auditory stimuli are employed in a serial learning task.

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[78]Wallace, loc. cit.

[79]Arbogast, loc. cit.

[80]Jersild, loc. cit.

[81]Arbogast, loc. cit.

INTERPRETATIONS OF THE VON RESTORFF EFFECT

Two major theoretical interpretations for the von Restorff effect have been proposed. An initial explanation was provided by von Restorff who interpreted the isolation effect by using Gestalt principles.[82] Gibson provided a second explanation with her interference theory.[83] Subsequent researchers have modified the Gestalt and interference theories in order to describe the isolation effect.

Gestalt Theory

After completing an array of experiments, von Restorff interpreted her findings within a Gestalt theoretical framework.[84] According to von Restorff, each item in a list forms a neural trace. The items in a homogeneous list are similar so individual traces lose some of their uniqueness and form an aggregation based on similarity. This aggregation serves as a background for the trace of a unique, different, item which becomes isolated in the trace system. The organizational processes within the trace system are similar to the organization of perceptual excitations. By the "law of similarity", the isolated trace against a homogeneous background is better retained since the aggregation of similar traces have relinquished individual trace identity. Thus, the isolated item forms a trace which becomes a "figure" against the "ground" of homogeneous aggregated traces.

An initial research project to test the Gestalt theory was conducted by Siegel who had 140 subjects memorize a structured list of

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[82]Koffka, loc. cit.

[83]Gibson, loc. cit.

[84]Koffka, loc. cit.

material.[85] An equivalent number of two different types of items appeared on the list. By varying isolation and homogeneity, Siegel proposed to see if perceptual organization does effect the memory traces and their stability. Isolation was achieved by preceding and following a single item of one type with several items of the second material type. The isolated items were then compared with crowded items in the same list. In accordance with von Restorff's findings, the isolated items were recalled better than the crowded items.

In the preceding study Siegel failed to control for item type differences and ordinal position effects. However, he discounted the possible significance of these two criticisms, by conducting another study within the same experiment. In this study the subjects learned a list containing alternating numbers and nonsense syllables. As predicted, he found no differences between the critical serial positions selected or for the material type making up the isolated item. Siegel concluded that his experiment provided positive support for the Gestalt theoretical interpretation of the isolation effect.

Saul and Osgood duplicated Siegel's study and provided for additional retention measures.[86] According to Gestalt theory, ". . . the better the perceptual organization or structure of the materials to be learned and retained, the more stable will be the traces laid down and hence the greater will be the ease of learning and degree of retention."[87] Saul and Osgood tested this hypothesis as it relates to

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[85]Siegel, loc. cit.

[86]Saul and Osgood, loc. cit.

[87]Ibid., p. 372.

retention. In their experiment they tested for immediate recall, as a measure of original learning, and two delayed recalls as retention measures. They suspected that if original learning was equated and if both isolated and homogeneous terms were subjected to equivalent retroactive and proactive interference, then the Gestalt theory must show an isolation effect in retention. Gestalt theory rests on the principle that the trace system is altered during the original learning process and this alteration should persist through a retention period. An analysis of the data revealed no evidence of better retention for the isolated items in the twenty-item, free learning list during either of the delayed recall trials. Also, only the first isolated item within a list showed a significant isolation effect. Since both isolated terms were equally isolated, Gestalt theory would predict an isolation effect for both terms. Unable to explain their findings according to Gestalt theory, Saul and Osgood regarded their results as support for the interference theory.

Interference Theory

The interference theory was generated by Gibson after she demonstrated in a paired-associate task that a "low-stimulus generalization" list was learned quickly as compared with a "high-stimulus generalization" list.[88] The items in the low-stimulus generalization list were distinct from each other and were paired with nonsense syllables. The high-stimulus generalization items were similar to each

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[88] Eleanor J. Gibson, "A Systematic Application of the Concepts of Generalization and Differentiation to Verbal Learning," Psychological Review, 47 (1940), pp. 196-229.

other. Gibson suggested that generalization occurs between the members of a list. Therefore, making a differentiation between list members influences verbal learning. Isolating an item within a list increases differentiation and lowers generalization among list members. Thus, isolation influences learning positively by lowering interference among the list members.

Support for the interference theory was provided by Postman and Phillips who conducted an incidental learning study.[89] Subjects for the study were placed in either an incidental learning or intentional learning group. The intentional learners were instructed to learn a twenty-item list while the incidental learners were instructed to sit next to the intentional learners and serve as experimenters. Isolation in the list was manipulated by structural changes and then by color changes. After being exposed to the list once, the subjects in both groups were given free-recall tests. After a twenty minute delayed interval, they were given a second recall test. The test results favored the interference theory because only the intentional learners produced an isolation effect for both original learning and retention. According to the interference theory, incidental learners make fewer differentiating responses to list items than intentional learners. Also, they form fewer associations, and thus less intra-list interference develops. Consequently, there is less reduction in intra-serial interference by the isolation of an item.

In a follow-up study utilizing the same serial lists, Saltzman and Carterette failed to find a significant isolation effect for either

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[89]Postman and Phillips, loc. cit.

incidental or intentional learners.[90] However, intentional learning was superior to incidental learning.

Stimulus and Response Generalization

An attempt to explain the von Restorff effect according to the concepts of stimulus and response generalization was made by Newman and Saltz.[91] Prior to testing, they made several predictions about isolation in serial learning tasks. They predicted that (a) the isolated term would be learned quickly as compared with its non-isolated counterpart, (b) the list containing the isolated term would be learned more readily than a control list, (c) the isolated term would appear less often as an intrusion error, (d) isolation should facilitate learning a response to the isolated term as a stimulus.

Using a thirteen word serial list in which the seventh term was an isolated paralog, Newman and Saltz found support for two of their predictions. Firstly, the isolated term was learned quickly as compared with its non-isolated counterpart. Secondly, when the isolated item was a stimulus, response learning was facilitated. Unexpectedly, the isolated item was found to be emitted frequently as an intrusion error. Saltz and Newman supported this finding again in a second experiment in 1959.[92]

After reviewing previous von Restorff experiments, Roberts suggested that a single isolated item in a list could not reduce generalization enough to facilitate total list learning.[93] He decided to use

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[90]Saltzman and Carterette, loc. cit.

[91]Newman and Saltz, loc. cit. [92]Saltz and Newman, loc. cit.

[93]Roberts, loc. cit.

three isolated terms among a fifteen-item list. The results of his experiment revealed a failure to find facilitated learning for the list containing three isolated items. Similar findings were reported by Jensen[94] and Steil and Hynum.[95]

Multiple isolation was also utilized by Lively who investigated Newman and Saltz's predictions in short term memory tasks.[96] Isolation was achieved by embedding consonants among digits and digits among consonants. As predicted, performance for the item following the isolated term was enhanced. Secondly, the isolated item appeared less often as an intrusion error than its control counterpart. Contrary to predictions, the isolated item was not recalled more frequently than its control counterpart. Also, total list learning was not facilitated when isolated items were inserted into a list. The four predictions made by Newman and Saltz appear to need further investigation before definite conclusions can be drawn.

Organizing Influence of the Isolation Effect

Several researchers in describing the von Restorff phenomenon have suggested that isolating an item within a list influences the way subjects organize their responses (e.g., Smith,[97] Smith and Stearns,[98]

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[94]Jensen, loc. cit. [95]Steil and Hynum, loc. cit.

[96]Barry L. Lively, "The von Restorff Effect in Short Term Memory," Journal of Experimental Psychology, 93 (1972), pp. 361-366.

[97]Smith, "The Influence of Isolation on Immediate Memory," pp. 405-411.

[98]Smith and Stearns, loc. cit.

Gleitman and Gillett,[99] Jensen[100] and Tulving[101]). Since subject recall illustrates what happens during the learning process, one may assume that organization influences the learning process. Smith[102] and Smith and Stearns[103] have suggested that the primary result of isolation manipulation is in serial organization of the list. Smith and Stearns manipulated isolation by printing one member of a thirteen adjective list in red to observe the effects of this alteration on the over-all learning of the list. While comparing the learning curves for the isolated and non-isolated lists, they noticed that superiority for learning the isolated list was greater in later stages of learning. According to Smith and Stearns, the later stages of learning involve establishing serial order for the known responses. Thus, the red item aids in establishing order. The non-isolated lists lack this isolated term which helps in establishing order for the later learning stages.

Jensen has shown that item isolation does not affect item learning, but instead the order of learning the items.[104] However, the isolated term is not used as an anchor point for learning new terms. The data suggests that the organizing aid provided by the isolated item

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[99]Gleitman and Gillett, loc. cit. [100]Jensen, loc. cit.

[101]E. Tulving, "Subjective Organization in Free Recall of 'Unrelated' Words," Psychological Review, 69 (1962), pp. 344-354.

[102]Smith, loc. cit. [103]Smith and Stearns, loc. cit.

[104]Jensen, loc. cit.

is specific to that item. Similar conclusions have been drawn by Goulet, Bone and Barker,[105] and Bone and Goulet.[106]

Contrary to the preceding studies, McLaughlin failed to find that a single isolated item produced any reorganization of the series to be learned.[107] In his experiment isolation was achieved by varying the size, shape, color and position of the isolated items.

Surprise and Attention

After reviewing the study by Saul and Osgood, Green concluded that it is the "surprise value" of being presented with a different type item which produces better recall and not the perceptual conditions of isolation.[108] Green defined surprise as the ". . . foreseeability of an event according to a prediction made or on an inductive basis."[109] In Saul and Osgood's study, the first structurally isolated item in the list demonstrated a von Restorff effect whereas the second isolated term did not.[110] Green suggested that the first isolated item had more "surprise value" than the second one.

In an experiment testing his "surprise" theory, Green predicted that when two items are equally isolated, the first item will be

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[105] L. R. Goulet, R. B. Bone, and D. D. Barker, "Serial Position, Primacy and the von Restorff Isolation Effect," Psychonomic Science, 9 (1967), pp. 529-530.

[106] R. B. Bone and L. R. Goulet, "Serial Position and the von Restorff Effect," Journal of Experimental Psychology, 76 (1968), pp. 494-496.

[107] J. P. McLaughlin, "The von Restorff Effect in Serial Learning: Serial Position of the Isolate and Length of List," Journal of Experimental Psychology, 72 (1966), pp. 603-609.

[108] Green, loc. cit.

[109] Ibid., p. 34.

[110] Saul and Osgood, loc. cit.

recalled significantly better than the second one.[111] For his study he used twenty-item, free-learning lists in which two items were structurally isolated. An analysis of the data revealed support for his prediction.

In a second experiment Green decided to reduce the surprise factor created by his first isolated item.[112] The forty-six subjects in this study were informed that an item type change would occur within the list. Green then predicted that these instructions would lower recall for the first isolated item. The scores for the forty-six instructed subjects were compared with scores from the previous uninstructed group. Contrary to expectation, there were no significant differences in recall between the instructed and uninstructed subjects on the first isolated item. Also, the instructed group performed significantly better on the second isolated term. Green noted that overall recall was somewhat higher for the instructed subjects. When he corrected for differences in overall recall, he found significantly better recall for his uninstructed group at the first isolated position. However, he failed to find the expected large difference in recall between the instructed and uninstructed groups.

After reviewing Green's experiments, Deutsch and Sternlight decided to test the surprise hypothesis.[113] They created a list in

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[111]R. T. Green, "Surprise, Isolation and Structural Change as Factors Affecting Recall of a Temporal Series," British Journal of Psychology, 49 (1958), pp. 21-30.

[112]Green, loc. cit.

[113]M. R. Deutsch and M. Sternlight, "The Role of Surprise in the von Restorff Effect," Journal of General Psychology, 76 (1967), pp. 151-159.

which the surprise value of the isolated term was eliminated. Data analysis revealed that the isolated item was still learned quickly as compared with its homogeneous counterpart in a control list. They concluded that the surprise hypothesis fails to account for the von Restorff effect.

Failing to find real support for his surprise hypothesis, Green next suggested that the von Restorff effect was being caused by the "attention-getting value" of structural change within a list.[114] In testing his prediction, Green utilized several free-learning lists consisting of six nonsense syllables and six numbers. The control groups received lists containing nonsense syllables and numbers in alternating positions. The list testing for structural change effects had the fourth item preceded by three items of a different material. The next five items following the fourth item were of the same material type as the fourth item. The isolated list of items had the fourth item preceded and followed by items of the other type of material. Green predicted that if isolation and structural change were distinct factors then the fourth item should be recalled more easily by the isolated group than by the structural change group. The isolated and structural change groups performed fairly equally on item four in the list. This finding led Green to suggest that structural change attracts the subject's attention and thus a significant von Restorff effect is

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[114]Green, "Surprise, Isolation, and Structural Change as Factors Affecting Recall of a Temporal Series," pp. 21-30.

demonstrated. Similar conclusions were drawn by Swartz, Pronko, and Engstrand,[115] and Kroll.[116]

Different results were reported by Wing and Painter who replicated Green's study with a few minor changes.[117] Green had used two-letter nonsense syllables and two-digit numbers. Wing and Painter chose to construct their free-learning list with six three-letter nonsense syllables and six three-digit numbers. An analysis of their data revealed superior recall for the isolation group as compared with the structural change group on the fourth item. This discrepancy in findings may have been caused by differences in procedure.

CONCLUSIONS

The von Restorff isolation phenomenon has stimulated much research. Many researchers have explored the properties and characteristics of the isolation effect while others have been more interested in theoretical explanations. The literature has revealed three consistent characteristics for the von Restorff effect: (a) the magnitude of the isolation effect varies directly with the degree of isolation, (b) intent to learn on the part of the subject determines whether an isolation effect will be obtained, (c) the meaningfulness of the homogeneous

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[115]P. Swartz, N. H. Pronko, and R. D. Engstrand, "An Extension of Green's Inquiry Into Surprise as a Factor in the von Restorff Effect," Psychological Reports, 4 (1958), pp. 431-432.

[116]Neal E. Kroll, "The von Restorff Effect as a Function of Method of Isolation," Psychonomic Science, 26 (1972), pp. 333-334.

[117]J. F. Wing and B. Painter, "Intraserial Interference versus Structural Change Explanations of Isolation Effects in Immediate Recall," (paper read at American Psychological Association, Los Angeles, September 9, 1964).

background influences the isolation effect. The von Restorff effect is a more controversial issue at the theoretical level. A possible combination of the Gestalt, interference and descriptive theories will be needed to explain the von Restorff phenomenon accurately.

Chapter 3

METHODS AND PROCEDURES

The following chapter describes the experimental procedures which were used in the present study. Information about the population and sampling procedures, data collection procedures, materials and instrumentation, design of the study and data analysis will be included.

POPULATION AND SAMPLING

The population for this experiment was all students enrolled in Introductory Psychology at Emporia State University for the fall semester of the 1977-78 academic year. The sample consisted of eighty subjects randomly selected from the above population. Subjects participating in the experiment were selected on an incidental nonprobability sampling basis. Two experimental groups and two control groups were used, each consisting of twenty subjects who by assumption were not familiar with learning experiments. An equivalent number of males and females were randomly assigned to the experimental and control groups by an assigned number and by the use of a table of random numbers. The age range for the subjects was from eighteen to twenty-four years. The expected intelligence level was average or above.

DATA COLLECTION PROCEDURE

A serial learning task was administered in a testing environment free from outside distractions which might have influenced performance.

The testing was conducted only during the daytime hours between eight and five o'clock in order to prevent a negative influence from subject fatigue. Each subject was tested individually by the examiner. Subjects were encouraged to remain silent about the nature of the testing situation. Information concerning this experiment and previous related studies was not disclosed until all testing had been accomplished.

MATERIALS AND INSTRUMENTATION

In this experiment eighty subjects learned a serial list by the anticipation method to a criterion of two perfect trials. The nine-item list contained five-letter nouns of equal occurrence obtained from Thorndike and Lorge.[118] The selected words were classified in category "A" which means that they occur more than fifty but less than one hundred times per one million written words. The fixed order of the serial list items for the control and experimental groups was: fence, route, print, frame, beach, match, trace, brush and clock.

The control subjects listened to the serial list items which were taped in a female voice at a sound intensity level of less than seventy decibels. The same taped list at the same sound intensity level was presented to the experimental subjects except that the number six serial item was vocally inflected to a level of seventy-five decibels. The position six item was chosen to be inflected because previous research has revealed that it is the most difficult position to learn

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[118] E. L. Thorndike and I. Lorge, The Teacher's Word Book of 30,000 Words (New York: Columbia University Press, 1944).

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[118] E. L. Thorndike and I. Lorge, The Teacher's Word Book of 30,000 Words (New York: Columbia University Press, 1944).

in a nine-item serial list.[119] The word "match" was not purposefully chosen to occupy the number six position. After the list was carefully constructed to equate meaningfulness and to avoid associations among the words, the neutral word "match" was found in position six.

The list was taped on a standard tape recorder and sixteen learning trials were available. Sixteen copies of the original list were taped sequentially by the tape recorder.

DESIGN OF THE STUDY

The study was designed to discover if the von Restorff effect could be demonstrated in a serial learning task when voice inflection was used to isolate an item. The nine-item serial list was played through once to acquaint each individual subject with list items and procedure. They then heard a tone indicating that the list was starting. A six second interval elapsed before the verbal presentation of the first correct word. The subjects were given a six second anticipation period before each consecutive item was presented.

Each subject was tested individually in the psychology testing laboratory at Emporia State University. The experimenter sat behind the subject to record his responses. By eliminating eye contact with the subject, the experimenter did not interfere with subject concentration or accidentally give helpful cues. After the initial presentation of the list, the experimenter began to record correct recalls, intrusion errors and failure to respond by the subject.

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[119] A. R. Jensen, "An Empirical Theory of the Serial Position Effect," Journal of Psychology, 53 (1962), pp. 127-142.

The subjects were given the following instructions which were previously used by Arbogast in his experiment on the auditory von Restorff effect.

> In the following experiment you are required to learn a list of words in the same order as you hear them presented to you from the tape recorder. There will be a six-second interval between words. After the presentation of each word you are to say verbally what the next word in the list will be. That is, anticipate what the next word will be. This procedure will be continued until you can recite the list perfectly for two consecutive trials. Please respond verbally and if you are not sure, please guess. The list will be played through once and you are to begin responding when you hear a tone that signals the start of the list again. If there are any questions, please ask them at this time.[120]

The experiment began after questions had been answered.

DATA ANALYSIS

In this experiment the number of errors for each experimental and control group was computed along with the mean number of errors and standard deviations. A statistical analysis of the data required the usage of a 2 x 2 fixed effects analysis of variance.

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[120]Arbogast, loc. cit.

Chapter 4

ANALYSIS OF DATA

This study was designed to investigate the possibility of a von Restorff effect in a serial learning task when voice inflection was used to isolate an item. The material presented in this chapter will include how the data were analyzed, tables of means and standard deviations, and summary tables for the results of the 2 x 2 analysis of variance for each position.

STATISTICAL ANALYSIS

Table 1 illustrates the mean number of errors and the standard deviations which were computed for each group and for each serial position. These data, along with the information obtained from a fixed-effects analysis of variance for each of nine positions, was used to examine the following two null hypotheses:

The von Restorff effect cannot be demonstrated in a serial learning task when voice inflection is used.

There is no significant difference in learning between males and females when the serial learning task is presented by a taped female voice.

The statistical analysis for serial position one indicates, as seen in Table 2, that no statistical difference between mean number of errors exists at the .05 level of probability. There was no significant difference in the learning of serial position one due to the type of

Table 1

Means and Standard Deviations for Number of Errors for Each Serial Position in the Control and Experimental Groups

Position	Male mean	Male SD	Female mean	Female SD
		Control Groups		
1	.500	1.360	.500	1.118
2	.800	1.600	.850	1.796
3	1.850	1.740	1.300	1.646
4	2.650	2.515	2.000	1.923
5	2.450	2.598	1.900	2.234
6	3.550	3.339	1.900	2.300
7	3.300	2.532	2.800	1.990
8	2.900	2.468	1.950	1.774
9	1.400	1.241	1.400	1.562
		Experimental Groups		
1	.400	.800	.750	.942
2	.950	1.117	1.400	1.319
3	3.450	2.924	2.450	2.578
4	3.200	3.010	3.400	2.577
5	2.950	2.334	3.000	2.168
6	4.100	3.646	3.700	2.685
7	4.350	3.087	3.300	2.648
8	2.850	2.574	3.400	3.007
9	1.850	1.651	2.000	1.304

list learned or the sex of the subject. There was no significant difference obtained for an interaction effect.

Table 2

Summary Table of Analysis of Variance for Number of Errors at Position 1

Source	df	SS	MS	F	p
A (type of list)	1	.112	.112	.092	NS
B (sex)	1	.612	.612	.502	NS
A x B	1	.613	.613	.503	NS
Error	76	92.551	1.218		
Total	79	93.888			

An F of 4.00 was necessary for significance at a probability of .05.

Table 3 indicates that there was no significant difference between mean number of errors, at the .05 level of probability between the isolated and non-isolated conditions and between males and females, at serial position two. Also, there was no significant interaction effect. Thus, there was no significant difference in the learning of serial position two due to the variables of sex or type of list that was learned.

Table 4 indicates that there was a significant difference between mean number of errors at the .05 level of probability between the isolated and non-isolated conditions at serial position three. The subjects in the non-isolated condition learned item three significantly quicker than those subjects in the isolated condition. However, there was no significant difference between males and females and no significant interaction effect.

Table 3

Summary Table of Analysis of Variance for Number of Errors at Position 2

Source	df	SS	MS	F	p
A (type of list)	1	2.450	2.450	1.061	NS
B (sex)	1	1.250	1.250	.541	NS
A x B	1	.800	.800	.346	NS
Error	76	175.500	2.309		
Total	79	180.000			

An F of 4.00 was necessary for significance at a probability of .05.

Table 4

Summary Table of Analysis of Variance for Number of Errors at Position 3

Source	df	SS	MS	F	p
A (type of list)	1	37.812	37.812	6.864	.05
B (sex)	1	12.012	12.012	2.181	NS
A x B	1	1.013	1.013	.184	NS
Error	76	418.650	5.086		
Total	79	469.487			

An F of 4.00 was necessary for significance at a probability of .05.

Table 5

Summary Table of Analysis of Variance for Number of Errors at Position 4

Source	df	SS	MS	F	p
A (type of list)	1	19.012	19.012	2.841	NS
B (sex)	1	1.012	1.012	.151	NS
A x B	1	3.612	3.612	.540	NS
Error	76	508.551	6.691		
Total	79	532.187			

An F of 4.00 was necessary for significance at a probability of .05.

Table 6

Summary Table of Analysis of Variance for Number of Errors at Position 5

Source	df	SS	MS	F	p
A (type of list)	1	12.800	12.800	2.223	NS
B (sex)	1	1.250	1.250	.217	NS
A x B	1	1.800	1.800	.312	NS
Error	76	437.700	5.759		
Total	79	453.550			

An F of 4.00 was necessary for significance at a probability of .05.

Table 7

Summary Table of Analysis of Variance for Number of Errors at Position 6

Source	df	SS	MS	F	p
A (type of list)	1	27.612	27.612	2.841	NS
B (sex)	1	21.012	21.012	2.162	NS
A x B	1	7.812	7.812	.804	NS
Error	76	738.750	9.720		
Total	79	795.187			

An F of 4.00 was necessary for significance at a probability of .05.

Table 8

Summary Table of Analysis of Variance for Number of Errors at Position 7

Source	df	SS	MS	F	p
A (type of list)	1	12.013	12.013	1.696	NS
B (sex)	1	12.013	12.013	1.696	NS
A x B	1	1.512	1.512	.213	NS
Error	76	538.149	7.081		
Total	79	563.687			

An F of 4.00 was necessary for significance at a probability of .05.

Table 9

Summary Table of Analysis of Variance for Number of Errors at Position 8

Source	df	SS	MS	F	p
A (type of list)	1	9.800	9.800	1.495	NS
B (sex)	1	.825	.825	.126	NS
A x B	1	11.225	11.225	1.713	NS
Error	76	498.100	6.554		
Total	79	519.950			

An F of 4.00 was necessary for significance at a probability of .05.

Table 10

Summary Table of Analysis of Variance for Number of Errors at Position 9

Source	df	SS	MS	F	p
A (type of list)	1	5.512	5.512	2.492	NS
B (sex)	1	.112	.112	.051	NS
A x B	1	.112	.112	.051	NS
Error	76	168.150	2.212		
Total	79	173.887			

An F of 4.00 was necessary for significance at a probability of .05.

Table 10, page 52, indicates that no significant difference between mean number of errors was obtained for serial position nine at the .05 level of probability. No significant interaction effect was indicated by the data. Consequently, the learning of serial position nine was not affected by the sex of the subject or the type of list the subject learned.

The statistical results of this experiment clearly indicated that the von Restorff effect could not be demonstrated in a serial learning task when voice inflection was used. The results also demonstrated that there was not a significant difference in learning between males and females. Consequently, both of the null hypotheses were accepted.

Chapter 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The structure and results of the study are discussed in this chapter. An exploration of the experimental results is presented along with suggestions for future researchers of the auditory von Restorff effect. The following sections are included in this chapter: summary, conclusions, and recommendations.

SUMMARY

In this experiment the auditory von Restorff isolation effect was investigated by using voice inflection. The study was conducted to discover if the isolation effect would be demonstrated in a serial learning task when voice inflection was used to isolate an item. Also, since the serial list was presented in a taped female voice, would there be a significant difference between males and females in learning facilitation. Eighty volunteer subjects learned the serial order of nine five-letter nouns by the anticipation method. Each subject was required to reach a criterion of two perfect consecutive trials. An equivalent number of males and females were placed in the experimental and control groups. The subjects were randomly divided into the experimental or control groups by an assigned number and the use of a table of random numbers. All subjects learned the same nine serial items with only the isolated item in the experimental treatment being altered by increased voice inflection.

A 2 x 2 fixed effects analysis of variance was used to analyze the statistical data.

CONCLUSIONS

An analysis of the data failed to reveal that a significant von Restorff effect occurs when voice inflection is employed in a serial learning task. There was not a significant difference between the mean number of errors at serial position six at the .05 level of probability. The data also indicate that there was no significant interaction effect. Thus, the learning of serial position six was not affected by the sex of the subject or the type of list the subject learned. However, there was a significant difference between the mean number of errors at the .05 level of probability between the experimental and control groups at serial position three. There was no significant difference between males and females and there was no significant interaction effect at the .05 level of probability at position three. Thus, the subjects in the control groups demonstrated a learning facilitation for item three over the experimental groups even though the sound intensity level was identical for all groups at this non-isolated position. There was no difference in learning between the males and females. Also, there were no significant differences demonstrated at the remaining seven serial positions. The results of this study are inconsistent with the findings of previous visual and auditory von Restorff experiments.

A more thorough analysis of this experiment reveals some ideas worth considering. Firstly, two experimental subjects obtained a very large number of errors at position three whereas none of the control subjects demonstrated this problem. As noted in Appendix A, if these

two error scores are subsequently dropped from the data along with the coinciding error scores from the control groups, then item three is still significant (at the .05 level of probability), but to a much lesser degree. Secondly, the experimental subjects' perception of voice inflection at serial position six might have interfered with learning facilitation. Some experimental subjects commented both during and after the experiment that they noticed the inflected word. Perhaps recognition of the isolated item unaccountably interfered with total list learning. Position six might have mistakenly become the starting point of the list for some subjects. Since position three would then become the sixth position following the sixth word, it would be the most difficult word for the experimental subjects to learn and would have the most errors. The control groups would not be confused over the starting point for the list and thus would accumulate fewer errors. Thirdly, verbal learning may be different from visual learning. A review of Arbogast's thesis revealed that in his experiment on the auditory von Restorff effect position three missed statistical significance by .007.[121] In the present experiment position three achieved definite statistical significance. Perhaps position three of a nine item serial list has an unknown significance in oral learning which is becoming evident in the auditory von Restorff experiments. Lastly, although the above suggestions appear feasible, a complete explanation concerning the results of this experiment is unknown. Future research into this phenomenon is necessary.

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[121]Arbogast, loc. cit.

RECOMMENDATIONS

This study was limited to the measurement of the effects of voice inflection on learning facilitation in a serial learning task. Future researchers studying the auditory von Restorff effect might consider the following recommendations. Firstly, if this experiment were repeated, the researcher might increase the decibel level of the isolated word. Since voice inflection involves a subtle usage of auditory stimuli, all of the experimental subjects might not have perceived the necessary difference between the isolated and non-isolated words. Secondly, a different list of words for the learning task could be selected. A comparison of the means and standard deviations for each position indicated that the list was learned too easily by some of the subjects. A larger sample of subjects, a more varied sample in terms of educational level, and the use of younger and older age groups would also be desirable. Finally, future researchers might be interested in studying a different aspect of the auditory von Restorff effect. The isolated word could be spoken slowly as compared with the other list items or the significance of voice inflection versus deflection could be studied. Although different aspects of voice inflection can be researched in future studies, the immediate need is to see if the results obtained from this study will be replicated.

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APPENDIX A

Summary Table of Analysis of Variance for Number of Errors at Position 3 With Correction

Summary Table of Analysis of Variance for Number of Errors at Position 3 With Correction

Source	df	SS	MS	F	p
A (type of list)	1	15.211	15.211	4.703	.05
B (sex)	1	8.895	8.895	2.750	NS
A x B	1	.842	.842	.260	NS
Error	72	232.842	3.234		
Total	75	257.789			

An F of 4.00 was necessary for significance at a probability of .05.