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A Comparative Analysis of the Effects of Positive Specific Feedback & Positive General Feedback on the Bowling Scores of College Age Men & Women

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A COMPARATIVE ANALYSIS OF THE EFFECTS OF POSITIVE SPECIFIC FEEDBACK AND POSITIVE GENERAL FEEDBACK ON THE BOWLING SCORES OF COLLEGE AGE MEN AND WOMEN

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A Comparative Analysis of The Effects of Positive Specific Feedback and Positive General Feedback On the Bowling Scores of College Age Men and Women

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A COMPARATIVE ANALYSIS OF THE EFFECTS OF POSITIVE SPECIFIC FEEDBACK AND POSITIVE GENERAL FEEDBACK ON THE BOWLING SCORES OF COLLEGE AGE MEN AND WOMEN

James Rauschenbach July 1989 63 Pages

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This study was conducted to examine the effects of positive specific feedback and positive general feedback on the bowling scores of subjects enrolled in two beginning bowling classes. Experimental groups were formed from two intact bowling classes, and a group of fifteen volunteers who made up the control group. The PSF group which contained twenty-eight subjects, was provided with positive specific feedback throughout the course of the study. The PGF group which contained thirty-five subjects, was provided with positive general feedback throughout the course of the study. Subjects were administered a pretest at the start of the study which consisted of the average score obtained after completing four games of bowling. Following the pretest, subjects in the PSF and PGF groups received eleven sessions of bowling instruction and twelve sessions of bowling competition. Subjects in the control group received no bowling instruction or practice. At the completion of the study subjects were administered a post-test which consisted of the average score obtain after completing four games of bowling.

An analysis of covariance performed on post-test scores revealed that significant differences existed among the three experimental groups. A post hoc test revealed that the PSF group scored significantly higher than the PGF and control group on the post-test. No other significant differences were revealed. The null hypothesis that no significant differences would exist among the post-test scores of the three experimental groups was rejected.

An analysis of variance with repeated measures was performed on the mean score of games bowled by subjects in the two treatment groups during six weeks of competition. Although a marked difference in improvement was noted between groups during the fifth and sixth weeks of competition, the null hypothesis that no difference in improvement would exist between groups, was accepted.

Chapter I

Introduction

Feedback has been considered one of the most important variables in the acquisition of motor skills. This belief has been stated by Thorndike (1927), Adams (1971), Newel (1976), Magil (1980), and Singer (1980). Holding (1965) defined two types of feedback:

1. Intrinsic Feedback: knowledge a performer receives as a result of movement
2. Augmented Feedback: information concerning the movement or degree of goal attainment.

My manipulating the amount of information subjects received, Thorndike pointed out the importance of intrinsic feedback. Studies conducted by Elwell and Grindley (1938), Trowbridge and Casons (1932), Macpherson et al. (1948), Bilodeau et al. (1958), Baker and Young (1960), Adams (1971), Smoll (1972), Shapiro (1977), and Wallace and Hagler (1979) have demonstrated the importance of augmented feedback. The studies conducted by Trowbridge and Casons (1932), Elwell and Grindley (1938), Macpherson et al. (1960), Bilodeau et al. (1958), Baker and Young (1960), Smoll (1972), and Wallace and Hagler (1979) indicated a positive regression between precision of augmented feedback and performance. Studies conducted by Yerg (1981a), Yerg (1981b), Pieron (1982), and Graham et al. (1983) concluded that high amounts of augmented feedback were not significantly correlated with student achievement. Pease (1987) stated, "In spite of these findings many teacher educators have felt that teacher

feedback is important." In the same article Pease stated:

> There is little doubt that the opportunity to practice is the most important variable in the learning of a motor skill, but for certain students in certain skills continued practice would not make a difference without teacher feedback.

The obvious importance of augmented feedback and the conflicting results of studies dealing with it have caused a need for more research to be done in this area.

Statement of Problem

The purpose of this study was to compare the effects of positive general feedback and positive specific feedback on the post-test bowling scores of college age men and women enrolled in beginning bowling classes.

Significance of Study

A review of the literature has revealed some questions that need to be answered. Magil (1980) listed three functions of augmented feedback:

1. Information
2. Reinforcement
3. Motivation

It was felt that if one group of subjects were reinforced and motivated with positive general feedback, and another group were supplied information through positive specific feedback, a comparison of the functions could be made. It was felt that results of the comparison would help to answer three questions:

1. How much information does a learner need, to acquire a motor skill?

2. What type of learner benefits the most from specific feedback?

3. Should teachers supply students with specific feedback or are reinforcement and motivation from the teacher just as valuable to students when they are learning a motor skill?

It was felt that this study, when combined with others could supply teacher educators with valuable information.

Hypotheses

This study tested the following null hypotheses:

1. There would be no significant difference in post-test bowling scores of subjects in the treatment group that received positive general feedback, subjects in the treatment group that received positive specific feedback, and subjects in the control group.

2. There would be no significant difference in improvement between the treatment groups during the six weeks of bowling competition.

Delimitations

The study was delimited to a comparison of the effects of positive general feedback and positive specific feedback on the acquisition of bowling skills. The study was also delimited to college age men and women enrolled in physical education classes at Western Kentucky University during the spring semester of 1989. Bowling scores were used to measure differences between experimental groups.

Limitations

The limitations of this study are:

1. Subjects were members of intact groups.
2. Prior to the study, the investigator had not taught a college level bowling course.
3. Assessments of subject's stance, approach, release, and follow through were performed by the investigator, utilizing a subjective rating scale.

Assumptions

In order to conduct this study, the following assumptions were made:

1. Subjects were representative of college age men and women.
2. Subject's willingness to learn was equal within groups and between groups.
3. The average of four games of bowling was a valid measure of subject's bowling skill.
4. Subjective assessment reflected the skill level of subjects.

Definitions

The following terms have been defined to promote clarity and understanding.

1. Approach: four steps and a pendulum swing made by a bowler as he prepares to release the ball
2. Augmented Feedback: information concerning the movement or degree of goal attainment provided in addition to intrinsic feedback
3. Beginner Bowler: subject who has never participated in an organized bowling league
4. Bowling Score: number from zero to three hundred which is the sum of the number of pins knocked down and the spare and strike bonuses

5. Class Session: sixty-minute periods, during which the treatment groups met

6. Delivery: one roll of the bowling ball, consisting of an approach, release, and follow through

7. Frame: one turn at bowling, one-tenth of a game

8. Follow through: motion of the body after the ball is released

9. Game of Bowling: ten frames consisting of twelve to twenty-one deliveries

10. Intrinsic Feedback: knowledge a performer received as a result of movement

11. Instructional Session: class sessions in which bowling instruction was supplied to subjects

12. Knowledge of Performance (KP): information concerning degree of goal attainment

13. Knowledge of Results (KR): information concerning degree of goal attainment

14. Positive General Feedback (PGF): statements made to less than half the group, following a skill attempt, which were general in nature; a form of praise

15. Positive Specific Feedback (PSF): positive statements made to less than half the group, following a skill attempt, which supplied specific information

16. Post test: average of four games of bowling and a subjective rating of skills

17. Pretest: average of four games of bowling and a subjective rating of skills

18. Release: letting go of the ball at the completion of the approach

19. Stance: alignment of body parts as the bowler prepares to make his approach

20. Subjective assessment: four item rating completed by the investigator which concerned the subjects' stance, approach, release, and follow through

Chapter II

Review of Related Literature

A review of the literature was undertaken to accomplish three goals:

1. Establish the importance of Knowledge of Performance (KP) and Knowledge of Results (KR).
2. Review studies which investigated effects of different degrees of precision of KR.
3. Review studies which measured effects of KP and KR in physical education settings.

The Importance of KP and KR

E. L. Thorndike was the first to investigate the effects of KP and KR on learning. After concluding nineteen years of research on animals and humans, Thorndike established his Law of Effect which stated "Reinforcement increases the strength of a connection." Thorndike believed that any action which resulted in a satisfying state of affairs would be repeated. He saw KR as a motivator for learning. Thorndike believed that no learning took place without KR.

Adams (1971) created a Closed Loop Theory of learning in which KP and KR held a key role. He used Thorndike's Law of Effect as one of the bases for his theory. Adams interpreted Thorndike's law with the following statement:

> Saying "Right" after a correct response is a rewarding event that will cause a human to acquire a desired response, and saying "Wrong" is a punishing event that causes an incorrect response to drop out.

Adams also stated that "A desired motor movement will evolve with the systematic application of "Right" and "Wrong".

For Adams learning was an error reducing process. Adams believed that a learner had a desired result in mind when practicing a skill. KP and KR were used to detect discrepancies between the desired result and the movement made by the learner. The learners task was to repeat the movement until the discrepancies were erased.

Adams cited several studies to document his theory, and his theory has been well accepted.

Bilodeau et al. (1958) withdrew KR from subjects performing a lever positioning task. Subjects were placed into three groups:

1. subjects who received KR during the first two practice trials
2. subjects who received KR during the first six practice trials
3. subjects who received no KR

The investigators discovered that when KR was removed, subjects performance deteriorated to the level of subjects who never received KR.

Newel (1974) conducted an experiment using thirteen year old boys as subjects. Their task was to use exactly one hundred and forty msec. to move a lever twenty-four cm. along a rod. Newel separated his subjects into groups which received KR during an unequal number of trials. Newel found that once subjects learned the task fairly well the removal of KR did not effect performance, but when KR was removed

after only a few trials, performance deteriorated. Newel concluded that his subjects used KR in the early stages of learning to create a reference. Subjects compared their practice trials with the reference.

Studies by Thorndike, Adams, Bilodeau et al., and Newel have shown KP and KR to be the most important variable controlling performance. They have demonstrated that there was no improvement without KP and KR and that performance deteriorated when KP and KR were withdrawn.

Studies Which Dealt With Precision

Studies that provided general and specific feedback in order to measure the effects of different precision levels of KR were reviewed.

Thorndike (1927) blindfolded subjects as they drew three to six inch lines. He provided one group with general feedback by responding to their attempts with an answer of "Right" or "Wrong". Subjects in the other group received no feedback. Subjects in the group which received general feedback improved twenty percent throughout the course of the study. Subjects in the group which received no feedback, made no improvement through the study.

Trowbridge and Cason (1932) replicated Thorndikes' study but separated their subjects into groups that received:

1. no feedback
2. a nonsense syllable
3. "Right" and "Wrong" statements
4. a statement of "Plus" or "Minus" indicating the direction and amount of error

Their results are shown in Table 1.

Table 1

Results of Trowbridge and Cason Study

Procedure	Average Percentage of Correct Responses
Blank	13.6
Nonsense	5.1
Right - Wrong	22.6
Plus - Minus	54.8

The score for each procedure was based on the results obtained from fifteen subjects and 1500 trials.

The investigators concluded that general feedback (Right-Wrong) provided motivation while specific feedback (Plus-Minus) provided motivation and information which helped subjects to correct errors.

Smoll (1972) provided subjects with three precision levels of feedback as they completed a duckpin bowling task. Their task was to roll a bowling ball at a duckpin, causing the pin to fall within a given period of time. Subjects were placed in groups which received:

1. statements of "too fast" or "too slow"
2. feedback accurate to within one-tenth of a second
3. feedback accurate to within one-hundredth of a second

After subjects performed 60 trials, Smoll made the following conclusions:

1. The mean absolute error for subjects in the group which received general feedback was significantly greater than the means for subjects in the groups which received specific feedback.

2. No significant difference was found between the mean score of subjects provided with feedback accurate to within one-tenth of a second and the mean score of subjects provided with feedback accurate to within one-hundredth of a second.

Rogers (1974) had subjects attempt to turn the knob of a micrometer a certain number of degrees. Subjects could not see the micrometer and had to rely on the investigators feedback. Subjects were placed into groups depending on the precision of feedback they received:

1. statements of "too short" or "too far"
2. amount of error rounded to one digit
3. amount of error rounded to two digits
4. amount of error rounded to four digits

Table 2 shows results of the last block of trials subjects performed.

Table 2

Results of Rogers Study

Digits of Feedback	Mean Response Error (in inches)
0	3.14
1	1.92
2	.87
4	2.81

A significant difference in amount of error existed between groups 0, 1 and 2. Rogers attributed the difference to the precision level of feedback each group received. Subjects in group 4 performed at about the same level as subjects in group 0. Rogers concluded that subjects were unable to use feedback expressed in four digits, and therefore performed almost as poorly as subjects who received no feedback.

Rogers repeated the experiment with a reaction time apparatus. Subjects were required to turn off a signal light after a period of exactly nine seconds by pressing a telegraph key. Subjects were placed in groups which received feedback expressed in one, four, or eight digits. Rogers, again, received the same results. Subjects who received four digits of feedback achieved scores significantly higher than subjects who received one digit of feedback. Subjects who received eight digits of feedback achieved slightly higher scores than subjects who received one digit of feedback.

Shapiro (1977) had four year old subjects perform a linear positioning task while she provided them with three precision levels of feedback. Subjects were required to find a hidden, one inch wide target. Subjects were placed into groups which received:

1. statements of "more" or "less"
2. statements of "a little more" or "a lot more"
3. statements of "a little more", "more", "a lot more" or "a little less", "less", "a lot less"

Shapiro discovered no significant differences between the performance of the three groups. Although there were no

significant differences Shapiro stated that:

> A significant reduction in variable error ($p<.05$) over trails seemed to indicate that children can utilize KR to become more consisting in learning.

The studies by Thorndike, Trowbridge and Casons, Smoll, Rogers, and Shapiro provided evidence for Adams' theory which stated:

> Performance improvement in acquisition [of motor skills] depends on knowledge of results. The rate of improvement depends upon the precision of knowledge of results.

Studies Which Investigated Effects of KP and KR in Physical Education Settings

Gentile (1972) altered the way researchers looked at the role of KP and KR with the following statement:

> The need for additional information beyond that which normally occurs as a consequence of the movement is not entirely clear. Simple redundancy would seem to have little value unless the performer (1) failed to attend, encode or retain input, or (2) was unable to determine degrees of goal accomplishment.

The statement was made in Gentile's model of skill acquisition. Her model was very well documented and has served as a reference for many studies.

When well accepted theories of KP and KR have been tested in physical education settings, the results have been inconclusive. The following studies are a few examples.

Hoff (1969), Ochs (1970), and Polvino (1971) conducted similar studies which measured effects of KP in the form of a video tape. The investigators had subjects involved in a bowling task. Subjects were placed in two groups:

1. subjects who viewed their performance on a video tape replay
2. subjects who did not view their performance

The results of all three studies indicated no significant difference existed between the performance of subjects in the two groups.

Kraft (1972) conducted a similar study in which subjects learned bowling skills. He supplied subjects with KP in the form of verbal cues and video tape replays. After each subject in the treatment group performed a practice trial, the investigator and subject viewed a video tape replay of subject's performance. As they viewed the tape, the investigator supplied appropriate verbal cues. Subjects in the group provided with verbal cues and video tape replays, achieved significantly higher scores than subjects in the group provided with no KP.

Yerg (1981a) measured the relationship between selected teacher behaviors and pupil achievement on a psychomotor task. Forty preservice physical education teachers taught a twenty-minute cartwheel lesson. Each teacher gave their lesson to three elementary school students. Teaching episodes were video taped. Five constructs were proposed to explain student achievement after instruction. One of the constructs was, the provision of specific, task related feedback. Yerg concluded that the provision of specific, task related feedback did not contribute significantly to pupil achievement.

Loughlin (1981) supplied subjects with KP as they learned the tennis forehand drive. Subjects were assigned to three groups based on the type of KP they received:

1. randomly supplied KP
2. relevant KP
3. no KP

The treatment consisted of one instructional session followed by two successive practice sessions. Subjects hit a total of one hundred and twenty practice trials. At the conclusion of the study, Loughlin found that the opportunity to practice, significantly effected subject performance. No significant difference in improvement between the performance of subjects in the three experimental groups indicated that KP had any significant effect on subject performance.

Eghan (1984) conducted a study to measure the interactive effects of KR and goal setting on subject performance in two motor skill tasks. The first task was to perform six discreet arm movements in 2500 msec. The second task was to juggle three balls. Subjects were assigned to four treatment groups based on combinations of general or specific feedback, and goal setting.

Eghan found that subjects provided with specific feedback achieved significantly higher scores on the post-test than subjects in the groups that received general feedback.

Summary

Significant results have been achieved by supplying KP and KR to subjects in controlled settings. A positive correlation has been found between subject performance and precision of feedback in controlled settings. When well documented theories of KP and KR have been tested in realistic settings the same results have not been achieved. These conflicting results have demonstrated that the physical education classroom is a complex setting. The simple task performed in studies may not have required the same cognitive and motor abilities that are required to learn more complex movement skills. The complex interaction of variables present in real classrooms may not have been present in controlled settings.

In order to settle the conflict, more studies conducted to measure the effects of KP and KR in realistic classroom settings need to be done.

Chapter II

Methodology

Subjects

Subjects for the study were students enrolled in two beginning bowling classes and two beginning racquetball classes at Western Kentucky University in the spring semester of 1989. A total of 79 subjects, 41 men and 38 women, composed the sample for this study.

To be eligible to participate in this study subjects had to meet the following criteria:

1. Agree to participate in the study and complete an Informed Consent Document (A copy of the Informed Consent Document can be found in Appendix A).
2. Attend a minimum of 80% of the class sessions (twenty-three of twenty-nine sessions).
3. Agree to bowl no more than three times outside of class sessions during the conduct of the study.

Experimental Design

The design for this study consisted of two treatment groups and a control group. Treatment groups were identified as:

1. Positive General Feedback (PGF) group
2. Positive Specific Feedback (PSF) group

Subjects assigned to the PGF group were to receive positive general feedback statements through the conduction of this study while being taught and developing their bowling skills. Subjects assigned to the PSF group were to receive positive specific feedback statements through the conduction of this study while being taught and developing their bowling

skills. Both treatment groups were formed from intact beginning bowling classes. Treatments were randomly assigned to groups.

The control group was composed of students from two beginning racquetball classes. Subjects in the control group received no instruction or feedback during the study.

Research Hypotheses

1. Subjects in the PSF group would have significantly higher post-test bowling scores than subjects in the PGF group. Subjects in the PSF and PGF groups would have significantly higher post-test bowling scores than subjects in the control group.

2. A significant difference in improvement would exist between PSF and PGF groups during the six weeks of competition.

Treatment Group Procedures

Subjects in each of the two treatment groups were scheduled to attend class sessions twice a week for one hours. Groups met at the same time but on different days of the week. Each group met for a total of twenty-nine sessions in the following sequence: 2 orientation sessions, 2 pretest sessions, 11 sessions of bowling instruction, 12 sessions of bowling competition, and 2 post-test sessions.

University lanes and equipment were used during the conduction of the study. All equipment complied with

specifications established by the American Bowling Congress. Lanes were shared by three or four subjects during each class session. Daily dressing of the lanes served to keep conditions as constant as possible throughout the study.

The study began with each treatment group receiving two orientation sessions. During the first session subjects were informed of the study and asked to complete a Demographic Information Sheet, and an Informed Consent Document. All students agreed to participate in the study.

During the second orientation session subjects in each treatment group received preliminary instruction in:

1. Selecting the proper ball
2. Techniques for gripping the ball
3. Procedures for scoring a game

This session served to acquaint subjects with a fundamental understanding of the basics of bowling prior to receiving the pretest.

The third and fourth class sessions were devoted to pretesting subjects. The pretest consisted of the average score subjects attained after completing four games of bowling. To facilitate scheduling, subjects bowled three games during regularly scheduled class sessions, and the last game outside of class, at a time arranged by the investigator. Scores for each subject were recorded on conventional bowling score sheets.

To establish preliminary assessments pertaining to stance, approach, release, and follow through, the

investigator assessed each subject as they completed two deliveries of the pretest. Assessments were recorded on evaluation forms and transferred to demographic data forms. Subjects received a score of "3", low rating through "1" high rating on each measurement. Pretesting was concluded within the second week of the school semester.

When all pretesting was completed, subjects in both treatment groups received five and one-half weeks of bowling instruction. Instruction included explanations, demonstrations, and visual aids. Each instructional lesson included time devoted to practicing skills. To insure that each treatment group received the same instruction, the investigator taught from lesson plans, emphasizing two key concepts during each instructional session. (The format and key concepts of instructional sessions can be found in Appendix B).

After the initial five and one-half weeks of instruction subjects in both treatment groups spent the next six weeks practicing the skills taught during the first five and one-half weeks of the study. Subjects from each group completed one and one-half games per class session. To insure that approximately the same number of deliveries were made by each treatment group, subjects were required to roll nineteen to twenty-one deliveries per session. During this portion of the study subjects bowled games in a competitive atmosphere and spirit. Subjects competed as individuals and within

teams.

As subjects were practicing and competing, the investigator circulated among subjects providing either positive specific feedback or positive general feedback depending upon the treatment group being taught. Throughout the feedback process, four guidelines were followed:

1. Each treatment group would receive a minimum of three feedbacks per minute.
2. The PSF group was to receive at least 90 percent specific feedback.
3. The PGF group was to receive at least 80 percent general feedback.
4. Whenever subjects asked a question the investigator was to couch his reply in either a specific feedback statement or a general feedback statement depending upon the treatment group receiving the instruction.

As the investigator circulated, feedback provided to subjects was recorded on a portable tape recorder. After each class session, the investigator replayed the tapes to tally and categorize statements. (A copy of the Tally Sheet can be found in Appendix C). Feedback statements were categorized as either Positive General Feedback or Positive Specific Feedback. A statement was categorized as Positive General Feedback if it met the following criteria:

1. Was made to less than half of the group
2. Provided information concerning the movement or degree of goal attainment
3. Followed a skill attempt or occurred during a skill attempt and was general in nature
4. Was a form of praise

A statement was categorized as Positive Specific Feedback if it met the following criteria:

1. Was made to less than half of the group
2. Provided specific information concerning the movement or degree of goal attainment
3. Followed a skill attempt or occurred during a skill attempt
4. Was positive in nature

At the conclusion of the fifteenth week, a post-test consisting of four games of bowling was administered. The post-test consisted of the average score subjects attained after completing four games of bowling. A final assessment of subject's stance, approach, release, and follow through was also completed. The procedures for administering the post-test were identical to those of the pretest. All post-testing was concluded within the sixteenth week of the study.

Control Group Procedures

Subjects in the control group received an orientation session similar to the one given each treatment group, pertaining to:

1. Selecting the proper ball
2. Techniques for gripping the ball

After the orientation session subjects were pretested in a manner identical to that of the treatment groups. The pretest consisted of the average score subjects attained after completing four games of bowling. A preliminary assessment of subject's stance, approach, release and follow through was also completed.

The pretest was followed by a twelve-week period in which no bowling instruction was administered. Subjects were

requested to refrain from bowling during this period. Any game bowled by a subject was reported to the investigator, to be recorded in a notebook.

At the conclusion of the fifteenth week, subjects participated in a post-test consisting of four games of bowling. A final assessment of subject's stance, approach, release, and follow through was also completed. The procedures for administering the post-test were identical to those of the pretest.

Analyzing Data

Three experimental groups were identified:

1. Positive Specific Feedback (PSF) group
2. Positive General Feedback (PGF) group
3. Control group

An analysis of variance was performed on pretest scores to determine if significant differences existed among experimental groups prior to the study.

The treatment effect was measured by analysis of covariance performed on the post-test scores, using the pretest scores as the covariate. Analysis of covariance was selected for this analysis to account for any difference which may have existed between groups, and to help control for any extraneous sources of variation which may have affected the dependent performance variable.

An analysis of variance with repeated measures was performed on the mean scores of games bowled by the PSF and

PGF groups during the six weeks of competition to determine if significant differences existed in improvement between groups.

A .05 level of significance was adopted to accept or reject null hypotheses.

Chapter IV

Presentation and Analysis of Data

Introduction

Data obtained during the study was recorded on applicable forms, translated to data code forms, and key punched by University Data Center personnel. Analysis was made on data pertaining to:

1. Subject Demographics
2. Pretest Scores and Skill Assessment
3. Post-test Scores and Skill Assessment
4. Game Scores
5. Teacher Behavior

A review of subject demographics was performed to examine the composition of experimental groups.

Pretest scores and skill assessments were analyzed to determine if significant differences existed among experimental groups prior to the study.

Post-test scores and skill assessments were analyzed to determine if significant differences existed among the post-test scores of subjects in the three experimental groups.

An analysis of variance with repeated measures was performed to determine if significant differences existed between the game scores of subjects in the PSF and PGF groups during the six weeks of competition.

A review was made of the data pertaining to the teacher's provision of feedback to determine if the investigator's guidelines for the provision of feedback were met.

A .05 confidence level was selected for all analysis.

Subject Demographics

The PSF group was composed of 28 subjects, the PGF group contained 35 subjects and the control group contained 15 subjects. There were 16 men and 19 women in the PGF group. The PSF group was composed of an equal number of men and women. The control group contained 9 men and 4 women. The greatest percentage of subjects in each group were freshmen. Table 1 contains the distribution of demographic data for each group.

Table 1

Subject Demographics By Group

	PSF Group		PGF Group		Control Group	
	F	%	F	%	F	%
N Size	28		36		15	
Men	14	50.0	17	45.7	9	69.2
Women	14	50.0	19	54.3	4	30.8
Freshmen	12	42.9	16	45.7	6	46.2
Sophomores	7	25.0	4	11.4	4	30.8
Juniors	4	14.3	7	17.1	2	15.4
Seniors	5	17.9	9	25.7	1	7.7
Left-handed bowlers	2	7.1	1	2.9	1	7.7
Right-handed bowlers	26	92.9	35	97.1	12	92.3
Capable of scoring a game	7	25.0	3	8.8	5	38.5
Commanded a knowledge of the rules	16	57.1	23	62.9	5	41.7
Beginning bowlers	25	89.3	35	97.1	12	92.3
Mean GPA	2.79		2.72		3.10	

Analysis of Pretest Scores

The pretest score was the average score subjects attained after completing four games of bowling during the second week of the study. The pretest mean for the control group was twelve points higher than the PGF group and ten points higher than the PSF group. Table 2 contains the mean and standard deviation of pretest scores by group.

Table 2

Mean and Standard Deviation of Pretest Scores By Group

Group	n	$\bar{x}$	Standard Deviation
PSF	28	101	27.1
PGF	35	103.5	25.2
Control	15	113.3	18.3

An analysis of variance was performed on pretest scores to determine if a significant difference existed among groups prior to treatment. The analysis of variance provided seventy-eight degrees of freedom. An "F" value of 3.07 was required to establish a significant difference. With an "F" value of 1.25, analysis of variance revealed that no significant differences existed among groups.

Table 3 contains analysis of variance of pretest scores among experimental groups.

Table 3

Analysis of Variance of Pretest Scores Among Groups

Source of Variation	DF	Sums of Squares	Mean Square	F Value
Model	2	1,536.22	768.15	1.25 ns
Error	76	46,799.02	615.78	
Total	78	48,335.32		

$p > .2931$

Analysis of Pretest Skill Assessment

To supplement pretest bowling scores, assessment of subject's stance, approach, release, and follow through was performed as subjects bowled the pretest. The investigator's assessments were expressed as numerical values ranging from 1. "high", to 3. "low".

Table 4 contains mean and standard deviation of pretest skill assessment scores. A Kruskal-Wallis "H" test was performed on each skill assessment to determine if significant differences existed among groups. The test revealed no significant differences among experimental groups. Table 5 contains results of the Kruskal-Wallis "H" test performed skill assessment scores.

Table 4

Mean and Standard Deviation of Pretest Skill Assessment Scores

Skill	PSF group			PGF group			Control group		
	n	x	SD	n	x	SD	n	x	SD
Stance	28	2.5	.51	34	2.7	.46	15	2.6	.51
Approach	28	2.6	.50	34	2.7	.46	15	2.5	.52
Release	28	2.6	.50	34	2.6	.48	15	2.5	.52
Follow Through	28	2.7	.44	34	2.7	.45	15	2.8	.41

Table 5

Kruskal-Wallis "H" Test Performed On Pretest Skill Assessment Scores

Stance Assessment		
Group	n	Mean Rank
PSF	28	35.9
PGF	35	42.8
Control	15	38.4

Chi-Square = 2.159 p > .3398 no significant difference existed

Approach Assessment		
Group	n	Mean Rank
PSF	28	37.8
PGF	35	43.4
Control	15	33.7

Chi-Square = 3.0372 p > .2190 no significant difference existed

Release Assessment		
Group	n	Mean Rank
PSF	28	39.3
PGF	35	41.5
Control	15	35.2

Chi-Square = 1.1185 p > .5716 no significant difference existed

Follow Through Assessment

Group	n	Mean Rank
PSF	28	39.7
PGF	35	38.4
Control	15	41.7

Chi-Square = .40897 p > .8152 no significant difference existed

Analysis of Post-test Scores

The post-test score was the average score subjects attained after completing four games of bowling during the last week of the study. The post-test mean for the PSF group was 141.6. The post-test for the PGF group was 117.8 and the post-test mean for the control group was 119.6. The post-test mean of the PSF group was twenty-four points higher than the PGF group and twenty-two points higher than the control group. The post-test mean of the control group was two points higher than the PGF group. Table 6 contains the mean and standard deviation of post-test scores by group.

Table 6

Mean and Standard Deviation of Post-test Scores By Group

Group	n	$\bar{x}$	SD
PSF	28	141.6	28.3
PGF	35	117.8	20.7
Control	15	119.6	22.5

An analysis of covariance was performed to test the hypothesis that no significant differences would exist among the post-test scores when controlling for any variation within the pretest scores. For an analysis of covariance seventy-seven degrees of freedom, an "F" value of 3.07 was required to establish a significant difference. With an "F" value of 21.06 the null hypothesis was rejected. Table 7 contains analysis of covariance among post-test scores of experimental groups.

Table 7

Analysis of Covariance Among Post-test Scores of Experimental Groups

Source of Variation	Df	Sums of Squares	Mean Square	F Value
Model	3	24242.946	8080.982	21.06 *
Error	70	26858.137	383.687	
Total	73	51101.083		
Group	2	11833.364		15.42 *
Pretest	1	14827.630		38.65 *

p > .0001

A post hoc test (Tukey's) was performed to make comparisons between group means and to determine where significant differences existed among post-test scores. Tukey's revealed that significant differences existed between the post-test means of the PSF and PGF groups as well as between the PSF and control groups. No significant difference existed between the post-test mean of the PGF and control group. Table 8

contains the differences between post-test means of experimental groups.

Table 8

Differences Between Post-test Means of Experimental Groups

Group	PSF	PGF	Control
PSF	-	-	-
PGF	23.8 *	-	1.9
Control	21.9 *	-	-

* indicates a significant difference between means at the .05 level

Analysis of Post-test Skill Assessment

To supplement post-test bowling scores as an indication of bowling skill: assessment of subject's stance, approach, release, and follow through was performed as subjects bowled the post-test. The investigator's assessments were expressed as numerical values ranging from 1. "high", 3. "low". Table 9 contains the mean and standard deviation of post-test skill assessment scores. A Kruskal-Wallis "H" test was performed on each skill assessment to determine if significant differences existed among groups. The test revealed significant differences among groups for the skills of stance, approach, and follow through. Table 10 contains results of the Kruskal-Wallis "H" test. A post hoc test (Mann-Whitney U test) was performed to compare mean rank scores and determine where significant differences existed. The test revealed that the scores of the PSF group were significantly higher than the

scores of PGF and control groups for the assessments of stance, approach, release and follow through. It was also revealed that the PGF group scored significantly higher than the control group for the follow through assessment. Table 11 contains the differences between post-test skill assessment rank means.

Table 9

Mean and Standard Deviation of Post-test Skill Assessment Scores

Skill	PSF Group			PGF Group			Control Group		
	n	$\bar{x}$	SD	n	$\bar{x}$	SD	n	$\bar{x}$	SD
Stance	28	1.8	.42	34	2.2	.46	15	2.2	.41
Approach	28	1.9	.57	34	2.3	.53	15	2.5	.52
Release	28	2.1	.65	34	2.3	.48	15	2.6	.51
Follow Through	28	2.2	.78	34	2.6	.48	15	2.9	.26

Table 10

Kruskal-Wallis "H" Test Performed on Post-test Skill Assessment Scores

Stance Assessment

Group	n	Mean Rank
PSF	28	30.7
PGF	35	44.1
Control	15	45.1

Chi-Square = 12.6895 p > .0018, a significant difference existed among groups

Approach Assessment

Group	n	Mean Rank
PSF	28	29.8
PGF	35	43.4
Control	15	48.6

Chi-Square = 11.7272 p > .0028, a significant difference existed among groups

Release Assessment

Group	n	Mean Rank
PSF	28	34.1
PGF	35	39.7
Control	15	49.2

Chi-Square = 5.7598 p > .0561, no significant difference existed

Follow Through Assessment (Continued)

Group	n	Mean Rank
PSF	28	30.1
PGF	35	41.4
Control	15	52.6

Chi-Square = 13.5640 p > .011, a significant difference existed among groups

Table 11

Differences Between Post-test Skill Assessment Rank Means

Stance Assessment

Group	PSF	PGF	Control
PSF	_____	13.4 *	14.4 *
PGF	_____	_____	.97
Control	_____	_____	_____

Approach Assessment

Group	PSF	PGF	Control
PSF	_____	13.6 *	18.8 *
PGF	_____	_____	5.2
Control	_____	_____	_____

Release Assessment

Group	PSF	PGF	Control
PSF	_____	5.7	15.2
PGF	_____	_____	9.5
Control	_____	_____	_____

Follow Through Assessment

Group	PSF	PGF	Control
PSF	_____	11.4 *	22.6 *
PGF	_____	_____	11.3 *
Control	_____	_____	_____

* indicates a significant difference between rank means at the .05 level of significance

Analysis of Mean Game Scores

Subjects bowled eighteen games; three games a week from the ninth to the fifteenth week of the study. Appendix E contains the mean game scores of the PSF and PGF groups.

An analysis of variance with repeated measures was performed to test the hypothesis that no significant difference would exist in the improvement of bowling scores between the PSF and PGF groups during the six weeks of bowling competition. Table 13 contains the mean score for each week. Both groups improved significantly during the competition. A marked increase in mean game score for the PSF group can be seen during the fourth, fifth and sixth weeks. The same increase did not occur in the scores of the PGF group. The analysis of variance with an "F" value of 2.21 revealed that the difference in improvement between groups was significant at the .0537 level. Although the .05 level of significance established prior to the study was not met, a clear trend toward a significant difference was revealed. Table 14 contains analysis of variance between the mean game scores of the PSF and PGF groups.

Table 12

Mean Game Scores For Each Week of Bowling Instruction

Week	PSF Group	PGF Group
	$\bar{x}$	$\bar{x}$
1	114.6	105.8
2	111.5	111.4
3	113.7	112.1
4	119.9	117.4
5	123	114.6
6	125.9	112.1

Table 13

Analysis of Variance Between the Mean Game Scores of the PSF and PGF Groups

Source	DF	Sums of Squares	Mean Square	"F" Value	Probability > F
Group	1	3,047	3,047	1.4	.241
Error	57	123,726.15	2170.63		
Time	5	4,984.36	996.87	5.26	.0001
Time by Group	5	2,097.67	419.53	2.21	.0537
Error	285	54,013.26	189.52		

Analysis of Investigator Feedbacks

Prior to the start of the study, the investigator established three guidelines to be followed during the conduct of the study. The guidelines pertained to:

1. the number of feedbacks provided to groups on a per minute basis

2. the percentage of positive specific feedback provided to subjects in the PSF group

3. the percentage of positive general feedback provided to subjects in the PGF group

The investigator's first guideline was to provide the PSF and PGF groups with three feedback statements per minute. The PSF group received an average of 3.1 while the PGF group received an average of 2.8 feedback statements per minute. A "T" test was performed to determine if a significant difference existed between the number of feedback statements provided to the groups. Analysis of variance, twenty-four degrees of freedom, and a "T" value of 2.064 were required to establish a significant difference. A "T" value of .3297 revealed that no significant difference existed between the number of feedbacks provided to the groups. Table 15 contains feedback data.

Table 14

Feedback Statements Provided to the PSF and PGF Groups

Group	n Classes	Feedbacks Per Minute	Standard Deviation	"T" Value
PSF	25	3.15	1.19	.3297
PGF	25	2.82	1.11	

p > .7429

The second guideline required that 90 percent of the feedback provided to the PSF group was to be positive specific feedback. The PSF group received 92.5 percent positive specific

feedback statements with the remainder being positive general feedback statements.

The third guideline required that 80 percent of the feedback provided to the PGF group was to be positive general feedback. The PGF group received 84.3 percent positive general feedback statements with the remainder being positive specific feedback. Table 15 contains the percentage of feedback statements provided to the PSF and PGF groups.

Table 15

Percentage of Feedback Statements Provided to the PSF and PGF Groups

Group	Positive Specific Feedback	Positive General Feedback
PSF	92.5	7.5
PGF	15.7	84.3

Summary

The purpose of this chapter was to present and analyze data collected in this study.

An analysis of variance performed on pretest scores revealed that no significant differences existed among experimental groups prior to the study.

An analysis of covariance performed on post-test scores, revealed that a significant difference existed among post-test scores of experimental groups. Post hoc test revealed that the post-test score of the PSF group was significantly higher than the post-test score of the PGF and control group.

No significant difference existed between the post-test score of the PGF and control group.

Although a difference of improvement was revealed during the fifth and sixth weeks, an analysis of variance with repeated measures revealed that no significant differences existed in the improvement of bowling scores between the PSF and PGF groups during the six weeks of bowling competition.

A review of the data revealed that the investigator's three guidelines for the provision of the feedback were met during the course of the study.

A discussion of the results of the analysis of data can be found in chapter five.

Chapter V

Discussions, Conclusions, and Recommendations

Discussion of Results

Data analyzed in chapter four was used to accept or reject null hypotheses.

The first research hypothesis stated that there would be no significant differences among the post-test scores of the PSF, PGF, and control groups. The null hypothesis was rejected. An analysis of covariance revealed that a significant difference existed. Post hoc test revealed that significant differences existed between the post-test means of the PSF and PGF groups as well as between the PSF and control groups.

The results of this study agreed with the results of studies by Eghan (1984), Kraft (1972), Smoll (1972), Shapiro (1977), and Rogers (1974).

Eghan incorporated a juggling task while Kraft and Smoll utilized a bowling task to achieve their results. In their studies, Shapiro and Rogers examined novel micrometer and linear positioning tasks. All of them discovered situations in which specific feedback was more effective than general feedback. Their findings support Gentile (1972) who believed that if specific feedback were going to have any

effect at all it would be during the acquisition of closed skills.

Studies by Yerg (1981 a, 1981 b), Pieron (1982) and Graham et al. (1983) yielded results that conflict with results found in this study. Their lack of significant results may have been due to the fact that augmented feedback was not the only variable being observed in the studies.

The post hoc test also revealed that no significant differences existed between the post-test scores of the PGF and control group. Many worthy of note studies including those by Rogers (1974), Newel (1974), Biodeau et al. (1958), and Thorndike (1927) disagrée with the results of this study. The results of their studies demonstrated that subjects provided with general feedback would achieve higher post-test scores than subjects provided with no feedback at all. Subjects in the PGF group improved by 15.4 points while subjects in the control group improved by 1.8 points between the pretest and the post-test. If provided with general feedback and the opportunity to practice for a longer period of time the PGF group may have exceeded the skill level of the control group. If the treatment were provided for a longer period of time perhaps the results of this study would agree with the results of other historical studies.

The second research hypothesis stated that there would be no significant difference in the improvement of bowling scores between the PSF and PGF groups during the six weeks of bowling competition. The null hypothesis was accepted.

An analysis of variance with repeated measures revealed that no significant differences existed in the improvement of bowling scores between the groups during the six weeks of competition.

Analysis of variance between weekly mean scores revealed a difference in improvement between groups at the .0537 level of significance. Although the null hypothesis was accepted, a trend towards a significant difference in improvement was beginning to be revealed between groups. The mean score of the PSF group increased markedly during the fourth, fifth and sixth weeks. The PGF group did not show a similar improvement. Perhaps subjects in the PSF group required enough time to master the fundamental movements of the skill before they could utilize the information provided by specific feedback. During the fourth week of competition subjects in the PSF group could begin to refine their skills. Without the benefit of specific feedback the PGF group may never have been able to begin refining their skills and improve beyond a beginning level of skill.

From the results of this study it is clear that positive specific feedback is an effective tool for the acquisition of skill. Perhaps it is most effective when subjects reach a point where they can begin to work on refining the skill.

Conclusions

Within the limitations of the design of this study an analysis of results has supported the following conclusions:

1. Subjects provided with positive specific feedback attained a higher level of bowling skill than subjects provided with positive general feedback.
2. Subjects provided with positive general feedback did not attain a higher level of bowling skill than subjects provided with no feedback or practice at all.
3. Although the bowling scores of PSF and PGF groups improved during the six weeks of competition no significant difference existed in improvement between groups. A marked difference was noted between groups during the fifth and six weeks of competition.

Suggestions for Further Study

The results and limitations of this study led to the following recommendations:

1. A study in which specific and general feedback were provided, for a longer period of time, would help identify the effects of feedback during different stages of learning.
2. A standardized motor assessment test could be utilized to identify subject's motor skill level. In this way a comparison of the effects of feedback on subjects with different motor skill levels could be made.

3. A study which included a group provided with no feedback while they practiced skills would investigate the effect of teacher feedback verses teacher presence, on subject performance.
4. A study in which specific feedback was provided at different intervals would help identify the stages of learning in which specific feedback was most effective.
5. A similar study conducted with subjects of various ages would help increase the external validity of the results of this study.
6. A study in which subjects were retested several weeks after the treatment would identify if a difference existed in the amount of skill retained by subjects who received specific feedback and those who received general feedback.

Appendix A

Informed Consent Document

During the spring semester your instructor will be involved in a study. The study is being conducted to fulfill the requirements for a masters degree. Your participation in the study will be greatly appreciated.

The study deals exclusively with the instructor's actions and their effects on learning. During the course the instructor will strive to create the best learning environment possible. The study will measure only the teacher's actions and not the student's. In no way will the student's behavior, or responses, or rate of learning, or final grade be used as part of the study. Participating in the study will not affect your grade in any way. Everyone in the class will receive the same treatment and instruction.

The only information being taken from the class for use in the study will be the scores from the pretest and post-test. No student names will be connected to the scores. Your name will not be used in the study. The scores from this class along with the scores of another bowling class taught by the instructor will be used as results in writing the study. In agreeing to be a part of the study, only two things are asked of you.

1. Your permission to use the scores of your pretest and post-test. 2. To refrain from bowling outside of this class during the spring semester. No other special request

will be asked of you as a participant in the study.

Feel free to ask your instructor anything about the study before agreeing to participate.

I agree to participate in the study.

Name _____ Date _____

Appendix B

The Format, Key Concepts, and Vocabulary Terms of Instructional Sessions

Instructional Session Format

Procedure

Time	
2 min.	Attendance, Check for bowling activity outside of the sessions
4 min.	Vocabulary Quiz
5 min.	Four to six warmup deliveries
3 min.	Review of previously taught concepts and skills
3 min.	Question and answer period
6 min.	Presentation of new concepts and skills
37 min.	Skill practice and extending activities

Key Concepts

Session	
1	ball selection, grip, pendulum swing
2	stance, pendulum swing from one knee, pushaway, one step approach
3	2nd target arrow, release, follow through
4	four step approach without a ball, strike ball starting position, coordinate pendulum swing with four step approach
5	four step approach, release and follow through, 1-3 pocket, develop a consistent hook, numbering the boards
6	mental check list while preparing for a delivery, lining up for right side spares, 3d target arrow
7	review and practice the 1-3 pocket
8	7 pin and 10 pin targets, consistently hit the 1-3 pocket
9	3-6-9 system of picking up spares, general rules for picking up spares
10	etiquette, review of scoring, picking up spares
11	bowling and scoring a game

Vocabulary Terms

strike	miss	gutter	leave
spare	split	open frame	mark
spot	arrow	dressing	hook
1-3 pocket	1-2 pocket	numbering the	diagrams of the
delivery	frame	pins	ball and pins
approach	baby split	big fill	brooklin side
bed post	christmas tree	big four	part of the
double	picket fence	tap	building
strike out	triple	deuce	grandma's teeth
greek church	turkey	shortpin	3-6-9-system
lily	woolworth	king pin	double pinochle
bucket	sleeper	field goal	punching out

Appendix C

Tally Sheet

Duration	Specific Feedback	General Feedback

Totals

General statements _____

Specific statements _____

Total statements _____

Total time _____

Statements per minute _____

day _____ date _____ group _____

Appendix D

Skill Assessment Form

Name _____

1 = very good 2 = good 3 = needs improvement

right hand ____ left hand ____

Stance

_____Score
_____left foot on 2nd spot from right of center
_____elbow in
_____shoulders square
_____adjust for spare

Approach

_____Score
_____four steps ballside ft., oppos. ft., ball side ft., oppos. ft.
_____straight path
_____straight pendulum swing

Release

_____Score
_____slide with opposite ft.
_____bent knee, low stance
_____on balance, shoulders square

Follow Through

_____Score
_____weight forward
_____arm comes up in line with target

_____Total

Observed _____once _____twice
_____three times _____four times

Appendix E

Mean Game Scores of the PSF and PGF Groups

		PSF Group			PGF Group		
Week	Game	n	x	SD	n	x	SD
1	1	28	116.3	27.4	34	103.2	20.2
	2	23	109.7	29.3	32	99.9	21.8
	3	21	113.2	32.8	31	114.5	32.4
2	4	28	104	31.9	35	105.8	27.3
	5	28	113.3	29.6	35	109.6	24.5
	6	28	116.9	29.3	34	119.3	28.3
3	7	28	118.3	28.1	36	107.5	25.7
	8	27	108.6	22.1	36	113	25.4
	9	27	114	32.1	32	113.9	28.1
4	10	25	117.9	32.7	33	110.9	19.5
	11	27	120.8	28.3	33	120.9	30.3
	12	26	121.1	29.9	31	120	30.5
5	13	25	117.5	33.9	34	112.7	23.9
	14	26	118.1	25.9	32	115.1	29.8
	15	26	125.9	27.2	31	112	29.2
6	16	28	127.8	34.5	33	110.8	28.1
	17	28	127.5	21.1	34	114.6	24.7
	18	27	124.3	29.8	31	116.3	36.4

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