Running Head: Order of Presentation and Memory

The Effects of Order of Presentation of Pictures and Words on Memory

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A thesis submitted to the Department of Psychology of Algoma University College in partial fullfillment of the requirements for the degree of Bachelor of Arts.

This study will investigate recognition for visually and verbally encoded pictures and words. Typically in memory experiments of this sort, subjects are presented information in one instance and then immediately tested for recall of that information. Previous studies have shown that the initial stages in which one processes pictures and written words are important in understanding and, that information is processed in either of two separate ways. In an attempt to explain encoding processes and their effects on memory, Allan Paivio designed the Dual Coding Model (1971). The model shows how visual and verbal material is stored, organized and retrieved. The dual coding theory postulates there are two independent but interconnected processing systems, one system for visual material and the other for verbal material. Words are verbally encoded while pictures are visually encoded. The verbal and nonverbal systems are assumed to be functionally independent in that one system can be active without the other or both can be active in parallel (Paivio, 1991). One process (verbal) is commonly used with spoken and written words while the other (visual), is used primarily for visual objects and images (Paivio, 1971). Compelling evidence for two distinct modes of representation that correspond to differences in encoding both in short-term and long-term memory have been provided by Baddelely, (1986); Baddeley & Hitch, (1974); and Paivio,

(1971). Information can be visually encoded into memory by loading new visual inputs from the eyes [Kosslyn, Brunn, Cave, & Wallach, (1984); Kosslyn Holtzman, Farah, & Gazzaniga, (1985)]. Information can be verbally encoded into memory by presenting written words or by auditorily presenting the words. The picture superiority effect (Paivio, Roger, & Smythe, (1968)) states that pictures are recalled better than concrete words or abstract words. This is probably because subjects in memory experiments are highly likely to name pictures of familiar objects (intentional or not), less likely to visualize concrete words (as opposed to abstract concepts), and least likely to visualize abstract words during learning (Paivio, 1971). In Shepard's study (1967), the comparison of pictures, words, and sentences, revealed a remarkably high recognition for pictures. The subjects in this study were in one of three groups receiving either pictures, words, or sentences. In another study that repeated Shepard's procedure, recognition scores averaged 90.5 percent correct, indicating retention of over 2000 items, some for as long as three days (Standing, Conezio, and Haber, 1970). Paivio and Csapo (1973) obtained results suggesting that the contribution of the visual code is greater than that of the verbal code, perhaps by a 2:1 ratio.

Providing subjects with both visual and verbal

information, Jenkins, Neale, and Deno (1967), measured recognition by having subjects respond on paper using a scale to measure how certain subjects were with their recognitions. This recognition approach was taken to rectify the criticism of earlier studies which presented information in the verbal and visual mode and then tested memory in written form. This approach offered an advantage to subjects who verbally encoded the information by testing them in a similar modality to the learning phase (known as the encoding specificity principle outlined by Tulving, (1973)). Even in light of this possible advantage, visual coding prevailed and the pictures were recalled better than the words adding support for the picture superiority effect.

In this same study, the results of the two conditions that experienced a stimulus modality change from the recognition phase to the test phase were compared. These conditions included switching from pictures to words; (P-W), and switching from words to pictures; (W-P). The P-W condition revealed a significantly higher measure of recall for the condition receiving the pictures and then the words in comparison to the W-P condition which received the words then the pictures.

Studies incorporating modality changes are useful for gaining knowledge with respect to how one processes information. As pointed out earlier, there is something about pictures that lead us to remember them better than

words and this is known as the picture superiority effect.

The dual coding theory assumes that, due to processing information in separate and distinct modes, we retain information about which sensory modality information is presented. From the previous studies, there is no information to be gained concerning memory for sensory modality.

The study by Jenkins, Neale, and Deno, (1967) indicates that even after modality switches, subjects still remembered stimuli previously presented but no information was gained concerning whether or not the subject would be able to remember which form the stimulus was presented. By simply demonstrating that subjects in the condition which had the picture presented first remembered more, does not provide information about retention of the modality in which it the stimulus was presented. The fact that the P-W subjects remembered significantly more than W-P subjects appears to contradict Paivio's assertion that we retain information about the stimulus modality in which information was presented. By implementing a third stimulus mode, namely the picture and word together mode (PW), and analysing modality errors, more information can be gained about how information is encoded. A study that taps into memory for the modality that a stimulus was presented in needs to be conducted. The results of such a study would not only clarify the misunderstanding between these two theories but

would provide information about how we encode material in general.

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INTRODUCTION:

The present study will compare the effects of the order of presentation of pictures and words on modality errors in a recognition task.

In an attempt to explain encoding processes and their effects on memory, Allan Paivio designed the Dual Coding Model (1971). The model shows how visual and verbal material is stored, organized and retrieved. The dual coding theory postulates there are two independent but interconnected processing systems, one system for visual material and the other for verbal material. Words are verbally encoded while pictures are visually encoded. The verbal and nonverbal systems are assumed to be functionally independent in that one system can be active without the other or both can be active in parallel (Paivio, 1991). Evidence for two distinct modes of presentation that correspond to differences in encoding both in short-term and long-term memory have been provided by Paivio, (1971). The dual coding model posits that pictures are processed dually: The picture itself is processed and it automatically generates a verbal label which also is processed. For words, processing may include an image to accompany the word depending on how complicated the word is. Words describing concrete objects are visually encoded more readily than are abstract nouns because the former are somewhat easier to

image (Paivio, Rogers, and Smythe, 1968).

In a recent overview of dual coding theory, Paivio, (1991, p 257) summarized the distinction between symbolic and specific sensorimotor systems. "Verbal and nonverbal systems symbolically represent the structural and functional properties of language and the nonlinguistic world, respectively. However, both classes of events come in different modalities...and the internal symbolic systems presumably retain these distinctions". In other words, one can recall not only the information presented, but one also retains knowledge concerning which system processes information. When the verbal and nonverbal codes refer to the same object such as a picture and its name, additive effects on recall can appear (Paivio, 1991).

Generally, pictures are recalled better than are words (Paivio et al, 1968): this is known as the "picture superiority effect". It has also been shown by several investigators that pictures are learned faster than words. For example, this was shown with a serial anticipation task by Herman et al, (1951). The same results were found by Lumsdaine (1949), Deno (1965), and Paivio and Yarmey (1966), using a paired-associate task. Further evidence for the picture superiority effect is found in Shepard's study (1967), where the comparison of pictures, words, and sentences, reveals a remarkably high recognition for pictures. In another study by Standing, Conezio, and Haber

(1970), Shepard's procedure was repeated and recognition scores averaged 90.5 percent correct, indicating retention of over 2,000 items, some for as long as three days. Paivio and Csapo (1973) obtained results suggesting that the contribution of the visual code is greater than that of the verbal code, perhaps by a 2:1 ratio.

Pursuing the issue in a more effective direction, Jenkins, Neale, and Deno added modality changes to assess the separate contributions to memory that pictures and words donated. Jenkins, Neale & Deno (1967) presented stimuli either as pictures ("P") or as words ("W"). They then tested for recognition, presenting stimuli either in the same form they had originally been seen ("P-P" and "W-W" conditions) or in the other form ("P-W" and "W-P" conditions). They found:

1. P-P subjects remembered more than W-W subjects; this is the picture superiority effect.

2. P-P and W-W subjects remembered more than P-W or W-P subjects; this reflects the general principle of encoding specificity, that material is best remembered when it is cued in the same form in which it was presented.

3. P-W subjects remembered significantly more than W-P subjects, almost as much as W-W subjects. This is the most interesting finding. Jenkins et al explain this result

by hypothesizing that, when a picture is presented, the subject spontaneously produces a verbal label and stores both the picture and the label of the picture in memory. Thus either is an effective retrieval cue. When a word is presented, however, the subject rarely produces a spontaneous visual image to accompany it, and hence stores it only in a verbal form.

If this interpretation is correct, it suggests that presentation of BOTH a picture AND a label would be no more effective than presentation of a picture alone. According to Paivio's dual coding theory, presentation of both a picture and the word label would result in additive effects causing increased recall. The fact that the P-W subjects remembered significantly more than W-P subjects appears to contradict Paivio's assertion that we retain information about the stimulus modality in which information was presented. Finally, it would make specific predictions about the type of error patterns which should emerge from the different conditions in the Jenkins et al. procedure. Unfortunately, Jenkins et al. offered no analysis of errors. The present experiment examines the effects of modality shift on recognition to clarify this issue.

HYPOTHESES:

1. Subjects presented with pictures that are labelled will reveal higher recognition than subjects presented with unlabelled pictures.

2. More modality errors will occur for material presented as pictures than for material presented as words.

NULL HYPOTHESIS:

1. There will be no differences between the recognition scores of subjects who are presented with pictures that are labelled in comparison with the scores of subjects who are presented with pictures alone.
2. There will be no differences between subjects' modality errors for material presented as pictures compared with material presented as words.

METHOD:

Stimuli.-The 270 stimuli were constructed by scanning pictures from simple black and white picture books. They were selected for simplicity and recognizability. The words were printed in lowercase block letters in red. The pictures and words always occupied the same space when they appeared on the screen. The stimuli were randomly assigned

to one of nine Phase 1/Phase 2 presentation combinations (P-P, P-W, P-PW, W-W, W-P, W-PW, PW-P, PW-W, PW-PW).

Subjects and Design.-The study utilized a within-subjects design. The subjects were 45 Algoma University College male and female students. The design included the three modes of presentation (P, W, and PW), and the same three modes of testing (P, W, and PW).

Procedure.-In both Phase One and Phase Two of the study the stimuli were presented on a standard size computer monitor. The rates of presentation were programmed into the computer. Each stimulus appeared on the screen for three seconds with one second delay between stimuli. The rate was such that subjects could easily recognize the stimuli as well as implicitly read the words. Subjects participated individually, seated in front of a computer. Each subject received all nine combinations of stimuli presentation. The same random order of presenting the stimuli were used for all subjects. All stimuli were presented to the subjects via a computer, one stimulus at a time. Subjects were told they will see a series of pictures and words which they should try to remember. Subjects were also told that the stimuli may appear in a different modality from the presentation phase. Phase One was completed before all subjects immediately proceeded to Phase Two. In Phase Two subjects had as much time as they needed to answer the questions "Did you see this?", and "How did you see this?".

The two phases of the experiment together lasted approximately thirty-five minutes.

PHASE ONE: PRESENTATION PHASE

In Phase One, a group of 45 subjects received 90 stimuli; 30 words, 30 pictures, and 30 pictures with their labels. All of the words were familiar words and all of the pictures were simple black and white drawings of familiar objects. Stimuli appeared on the screen for three seconds with one second between each of the 90 stimuli presented. This made the total length of time to complete Phase One approximately 10 minutes.

PHASE TWO: RECOGNITION TEST PHASE

In Phase Two, subjects were presented 180 stimuli; 60 words, 60 pictures, and 60 pictures with their labels. In total, 90 stimuli (the original stimuli from Phase One) were mixed in with 90 new stimuli with the subject's task being to identify those stimuli presented in Phase One.

Of the 60 words, 30 were stimuli presented in Phase One while the other 30 were distracters not seen before. Of the 30 stimuli seen previously in Phase One, 10 appeared as words (W-W), 10 appeared as pictures (W-P), and 10 appeared as both (W-PW).

Of the 60 pictures, 30 were presented in Phase One while the other 30 were distracters not seen before. Of the 30 stimuli seen previously in Phase One, 10 appeared as

pictures (P-P), 10 appeared as words (P-W), and 10 appeared as both (P-PW).

Of the 60 pictures with their labels, 30 were presented in Phase One while the other 30 were distracters not seen before. Of the 30 stimuli seen previously in Phase One, 10 appeared as words (PW-W), 10 appeared as pictures (PW-P), and 10 appeared as both (PW-PW).

By the end of Phase Two, each subject received 10 of each combination of stimuli presentation; W-W, W-P, W-PW, P-P, P-W, P-PW, PW-W, PW-P, PW-PW, and 90 distraction stimuli totalling 180 stimuli.

Before beginning, subjects were told the stimuli presented to them in Phase Two will be either: stimuli they would recognize from Phase One in the same mode, stimuli from Phase One but in a different mode, or stimuli they would not recognize at all. In Phase Two, subjects were instructed to answer the questions presented by the computer. The computer presented each stimulus randomly. At the same time the stimuli were presented, subjects were asked to respond whether or not they saw the stimulus and in what form the stimulus was presented in. Subjects used the mouse control to answer the questions by "clicking" on the desired box on the screen. These boxes contained either a "P", "W", or "PW". Subjects had as long as they needed to answer the questions presented to them on the computer screen. The computer program was designed to run in this

fashion until all 180 stimuli were presented and all questions answered. Phase Two lasted approximately 30 minutes and then the session was finished.

RESULTS:

The correct recognition responses were scored strictly, being counted only when a subject responded by clicking on the "yes" square to the question "Did you see this?" when the stimulus had in fact been presented. The mean scores for correct recognition as a function of order of presentation are presented in Figure 1. The data were analyzed by a one-way analysis of variance. To conduct the multiple-comparisons between the nine condition means, the Newman-Keuls test was employed.

With respect to hypothesis one, the statistical test did not show that conditions in which pictures were presented with their word label resulted in higher recognition scores than conditions in which the pictures were not labelled. In fact, no matter which mode the test stimulus was presented, the recognition values for pictures presented with their word labels were still lower than values for pictures presented alone. See Figure 1. For a comparison of means for correct recognition responses see Figure 3.

Hypothesis two: More modality errors will occur for

material presented as pictures than for material presented as words. See Figure 2. For a comparison of means for modality errors see Figure 4. As can be seen, the actual results are opposite to the expected results in that less modality errors occurred for material presented as pictures when compared to the number of modality errors that occurred for material presented as words.

DISCUSSION:

The viewpoints of the two researchers that are focused on in this paper are both valid viewpoints yet they make for totally different predictions. Initially, siding with what Jenkins, Neale, and Deno's data suggest, it was predicted that both pictures alone and pictures with their word labels were encoded similarly, which provided the prediction that the both modes of presentation would result in similar recognition scores. If this were the prediction that was went with in this study, the resulting null hypothesis would have been as follows: There will be differences in recognition scores between conditions presenting the picture stimuli alone and conditions presenting the picture stimuli with its word label. This null hypothesis has scientific complications in that it is impossible to show that the differences between the respective conditions are due to the way the stimuli were presented. It is because of this

complication that the present hypothesis was offered. That is: Pictures presented with their word label will result in higher recognition scores than will pictures presented alone. As pointed out previously, this prediction was not supported with a statistically significant result. The fact that the picture stimuli presented with their word labels resulted in significantly lower recognition than pictures being presented alone, suggests that the words being presented with the pictures actually detract from the effectiveness of the picture thus resulting in decreased recognition.

The results are consistent in almost every detail with predictions from previous studies concerning the picture superiority effect and the encoding specificity principle. In support of the picture superiority effect, the percentage of correct recognitions with and without modality changes from Phase One to Phase Two (presentation phase and test phase), were highest for pictures, second highest for pictures and their word labels, and poorest for words. Remembering material better when it is tested in the same form it was presented, or the encoding specificity principle, gains little support from this data. When pictures are presented, they are expected to be recalled best when tested with pictures. When pictures were tested in the same form in this study, the percentage of correct recognition was the highest score at 91 percent, but testing

pictures in the picture and word form together tied this with a score of 91 percent as well (Fig. 1). When words were tested in the word form, higher recognition resulted than when the words were tested as either pictures or both the picture and word together. When pictures and words were presented together, the highest recognition was supposed to result when tested when the same picture and word were tested together but this was not the case. Although the results of testing in both the picture and word form were not far behind, pictures and words presented together actually resulted in the highest recall when tested in the picture form alone.

It is interesting to note that although the percentage of correct recognitions was significantly higher in the P-W condition compared to the W-P condition, the number of modality errors in the W-P condition were not significantly higher than those in the P-W condition. It is reasonable to presume that if one recognizes pictures significantly better than words even after a modality switch, one would also make significantly less mistakes when asked to identify how the stimulus was presented. The data do not reflect this assumption. This distinction is interesting in that, one possible answer for the discrepancy is that the pictures prompted a dual encoding of both the picture and its word label while the words were encoded verbally but not imaged.

This means only one encoding was available for words while two encodings were available for pictures thus the power of the encoding was strong enough to result in significantly higher recognition levels but not strong enough to result in a significantly lower degree of modality errors.

Whether or not information is dually encoded in two separate and distinct processes (Paivio, 1991) or information is encoded dually but only in one process (Jenkins et al., 1967) is still not known for sure and must be investigated further. The procedure used in this study is the procedure of choice when searching for more answers in that it offers the most information about how we process information. Unfortunately, all the answers are not found in this study and more research is warranted.

Figure 1. Percent Correct Recognition Graph

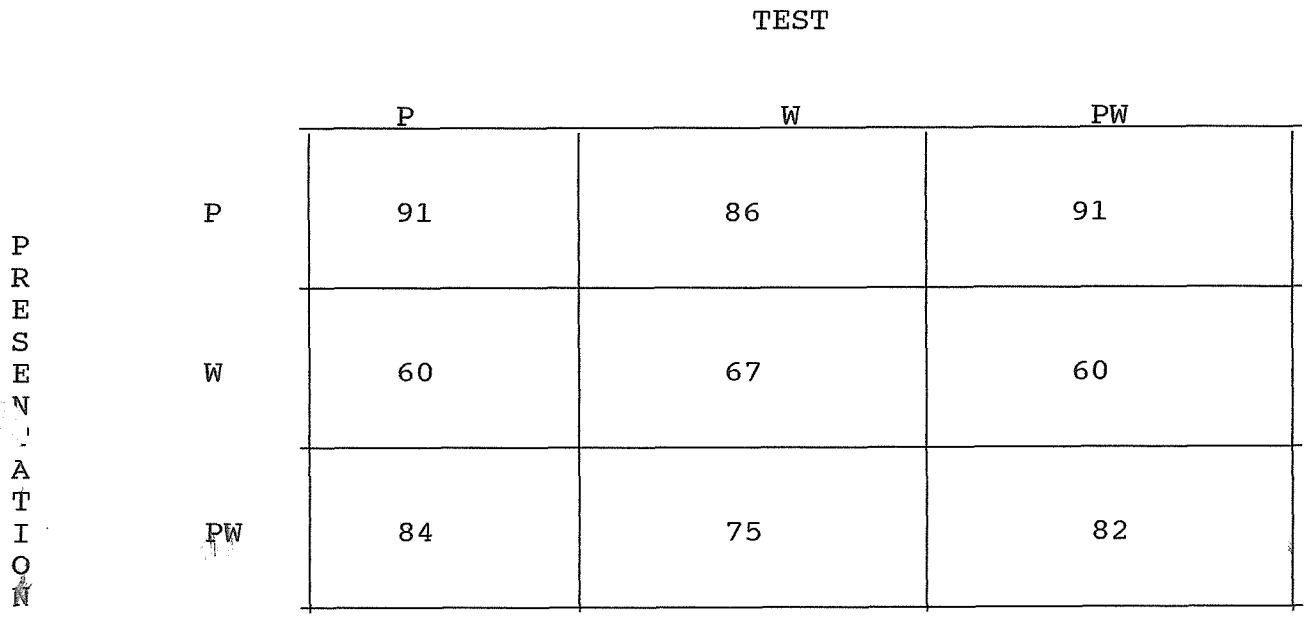

Figure 2. Percent Modality Errors Graph

TEST

PRESENTATION	P	W	PW
P	11	10	15
W	13	13	15
PW	48	48	32

Figure 3. Condition means, standard deviation, and F value graph for correct recognition responses.

Conditions	N	MEAN	STDEV	
P-P	45	9.133	1.342	
P-W	45	8.622	1.336	
P-PW	45	9.111	1.153	
W-P	45	5.511	2.351	F = 20.75
W-W	45	6.733	2.178	
W-PW	45	6.578	2.039	
PW-P	45	8.200	1.753	
PW-W	45	7.467	2.095	
PW-PW	45	8.156	1.846	

Figure 4. Condition means, standard deviation, and F value graph for modality errors.

Conditions	N	MEAN	STDEV	
P-P	45	1.000	0.769	
P-W	45	0.844	0.737	
P-PW	45	1.333	1.066	
W-P	45	0.756	1.090	F = 39.46
W-W	45	0.867	1.198	
W-PW	45	0.889	1.369	
PW-P	45	4.000	1.859	
PW-W	45	3.600	1.839	
PW-PW	45	2.622	1.862	

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