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Title: THE EFFECT OF SEX OF THE SUBJECT, SEX OF THE EXPERIMENTER, AND REINFORCEMENT CONDITION ON SERIAL DIGIT LEARNING

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This investigation tested the hypotheses that the sex of the experimenter, sex of the subject, and treatment conditions of reward, punishment, and neutral do not have an effect on serial digit learning. One-hundred-twenty subjects volunteered from undergraduate psychology courses. The subjects were randomly assigned to a male or female experimenter and then randomly assigned to a reward, punishment, or neutral treatment condition. A list of positive and negative statements were made to provide reward or punishment to a subject, while in the neutral condition the subjects were told nothing regarding their performance. The treatment ended when the subject obtained a perfect trial of recalling the list of digits. The subject was then read a previously selected passage and asked to recall on paper the list of digits. A 2 x 2 x 3 between-subjects analysis of variance,

simple main effects analysis, and Newman-Keul's Test were used to analyze the data. The results indicated that there were no significant differences between sexes of the experimenters, sexes of the subjects, or between the reward, punishment, or neutral treatment conditions. There was a significant three-way interaction effect. When reward was the treatment condition male subjects with male experimenters required fewer trials to learn than male subjects with female experimenters. The male subjects with male experimenters required fewer trials to learn than female subjects with male experimenters. Finally, female subjects with female experimenters required fewer trials to learn than female subjects with male experimenters.

THE EFFECT OF SEX OF THE SUBJECT, SEX OF THE EXPERIMENTER, AND REINFORCEMENT CONDITION ON SERIAL DIGIT LEARNING

A Thesis

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by

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Chapter 1

INTRODUCTION

This study was an investigation concerning the effects of sex of the subject, sex of the experimenter, and reinforcement condition on digit learning. This chapter includes the theoretical formulation, statement of the problem, statement of the hypotheses, statement of the purpose, and the significance of the study. Terms pertinent to the study have been defined and the limitations imposed.

Theoretical Formulation

Since the beginning of psychology, researchers have been interested in the process of memory. Recent literature indicates that memory may be a function of the interpersonal situation in which learning occurs. Learning studies have generally not controlled or reported an interaction between sex of the subject and sex of the experimenter. Previous investigators have indicated that such an interaction between a subject and the experimenter would have important implications on findings of the past learning studies; however, relatively few studies have investigated these variables.

Archer, Cejka, and Thompson (1961) found the learning performance of male subjects was unaffected by the sex of the experimenter, but with female subjects learning was significantly more rapid with a male experimenter than with a female experimenter. They used consonant-vowel-consonant trigrams as the learning stimulus with serial anticipation as the learning method.

Hetherington and Ross (1963) attempted to replicate Archer, Cejka, and Thompsons' (1961) findings. They used the same list of trigrams and the same serial anticipation method. Hetherington and Ross did employ more subjects and experimenters. They also investigated the variable of verbal reinforcement conditioning. Their analysis showed no significant interaction between the subject and the experimenter. They did find that females learned significantly faster under reward or punishment than under neutral conditions, while males' performances were not significantly affected.

With the exception that all subjects and experimenters were Black, Littig and Waddell (1967) attempted to replicate the Hetherington and Ross (1963) study. Their findings indicated that female subjects learned more rapidly with a male experimenter than with a female experimenter, and they also found that reward and neutral conditions facilitated more rapid learning than punishment.

Sobal and Juhasz (1977) felt that the learning stimuli in the previous studies were too artificial. The design of their study used two typewritten lists; one of 15 two-digit numbers, the other of 20 two-syllable words. Reinforcement occurred after the subject recalled the list of numbers. The experimenter then administered the list of words for recall. Sobal and Juhasz (1977) did replicate the findings of Hetherington and Ross (1963) in that reward and punishment were found to be more conducive to improved learning over neutral reinforcement. Like Archer, Cejka, and Thompson (1961) and Littig and

Waddell (1967), they found that subjects yielded improved performance for male experimenters rather than female experimenters.

The above studies cited have all used verbal learning stimuli. In review of the literature Maccoby and Jacklin (1974) found superiority of females over males in verbal memory. By contrast, sex differences are seldom found for objects or digits, while males excel in visual-spatial and mathematical ability. The findings also indicated that neither sex is more susceptible to simple conditioning.

A need for a better understanding of the interaction between sex of the subject and the sex of the experimenter has been indicated. Findings from further investigations should be comparable to previous research and provide a better understanding of behavior.

The Problem

Taking the findings into account, the inconsistencies of past studies, and also reviewing the variables of other situations, this investigator was led to believe that sex of the subject and sex of the experimenter and reinforcement condition should have used a situation requiring the learning of digits. Where past studies involved the use of verbal material which was shown in the literature to be learned more efficiently by females, sex differences have seldom been found for learning of digits. The literature reveals the need for further clarification on the relationship between the experimenter, the subject, and the reinforcement condition.

Statement of the Problem

Is there a significant difference in the mean number of trials to learn a list of digits when the sex of the subject is male and female?

Is there a significant difference in the mean number of trials to learn a list of digits when the sex of the experimenter is male and female?

Is there a significant difference in the mean number of trials to learn a list of digits when reward, punishment, and neutral are the reinforcement conditions?

Is there a significant difference in the mean number of trials to learn a list of digits as the result of an interaction effect?

Statement of the Hypotheses
(Null Form)

There are no significant differences in the mean number of trials to learn a list of digits when the sex of the subject is male or female.

There are no significant differences in the mean number of trials to learn a list of digits when the sex of the experimenter is male or female.

There are no significant differences in the mean number of trials to learn a list of digits when reward, punishment, or neutral are the reinforcement conditions.

There are no significant differences in the mean number of trials to learn a list of digits as the result of an interaction effect.

Purpose of the Study

The purpose of this investigation was to determine any sex differences in learning behavior. The study was developed from a review of past research and was intended to direct future investigation towards a greater understanding of learning. This study utilized human subjects to find whether the sex of the subject and sex of the experimenter would affect the mean number of trials to learn a list of digits by the serial anticipation method when reward, punishment, and neutral were the treatment conditions.

Significance of the Study

The significance of the interpersonal interaction between the sex of the subject and the sex of the experimenter in a learning situation is unclear. Motivational factors involved in the learning process show contradictory evidence, (Sobal & Juhasz, 1977). As learning and achievement are everyday goals in the American society this study has explored the interpersonal situation to provide a better understanding of the situation in which learning occurs.

Definition of Terms

To insure continuity of meaning, specific terms used in this study will be defined as follows:

Serial Anticipation Method

The serial anticipation method is a learning process in which successive stimulus-response combinations are presented in a series. Each stimulus serves as a cue for the following response. The subject has learned the series when all items presented are correctly anticipated (Chaplin, 1968).

Inter-trial Interval

A segment of time between successive presentations of the stimuli is an inter-trial interval (Chaplin, 1968).

Ceiling Criterion

The ceiling criterion is the maximum score attainable on a test (Chaplin, 1968).

Reward

A verbal statement which produces satisfaction and which tends to increase the probability of the behavior involved is a reward statement (Chaplin, 1968).

Punishment

A verbal statement which results in annoyance or discomfort is a punishment statement (Chaplin, 1968).

Neutral

A neutral treatment is an indifferent stimulus of an intermediate region which is usually characterized between positive and negative (Chaplin, 1968).

Consonant-Vowel-Consonant

A consonant-vowel-consonant is a three letter nonsense syllable consisting of a consonant-vowel-consonant (Archer, 1960).

Limitations of the Study

This study was limited to volunteer students at Emporia State University for subjects and experimenters. Experimenters were required to have completed a course in experimental psychology. Subjects were randomly assigned to experimenters and then subjects were randomly assigned to treatment conditions. The number of digits used was arbitrarily chosen following a pilot study. A variable that was beyond the control of this investigation, which may have affected the results, was the likelihood that the experimenter would have been previously acquainted with the subject he/she tested. Another uncontrolled variable was the difference in each individual experimenter's ability to perform the study beyond the structure of standard instructions, materials, and training in experimental procedure.

Chapter 2

REVIEW OF THE LITERATURE

This chapter is a review of literature regarding sex differences. The chapter presents unfounded beliefs about sex differences, reasonably well established sex differences, the etiology of sex differences, and a summary.

Unfounded Beliefs About Sex Differences

The belief that females are more social than males has not been supported by the majority of research. Specifically, with studies using social reinforcement, females are no more affected than males (Berkowitz, Butterfield, & Zigler, 1965; McManis, 1965; Patterson, 1965; Lott & Lott, 1969; Brooks, Brandt, & Weiner, 1969; Montanelli & Hill, 1969; Unikel, Strain, & Adams, 1969; Crowder & Hohle, 1970; Leventhal & Fischer, 1970; Todd & Nakamura, 1970; Allen, Spear, & Lucke, 1971; Hill & Watts, 1971; Quay, 1971; Meddock, Parsons, & Hill, 1971; Spear & Spear, 1972; Spence, 1972; Zigler & Balla, 1972; Zimmerman, 1972). The few exceptional studies found males do have improved performance with social reinforcement (Unruh, Gross, & Zigler, 1971; Pawlicki, 1972), found females improved performance when deprived of social reinforcement (Babad, 1972) and found males improved performance with neutral reinforcement (Deci, 1972).

The two sexes are found to be equally interested in interacting with others, equally interested in social stimuli, and both are equally proficient in benefiting from model learning (Maccoby & Jacklin, 1974). Maccoby also concluded from the literature that the only noticeable difference between males and females has been that males prefer larger groups than females.

Females are not better at rote learning or simple repetitive tasks. In the following studies using a rote form of learning called paired-associates no differences were found between males and females: Stevenson & Odom, 1965; Carroll & Penney, 1966; Shapiro, 1966; McCullers, 1967; Pallak, Brock, & Kiesler, 1967; Gahagan & Gahagan, 1968; Stevenson, Hale, Klein, & Miller, 1968a; Reese, 1970; Stevenson, Friedricks, & Simpson, 1970; Fraunfelker, 1971; Katz, Albert, & Atkins, 1971; Hoving & Coates, 1972; Hoving & Choi, 1972; Reese, 1972; Shultz, Charness, & Berman, 1973. There was no evidence of sex differences in discrimination learning, reversal shifts, and probability learning (Maccoby & Jacklin, 1974).

Reasonably Well Established Sex Differences

Females appear to have superior verbal ability than males after the age of 11 according to the available research (Rosenberg & Sutton-Smith, 1964; Monday, Hout, & Lutz, 1966-67; Circirelli, 1967; Very, 1967; Stevenson, Hale, Klein, & Miller, 1968a; Stevenson, Klein, Hale, & Miller, 1968b; Achenbach, 1969; Rosenberg & Sutton-Smith, 1969; Walberg, 1969; Shepard, 1970; Stevenson, Friedricks, & Simpson, 1970; Cotler & Palmer, 1971; Svensson, 1971; Backman, 1972; Blum, Fosshage, & Jarvik, 1972; Nakamura & Finck, 1973). Droege (1967) found in a longitudinal study with a large group of high school students that females verbal superiority increased from the ninth to the twelfth grade. This study was able to control for attrition. It also provided measures of skills such as comprehension and creativity rather than just spelling, punctuation, and talkativeness. The literature has indicated that from preschool to early adolescence there are no sex differences for verbal ability (Maccoby & Jacklin, 1974).

For verbal content, females also show a better memory. Numerous studies find no sex differences (Sarason & Harmatz, 1965; Hall & Ware, 1968; Stevenson, Friedricks, & Simpson, 1970; Cole, Frankel, & Sharp, 1971; Laurence & Trotter, 1971; Weener, 1971; Backman, 1972; Cramer, 1972; Hall & Halperin, 1972), but where differences are found, females have the higher scores (Tulving & Pearlstone, 1966; Stevenson, Hale, Klein, & Miller, 1968a; Sitkei & Meyers, 1969; Felzen & Anisfeld, 1970; Milburn, Bell, & Koeske, 1970; Kossuth, Carroll, & Rogers, 1971; Amster & Wiegand, 1972; Finley & Frenkel, 1972; Shepard & Ascher, 1973).

While females excel in verbal ability Maccoby & Jacklin (1974) reported that the literature showed evidence that males excel in visual-spatial and mathematical ability. Males are also more aggressive than females. Unlike females superiority for memory of verbal content, males show no superiority for memory of digits. The literature indicated no sex differences in memory for digits (Anders, Fozard & Lillyquist, 1972; Blum, Fosshage, & Jarvik, 1972; Spitz, Goettler, & Webreck, 1972).

The Etiology of Sex Differences

The development of sex differences are typically explained by three kinds of factors: biological, socializing agents, and an individual's spontaneous learning of appropriate behavior through imitation (Maccoby & Jacklin, 1974). Differences between the sexes are an interaction of the three factors.

Direct influence of biological factors on the sex difference of aggression has been very clearly shown. Sex hormones have been found to be related to aggressive behavior (Hutt, 1972; Hamburg & Van Lawick-Goodall, 1973; Lunde, 1973; Levine, 1971; Money & Ehrhardt, 1972). Young, Goy, and Phoenix (1964) found that during prenatal development male hormones administered to female monkeys resulted in increased aggressive behavior. Increased male hormones after postnatal development also increases aggressive behavior (Joslyn, 1973). It was suggested by Kreuz and Rose (1972) that a higher level of male hormones resulted in increased aggressive behavior. These findings have revealed evidence that males are more biologically prepared to learn aggression (Maccoby & Jacklin, 1974).

Visual-spatial ability is another specific ability which has been shown to have some genetic determination. The literature revealed evidence that high spatial ability is related to a recessive sex-linked gene (Bock & Kolakowski, 1973). A theory of how the gene affects the body to produce such a sex difference is once again related to hormones (Broverman, Klaiber, Kobayashi, & Vogel, 1968), although there appears to be further investigation on how specific hormones have such an effect.

Direct socialization, or sex-typing behavior, is another important influencing factor. There are two prevalent learning theories which account for shaping male and female behavior. Parental reinforcement attempts to account for differential behavior between the sexes (Gewirtz & Gewirtz, 1968). This theory emphasizes that the parents will reinforce and shape a child toward what is described as appropriate for that child's sex. The parent's differential reinforcement appears to explain some sex-typed behaviors such as boys prevented from wearing dresses, but in other areas it does not appear crucial (Maccoby & Jacklin, 1974). The second learning theory, which has been very popular in explaining sex differences, is imitation. Acquisition of male or female behaviors are obtained by the individual's identification and imitation of the same-sex parent and other same-sex models (Kagan, 1964; Mischel, 1970). Research does not appear to support the theory of imitation as it has been found that model selection appears to be random (Maccoby & Jacklin, 1974). Socialization does not appear to sufficiently explain sex differences. Maccoby & Jacklin indicated that learning is certainly important but it cannot tell the whole story of differences between males and females. It is also difficult for biological and learning factors to be separated. It should be emphasized that certain behaviors may be more readily learned by a given sex because of a genetically controlled characteristic.

The third kind of process to explain sex differences is self-socialization. Self-socialization is basically a child's active role in development of his/her behavior. Kohlberg (1966) stressed the importance of this process. He believed that sex-typed behavior is a combination of what an individual has observed, what he has been told, and in many ways an actual distortion of reality as childrens' sex role conceptions are oversimplified, exaggerated, and stereotyped.

It is frequently difficult for a child to determine appropriate behavior for his sex as he fails to realize the likeness of all in his gender. After a child fully understands sex groupings, he is then able to determine appropriate behavior for his sex and match his own behavior to the conceptions he has learned and observed.

To explain the acquisition of sex-typed behavior it appears necessary for all three learning processes to occur. Direct reinforcement and imitation alone are not sufficient enough to explain the development of masculinity and femininity (Maccoby & Jacklin, 1974).

Summary

It is difficult to compare studies as they use different ages of population, different sample sizes, and different variables in their experimental designs. Investigators also use different techniques in obtaining data: observation, ratings, questionnaires, or experimental situations. These variations make it difficult to compare studies for sex differences that have been found.

Some sex differences may be situation-specific. For example, a male may be more dominant towards his girl friend when around others than when they are alone. An example of the situational-specific sex differences which has been established (Maccoby & Jacklin, 1974) is that males and females, as children, interact equally with their parents, yet boys interact more with their peers than do girls. These subtleties are important in further research and should be discussed to provide a clearer understanding in the documentation of sex differences.

Sex differences may also appear in certain subgroups and certain ages while not in others. Many studies have emphasized certain age groups, while other age groups have received very little attention. The majority of studies have involved children, yet Maccoby and Jacklin (1974) indicated that the age 18-22 may be the most important time for sex differences to emerge. During this time period an individual dates, marries, and plans for his/her future roles, thus making it important for him/her to define their masculinity or femininity.

These details have often gone unrecognized in investigating sex differences. More recognition needs to be given to sex differences in the detailed aspects of a situation and how the variables in the situation interact (Maccoby & Jacklin, 1974).

Chapter 3

METHODS AND PROCEDURES

The methods and procedures of this study were to determine if there was a significant effect on digit learning as a result of the sex of the subject, sex of the experimenter, and reinforcement condition. This chapter includes: population and sampling, materials and instrumentation, design of the study, data collection and data analysis.

Population and Sampling

The subjects for this experiment were Emporia State University students enrolled in undergraduate psychology courses. The students volunteered for participation at the request of their instructors. The experimenters for this study were Emporia State University students enrolled in advanced experimental psychology. The 120 subjects were randomly assigned to one of ten experimenters. Each subject was then randomly assigned to reward, punishment, or neutral treatment condition. The experimenters consisted of five males and five females. Each of the ten experimenters ran subjects under each treatment condition; there were 40 subjects in each of the three treatment conditions.

Materials and Instrumentation

Instrumentation

All subjects were presented the same list of digits by means of a standard memory drum (Lafayette Co.). Two standard memory drums were utilized to hasten the completion of the experiment.

Materials

Each subject learned a list of 13 two-digit numbers using the serial anticipation method. The numbers used were as follows: 15, 37, 61, 05, 28, 94, 76, 82, 38, 40, 54, 73, 10 which were chosen from a list of numbers used in the Sobal and Juhasz, (1977) study. The digits were presented on a standard memory drum for a 2 second exposure, with 2 seconds between each digit and with a 2 second inter-trial interval. Learning continued to a criterion of 1 perfect trial or a ceiling criterion of 25 trials.

The reinforcement conditions were defined in terms of the comments made by the experimenter to the subject during the inter-trial interval. Twenty statements were used for the reward and punishment conditions. The experimenter remained silent during the inter-trial interval under the neutral condition. These statements are listed in Appendix 1 in the order in which they were presented. Statements were taken from the study completed by Hetherington and Ross (1963) with the exception of those statements marked by an asterisk which were incorporated by this investigator. If the subjects did not meet the learning criterion by 20 trials the list was repeated. The same order of statements were used for all subjects. All subjects were read a previously selected passage (Appendix 2) by the experimenter upon completion of the experimental treatment. Further data was then obtained from the subjects to complete the experiment.

Design of the Study

This study was a 2 x 2 x 3 between subjects design (see Appendix 3). The study was an investigation of how the three independent variables influenced the learning of digits. Each subject was asked to learn a list of 13 two-digit numbers presented on a memory drum by the serial anticipation method. The subjects were designated by sex and were randomly assigned to a male or female experimenter. During the inter-trial intervals the subject received either a reward, punishment, or neutral treatment condition. Experimenters recorded the number of trials necessary for a subject to correctly recall all the numbers in one trial. One-hundred-twenty subjects were used from undergraduate psychology classes and were randomly assigned to one of five male or five female experimenters. They were then randomly assigned to one of the three treatment conditions.

Data Collection

The selection of subjects for the study was based on the availability of those who volunteered. For approximately fifteen minutes, each subject individually participated in the experiment. Each experimenter was trained to use a standard set of instructions. Procedures were the same for every subject and every experimental condition.

Once the subject entered the experimental room he/she was greeted and the following instructions were read:

> You are going to be asked to participate in an experiment on memory. You will be shown a list of 13 two-digit numbers on a memory drum. You will be given a 2 second exposure to each number. After you have studied the complete list of numbers you will be asked to recall each number before it appears on the memory drum, as the list will be repeated. Please learn the list as rapidly as possible as the experiment will continue until you recall all the numbers correctly. Are there any questions?

After the memory drum had shown the complete list of numbers, the subject was then instructed to begin recalling the digits. The experimenter then provided one of the three treatment conditions (Appendix 1) during the inter-trial interval until the subject recalled all of the numbers correctly in one trial or until they met the ceiling criterion of 25 trials. After the subject had met the learning criterion, the experimenter then asked the subject to listen to a previously selected passage taken from Zimbardo and Ruch (1975), as presented in Appendix 2. Following the reading of the passage the subject was then provided with a sheet of paper and read the following instructions, "you will be given 1 minute to write down all of the numbers which you can remember, that were presented on the memory drum."

Before dismissing the subject the experimenter recorded the subject's sex, treatment condition received, and sex of the experimenter. The experimenter then discussed with the subject the nature of the study, thanked the subject for his/her participation, and explained the importance of not discussing the experiment until further notification.

Data Analysis

A 2 x 2 x 3 between-subjects analysis of variance (ANOVA) was the statistical technique used to analyze the data for significant differences between means (Linton & Gallo, 1975) (see Table 1). A three-factor between subjects analysis of variance (ANOVA) was also completed on the cell means for number retention (Linton & Gallo, 1975) (see Table 1).

In addition, a simple main effects analysis (Kirk, 1968) (see Appendix 4) and Newman-Keul's Test (Kirk, 1968) (see Appendix 5) were implemented for comparison of means where there were significant interaction effects. The .05 level of confidence was used to determine statistical significance.

Table 1
Summary Table: Three-Way Between-Subjects ANOVA
(Linton and Gallo, 1975)

Source	df	Sum of squares (SS)	Mean square (MS)	F
A	(a - 1)	$SS_A = \sum_{A=1}^{a} T_A^2/n_A - G^2/N$	$MS_A = SS_A/(a - 1)$	$F_A = MS_A/MS_E$
B	(b - 1)	$SS_B = \sum_{B=1}^{b} T_B^2/n_B - G^2/N$	$MS_B = SS_B/(b - 1)$	$F_B = MS_B/MS_E$
C	(c - 1)	$SS_C = \sum_{C=1}^{c} T_C^2/n_C - G^2/N$	$MS_C = SS_C/(c - 1)$	$F_C = MS_C/MS_E$
AB	(a - 1)·(b - 1)	$SS_{AB} = \sum_{AB=1}^{ab} T_{AB}^2/n_{AB} - SS_A - SS_B - G^2/N$	$MS_{AB} = SS_{AB}/(a - 1)(b - 1)$	$F_{AB} = MS_{AB}/MS_E$
AC	(a - 1)·(c - 1)	$SS_{AC} = \sum_{AC=1}^{ac} T_{AC}^2/n_{AC} - SS_A - SS_C - G^2/N$	$MS_{AC} = SS_{AC}/(a - 1)(c - 1)$	$F_{AC} = MS_{AC}/MS_E$
BC	(b - 1)·(c - 1)	$SS_{BC} = \sum_{BC=1}^{bc} T_{BC}^2/n_{BC} - SS_B - SS_C - G^2/N$	$MS_{BC} = SS_{BC}/(b - 1)(c - 1)$	$F_{BC} = MS_{BC}/MS_E$
ABC	(a - 1)·(b - 1)·(c - 1)·	$SS_{ABC} = \sum_{ABC=1}^{abc} T_{ABC}^2/n_{ABC} - SS_A - SS_B - SS_C - SS_{AB} - SS_{AC} - SS_{BC} - G^2/N$	$MS_{ABC} = SS_{ABC}/(a - 1)(b - 1)(c - 1)$	$F_{ABC} = MS_{ABC}/MS_E$
Error	(N - abc)	$SS_E = SS_{Total} - SS_A - SS_B - SS_C - SS_{AB} - SS_{AC} - SS_{BC} - SS_{ABC}$	$MS_E = SS_E/(N - abc)$	
Total	N - 1	$SS_{Total} = \sum X^2 - G^2/N$		

Chapter 4

ANALYSIS OF DATA

The purpose of this chapter is to present the analysis of data. Included in this chapter are the results of the three-way between-subjects analysis of variance (ANOVA) on the number of trials and the retention of numbers, the results of simple main effects analysis, Newman-Keul's Test, and graphic representation of the three-way interaction effect.

Trials

"Trials" refers to the number of exposures by a subject to achieve the learning criterion or to learn the series of digits correctly. A subject having a higher value in trials did not learn the series of digits as quickly as a subject lower in trials. The lower the number of trials, the faster the subject reached the learning criterion.

In this study the most efficient subject reached the learning criterion in 3 trials; however, the least efficient subject required 25 trials before achieving total learning. There was a mean number of 12.2 trials for all subjects before learning was achieved. There was no significant difference ($p > .05$) in the number of trials necessary to reach the learning criterion under any combination of variables. Although no significant difference appeared, there should be attention given to the difference between the highest and lowest number of trials necessary to reach the learning criterion. Those subjects who had not achieved the learning criterion by 25 trials discontinued their learning of the series of digits, but participated in the remainder of the experiment. If these subjects had been allowed to continue, a greater deviation may have occurred from the subjects that required fewer trials.

The analysis of variance of the cell means for the number of trials to learn the list of digits (see Table 2) showed no significant difference for the three independent variables at the .05 level: $F_A = .03$, $F_B = .12836$ and $F_C = 2.44$. This indicated that there was no significant difference between the sex of the experimenter being male or female, no significant difference between the sex of the subject being male or female, and no significant difference between the treatment conditions of reward, punishment or neutral. The following levels of interaction showed no significant difference at the .05 level: $F_{AB} = 2.16$, $F_{AC} = 2.31$, and $F_{BC} = .87$. The analysis of variance did show a significant interaction effect at the third level ($p < .05$) $F_{ABC} = 3.24$. Figure 1 illustrates graphically the three-way interaction. Since the analysis showed no significnat difference ($p > .05$) between the reward, punishment and neutral treatment conditions, a simple main effect analysis was completed on the cell means in each treatment condition (see Appendix 4). The analysis indicated a significant difference ($p < .05$) between the cell means when reward was the treatment condition. When the treatment condition was punishment or neutral, there was no significant difference ($p > .05$) between the cell means. To determine which cell means were significantly different

Table 2
Raw Score Data of Trials

Trials - D.V.		REWARD		PUNISHMENT		NEUTRAL		
Male Exper.	Male Subject	3	7	13	13	9	5	$\bar{X}_{Total}$ Male exper. Male subject = 11.766
		9	12	14	8	14	11	
		16	12	15	13	16	18	
		8	10	11	15	14	6	
		11	10	25	14	10	11	
		$\bar{X}$ = 9.8		$\bar{X}$ = 14.1		$\bar{X}$ = 11.4		
	Female Subject	12	25	21	9	6	6	$\bar{X}_{Total}$ Male exper. Female subject = 12.8
		17	13	10	10	5	25	
		16	21	19	5	19	15	
		10	16	4	9	21	11	
		9	6	5	13	13	13	
		$\bar{X}$ = 14.5		$\bar{X}$ = 10.5		$\bar{X}$ = 13.4		
Female Exper.	Male Subject	8	14	4	6	20	12	$\bar{X}_{Total}$ Female exper. Male subject = 12.966
		25	5	5	6	13	15	
		17	4	8	16	25	22	
		16	17	15	8	10	12	
		9	21	13	12	15	16	
		$\bar{X}$ = 13.6		$\bar{X}$ = 9.3		$\bar{X}$ = 16.0		
	Female Subject	5	15	11	10	8	11	$\bar{X}_{Total}$ Female exper. Female subject = 11.266
		12	17	15	9	6	15	
		8	12	6	9	14	12	
		7	4	3	11	12	22	
		21	14	8	14	13	14	
		$\bar{X}$ = 11.5		$\bar{X}$ = 9.6		$\bar{X}$ = 12.7		
		$\bar{X}_{Total}$ Reward = 12.35		$\bar{X}_{Total}$ Punishment = 10.875		$\bar{X}_{Total}$ Neutral = 13.375		

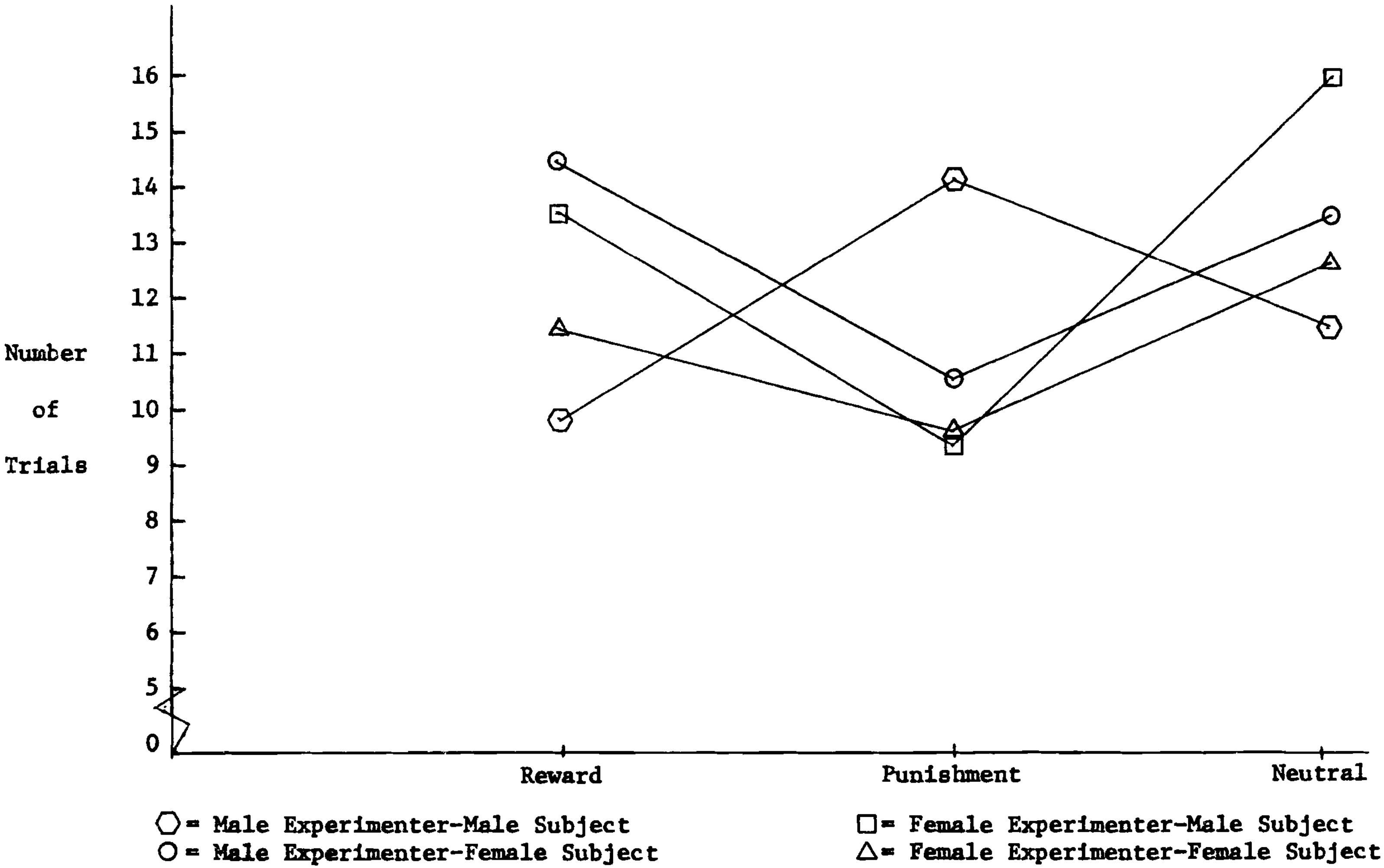

Figure 1
Cell Means of Significant
Three-Way Interaction Effect

in the reward treatment condition the Newman-Keul's Test was utilized (Appendix 5). The results of this analysis revealed that male subjects with male experimenters required fewer trials to learn than male subjects with female experimenters. The analysis indicated that male subjects with male experimenters required fewer trials to learn than female subjects with male experimenters. Finally, female subjects with female experimenters required fewer trials to learn than female subjects with male experimenters.

Number Retention

"Number Retention" refers to the amount of retention subjects had for the digits learned using the serial anticipation method. After reaching the learning criterion, or correctly recalling all of the numbers presented on the memory drum, the experimenter read to the subject. After the passage was read, the subject was then asked to recall on paper as many of the numbers presented on the memory drum that he or she could remember. The list of digits did not need to be recalled in order. A subject with perfect number retention would have recalled 13 numbers that were presented on the memory drum.

No significant differences were indicated for number retention ($p > .05$); however, the differences between the highest number retention of 13 and the lowest number retention of 8 should be noted. Possibly, some subjects may have had greater retention capacity than allowed by this study. For all subjects the mean number retention was 12.33. The highest mean cell value was 13.0 and the lowest mean cell value was 12.0. Table 3 shows the number of digits each subject correctly recalled. Analysis of variance showed no significant difference ($p > .05$) for all

Table 3
Raw Score Data of Number Retention

Numbers	- D.V.	REWARD		PUNISHMENT		NEUTRAL		
Male Exper.	Male Subject	10	13	11	13	13	13	$\bar{X}_{Total}$
		12	12	13	13	13	13	Male exper.
		12	12	11	13	13	13	Male subject =
		12	12	11	12	13	13	12.4
		13	12	13	12	13	13	
		$\bar{X}$ = 12.0		$\bar{X}$ = 12.2		$\bar{X}$ = 13.0		
	Female Subject	8	13	13	13	12	11	$\bar{X}_{Total}$
		13	12	13	12	13	13	Male exper.
		12	13	13	12	12	13	Female subject =
		13	13	13	13	13	13	12.433
		13	12	10	13	13	13	
		$\bar{X}$ = 12.2		$\bar{X}$ = 12.5		$\bar{X}$ = 12.6		
Female Exper.	Male Subject	12	13	12	13	13	11	$\bar{X}_{Total}$
		13	13	11	13	12	13	Female exper.
		13	13	12	12	10	11	Male subject =
		10	13	11	12	13	12	12.2
		13	13	13	13	12	13	
		$\bar{X}$ = 12.4		$\bar{X}$ = 12.2		$\bar{X}$ = 12.0		
	Female Subject	12	13	13	13	11	10	$\bar{X}_{Total}$
		13	13	13	10	13	13	Female exper.
		11	13	13	13	11	13	Female subject =
		12	13	10	11	13	13	12.3
		13	12	13	13	13	12	
		$\bar{X}$ = 12.5		$\bar{X}$ = 12.2		$\bar{X}$ = 12.2		
		$\bar{X}_{Total}$ Reward = 12.275		$\bar{X}_{Total}$ Punishment = 12.275		$\bar{X}_{Total}$ Neutral = 12.45		

three main variables and no significant difference ($p > .05$) for any interaction effect, ($F_A = .87$, $F_B = .14$, $F_C = .43$, $F_{AB} = .04$, $F_{AC} = 2.87$, $F_{BC} = .22$, and $F_{ABC} = 1.16$).

Summary

The three-way between-subjects analysis of variance found no significant difference in the levels of the three independent variables. Therefore, the null hypotheses were retained as follows: There was no significant difference between male and female subjects; there was no significant difference between treatment conditions of reward, punishment and neutral when a subject had been asked to learn a list of digits by the serial anticipation method. The analysis of variance indicated a significant interaction effect ($p < .05$).

There was no significant difference found when subjects were asked to recall the list of digits after listening to a reading. Although no significant difference was found ($p > .05$), perfect recall only occurred when the experimenter was male, the subject was male and the treatment condition was neutral. An analysis for individual differences between experimenters was not completed as each experimenter did not run an equal number of subjects.

Chapter 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter includes a summary of the study, conclusions made from the analysis of data, discussion of the conclusions, and recommendations for future study.

Summary

The analysis of variance supported the null hypotheses for the three main independent variables. When subjects were asked to learn a list of digits the sex of the experimenter had no significant effect on the subject's learning performance. There was no significant difference between male and female subjects in learning digits. Learning performance was not significantly affected by reward, punishment, or neutral treatment conditions. The analysis indicated a three-way interaction effect that was significant. When reward was the treatment condition male subjects required fewer learning trials than female subjects with a male experimenter. The male subjects required fewer learning trials than female subjects with a male rather than a female experimenter. The female subjects required fewer learning trials than male subjects with a female rather than a male experimenter.

Results of the study suggested that in a positive learning condition an important factor in learning may be the sex of the person requesting the material to be learned. Recommendations for further investigation included using a more general population, inquiry into the effects of the number of experimenters used in a study, and replication of the study using digits, along with other learning stimuli.

Conclusions

The null hypotheses were supported by this study with regard to the three independent variables. A subject's performance in learning a list of digits by the serial anticipation method was not affected by the experimenter being male or female. The analysis of variance showed no significant difference between the sex of the subjects in their ability to learn a list of digits. A subject's learning was not significantly affected by the reward, punishment, or neutral treatment condition they received.

The analysis of variance did not support the null hypothesis of no interaction effect. The data indicated significant three-way interaction effect. When reward was the treatment condition, male subjects required fewer learning trials with a male experimenter than with a female experimenter. The male subjects also required fewer learning trials than female subjects with a male experimenter. The female subjects required fewer learning trials with a female experimenter than with a male experimenter. There were no significant differences between the cell means in the punishment or neutral treatment condition.

This study also investigated the subject's retention of digits after the subject had achieved the learning criterion. The analysis of the data indicated that there were no significant differences between the cell means.

Discussion

This study attempted to replicate the procedures used in previous learning studies which have implemented the following variables: sex of the experimenter, sex of the subject, and conditions of reward, punishment, and neutral treatment. Where earlier studies used verbal learning as the stimulus this was an exploratory investigation using digit learning. Digits were chosen as the stimulus since research shows neither sex to be more proficient in learning numbers, whereas, females have been found superior in learning verbal material (Maccoby & Jacklin, 1974). There are questions about the validity of this study; this investigator would encourage the study be repeated with more highly trained experimenters.

The data accumulated in this investigation indicated that a subject will learn as well for a male experimenter as for a female experimenter. This outcome would suggest that learning studies using digits as a stimulus do not need to control for sex of the experimenter. In comparison to those studies that used verbal material, there was some support that the experimenter's sex has no effect on the subject's performance. The study completed by Hetherington and Ross (1963) found no significant difference between male and female experimenters. In utilizing ten male and ten female experimenters, they did find individual differences between the experimenters. A later study by Littig and Waddell (1967) attempted to replicate the investigation by Hetherington and Ross with the exception that all subjects and experimenters were Blacks. They found no individual differences between experimenters nor any significant difference between male or female experimenters. Since Littig and Waddell used only two male and two female experimenters this may account for the lack of significant differences between individual experimenters.

A study that did find a significant difference between male and female experimenters, with the use of verbal material, was Archer, Cejka, and Thompson (1961) which incorporated one female and two male experimenters. Recently, Sobal and Juhasz (1977), used two male and two female experimenters to find that subjects learned significantly better for a male than they did for a female. It would appear that the fewer the experimenters the more likely significance will occur with the exception of the Littig and Waddell study (1967). Since this study incorporated five male and five female experimenters there may have been too many experimenters for a significant difference to occur between the sex of the experimenters. An analysis of individual differences between experimenters was not completed as each experimenter did not test an equal number of subjects. The possibility exists that each experimenter had an individual effect on the subjects.

There was no significant difference found between male and female subjects in the number of trials needed to obtain the learning criterion. The learning criterion was met when each subject had learned the list of digits. This finding was supportive of earlier investigations which have reported no sex difference in the learning of digits (Maccoby & Jacklin, 1974).

A select group of the general population was used in this study to obtain the data. A similar study with a more representative sample of the general population may not obtain the same results. All male and female subjects in this investigation were students who volunteered to participate in this study and were enrolled in psychology classes at Emporia State University. College students are typically in the practice of taking tests, which may have facilitated faster learning of the list of digits. College students may also be more capable of coping with pressures of a test session than those individuals in the general population. A more representative sample of the general population that were not as experienced in taking tests, might result in a greater variability between the subjects' performances; thereby, affecting different results of the study.

In this study the analysis of data found no significant difference between the reward, punishment, or neutral treatment conditions. Earlier studies that have investigated these variables, using a verbal learning stimulus, have found a significant difference between the treatment conditions. The reward and punishment conditions were found to be more conducive to learning than the neutral condition (Hetherington & Ross, 1963; Sobal & Juhasz, 1977). The study completed by Littig and Waddell (1967) found subjects learned more rapidly under reward and neutral conditions than under the punishment condition. The subjects and experimenters in the Littig and Waddell study were all Black which they assumed may have accounted for a difference in results from the Hetherington and Ross study (1963). This investigation would seem to indicate that the subject's performance in learning digits, unlike learning verbal material, are not affected by different treatment conditions.

A significant difference was found in a three-way interaction of the independent variables. When reward was the treatment condition male subjects required fewer learning trials for a male experimenter than male subjects for a female experimenter. The male subjects required fewer learning trials than female subjects with a male experimenter. The female subjects required fewer learning trials for a female experimenter than female subjects for a male experimenter. When the treatment conditions were punishment and neutral there were no significant differences found between the cell means. Based upon these findings it could be speculated that when reward is the treatment condition that a subject performs best in learning a list of digits for an experimenter of the same sex. Previous research indicated that learning was partly a function of the sex of the person requesting the material to be learned (Sobal & Juhasz, 1977). This study supported that finding, but only under a positive learning condition. The subjects learn a list of digits as well for a male as a female when the setting provides a punishment or neutral condition.

The data obtained, regarding the subjects retention of digits, indicated that all subjects were able to retain the digits regardless of their experimental condition. Such data also indicated that the experimental design provided the subjects the opportunity to learn the list of digits.

Finally, the results did not suggest that the list of digits was too long or too short. The length of the digit list was arbitrarily selected. One subject learned the list in 3 trials, while another subject required at least 25 trials. The mean number of trials required for all subjects was 12.2.

Recommendations

Future studies that address the investigation of these variables should consider obtaining their subjects from a more general population rather than from such a select group as college students. Such a sample might promote a clearer picture of interpersonal roles between subjects and experimenters. It may also promote greater variability between subject groups. The findings from a study using a more general population may provide a better understanding of productivity in students and employees.

Further research is needed on the effects of the number of experimenters used in a study. There is some indication that the fewer the experimenters, the more likely significance will occur between male and female experimenters.

It is recommended that this investigation be repeated since no other studies have used digits for the learning stimulus with these variables and the reliability of the results in this investigation are in question. Consideration should also be given to other learning situations in which interpersonal communications occur between the sexes. For example, different results may be obtained when a subject has been asked to learn a list of pictures or a group of objects.

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APPENDICES

APPENDIX 1

Statements for Treatment Conditions

Reward and Punishment Statements

Reward	Punishment
You're doing fine.	Let's hope you do better next time.
Good. Let's try again.	You had a lot of errors that time.
That was very good.	Try again.
You're improving quickly.	Are you really trying?
That was a good trial.	*You're not doing very well.
You're a fast learner.	Wrong again.
Very good.	No you're still making mistakes.
You're doing better all the time.	*Try harder next time.
Fine.	Come on now. Concentrate.
Keep up the good work.	*Strive for improvement.
That was a good one.	You're not making much progress.
You've almost got it.	This could go on forever.
That was close.	*Please apply yourself.
You're doing very well.	We'll be here all day at this rate.
You're one of the fastest subjects-	*Some of those were incorrect.
I've had today.	*Try to be more attentive.
Excellent.	Wrong.
You'll have it in no time.	You have no place to go but up.
You're close.	Will you please try a little harder.
Good.	Well here we go again.
That's the way to go.	

*Statements incorporated by the investigator

APPENDIX 2

Passage

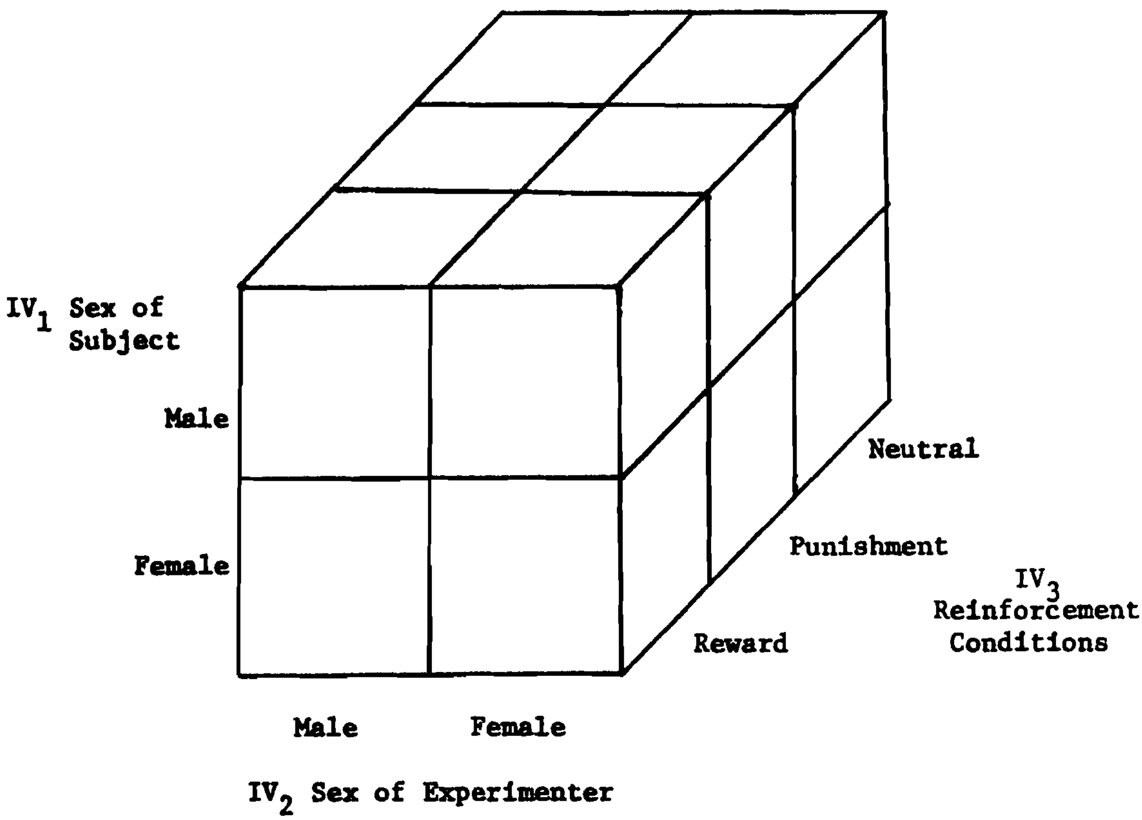
Passage

Psychology is the scientific study of the behavior of organisms. It is learning what makes people tick and finding out how the mind works. Psychology is a way of thinking about how living creatures cope with their environment and interact with each other; as such it is at the intersection of philosophy, biology, sociology, physiology, and anthropology. Psychology is what distinguishes humans from machines. Perhaps most importantly, psychology is a kind of knowledge and approach that can be used to improve the quality of human life.

APPENDIX 3

Diagram of the Independent Variables

INDEPENDENT VARIABLES



APPENDIX 4

Simple Main Effects Analysis

for

Three-Way Interaction

SS_{AB} at C_1 =

Step 1
$$\left[\frac{(T_{A_1B_1C_1})^2}{n} + \frac{(T_{A_1B_2C_1})^2}{n} + \frac{(T_{A_2B_1C_1})^2}{n} + \frac{(T_{A_2B_2C_1})^2}{n} - \frac{(T_{C_1})^2}{(n)(a)(b)}\right] -$$
$$\left[\frac{(T_{C_1})^2}{(n)(a)(b)} - \left(\frac{(T_{A_1}\text{ at }C_1)^2}{n_{A_1}} + \frac{(T_{A_2}\text{ at }C_1)^2}{n_{A_2}}\right)\right] - \left[\frac{(T_{C_1})^2}{(n)(a)(b)} - \left(\frac{(T_{B_1}\text{ at }C_1)^2}{n_{B_1}} + \frac{(T_{B_2}\text{ at }C_1)^2}{n_{B_2}}\right)\right]$$

Step 2
$$\left[\frac{(98)^2}{10} + \frac{(145)^2}{10} + \frac{(136)^2}{10} + \frac{(115)^2}{10} - \frac{(494)^2}{40}\right] -$$
$$\left[\frac{(494)^2}{40} - \left(\frac{(243)^2}{20} + \frac{(251)^2}{20}\right)\right] - \left[\frac{(494)^2}{40} + \left(\frac{(234)^2}{20} + \frac{(260)^2}{20}\right)\right] =$$

Step 3 $\quad 6235.0 - 6100.9 - 1.60 - 16.90 =$

Step 4 $\quad 134.1 - 1.60 - 16.90 = 115.60$

$$F = \frac{SS_{AB}\text{ at }C_1}{MS_{Error}} = \frac{115.6}{25.9425} = 4.45$$

df = 1,108 $\qquad p < .05$

PUNISHMENT

SS_{AB} at C_2 =

Step 1

$$\left[\frac{(T_{A_1B_1C_2})^2}{n} + \frac{(T_{A_1B_2C_2})^2}{n} + \frac{(T_{A_2B_1C_2})^2}{n} + \frac{(T_{A_2B_2C_2})^2}{n} - \frac{(T_{C_2})^2}{(n)(a)(b)}\right] -$$

$$\left[\frac{(T_{C_2})^2}{(n)(a)(b)} - \left(\frac{(T_{A_1}\text{ at }C_2)^2}{n_{A_1}} + \frac{(T_{A_2}\text{ at }C_2)^2}{n_{A_2}}\right)\right] - \frac{(T_{C_2})^2}{(n)(a)(b)} - \left[\left(\frac{(T_{B_1}\text{ at }C_2)^2}{n_{B_1}} + \frac{(T_{B_2}\text{ at }C_2)^2}{n_{B_2}}\right)\right]$$

Step 2

$$\left[\frac{(141)^2}{10} + \frac{(105)^2}{10} + \frac{(93)^2}{10} + \frac{(96)^2}{10} - \frac{(435)^2}{10}\right] -$$

$$\left[\frac{(435)^2}{40} - \left(\frac{(246)^2}{20} + \frac{(189)^2}{20}\right)\right] - \left[\frac{(435)^2}{40} - \left(\frac{(234)^2}{20} + \frac{(201)^2}{20}\right)\right] =$$

Step 3 $\quad 4877.10 - 4730.625 \quad - 27.225 - 81.225 =$

Step 4 $\quad 146.475 \quad - 27.225 - 81.225 = 38.025$

$$F = \frac{SS_{AB}\text{ at }C_2}{MS_{Error}} = \frac{38.025}{25.9425} = 1.47$$

df = 1,108 $\quad p > .05$

SS_{AB} at C_3 =

Step 1
$$\left[\frac{(T_{A_1B_1C_3})^2}{n} + \frac{(T_{A_1B_2C_3})^2}{n} + \frac{(T_{A_2B_1C_3})^2}{n} + \frac{(T_{A_2B_2C_3})^2}{n} - \frac{(T_{C_3})^2}{(n)(a)(b)}\right] -$$
$$\left[\frac{(T_{C_3})^2}{(n)(a)(b)} - \left(\frac{(T_{A_1}\text{ at }C_3)^2}{n_{A_1}} + \frac{(T_{A_2}\text{ at }C_3)^2}{n_{A_2}}\right)\right] - \left[\frac{(T_{C_3})^2}{(n)(a)(b)} - \left(\frac{(T_{B_1}\text{ at }C_3)^2}{n_{B_1}} + \frac{(T_{B_2}\text{ at }C_3)^2}{n_{B_2}}\right)\right]$$

Step 2
$$\left[\frac{(114)^2}{10} + \frac{(134)^2}{10} + \frac{(160)^2}{10} + \frac{(127)^2}{10} - \frac{(535)^2}{40}\right] -$$
$$\left[\frac{(535)^2}{40} - \left(\frac{(248)^2}{20} + \frac{(287)^2}{20}\right)\right] - \left[\frac{(535)^2}{40} - \left(\frac{(274)^2}{20} + \frac{(261)^2}{20}\right)\right] =$$

Step 3 $\quad 7268.10 - 7155.625 \quad - 38.025 - 4.225 =$

Step 4 $\quad 112.475 \quad - 38.025 - 4.225 = 70.225$

$$F = \frac{SS_{AB}\text{ at }C_3}{MS_{Error}} = \frac{70.225}{25.9425} = 2.71$$

$df = 1{,}108 \qquad p > .05$

APPENDIX 5

Newman-Keul's Test

Cell Means at C_1 in Rank Order

	9.8	11.5	13.6	14.5
9.8	---	1.70	3.80*	4.70*
11.5		----	2.10	3.00*
13.6			----	.90
14.5				----

$$\text{Tabulated Studentized Range}\sqrt{\frac{MS_{Error}}{(n)(a)(b)}} = F$$

$$\text{4th Step} = 3.74^{**}\sqrt{\frac{25.9425}{40}} = 3.03$$

$$\text{3rd Step} = 3.40^{**}\sqrt{\frac{25.9425}{40}} = 2.75$$

$$\text{2nd Step} = 2.83^{**}\sqrt{\frac{25.9425}{40}} = 2.29$$

*Indicates significant difference between the two means.

**Tabulated studentized range at .05 level, df = 1,108.