Variable-Interval Schedule of Conditioned Reinforcement and Practising Behavior of Two Rugby Kicking Skills.

by

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Abstract

The purpose of this study was to investigate the effects of a variable-interval schedule of conditioned reinforcement (VI) on the level of practice behavior of two rugby skills: the place kick for goal and the dropkick restart. A multiple-baseline across-behaviors design was employed. Subjects were four intermediate level kickers who were asked to attempt: (a) goalkicks within an eight station kicking routine and (b) a dropkick task which involved landing balls within a target area. Success criteria for the two skills were based upon the successful performance of the skill within the game situation. Subjects practised kicking both skills twice a week for six weeks. Baseline data were taken for goalkicking until the number of attempted kicks per session became stable. Treatment was then introduced in which subjects were reinforced for the first successful behavior occurring after an interval varying around a mean of three minutes. Once it was apparent that treatment was effective, subject's VI was increased. Following four weeks of data collection, treatment was introduced to the dropkick practising behavior. Initially reward was based upon a VI four minute schedule, but the interval was increased to five minutes after it appeared that practice behavior had increased. Numerical results demonstrate that following the introduction of treatment all four subjects' total practice behavior and successful practice behavior per session increased for both skills. A qualitative analysis of findings demonstrates a similar result. It was hoped that an increase in practising behavior would lead to an increase in kicking performance. All subjects' percentage of successful dropkicks increased after intervention and all but one subject's goalkick success rate improved, although not to a degree which would clearly suggest that increases in repetitive practice improved performance.

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Chapter I

Introduction

Rugby is a team game that requires individual players to demonstrate a high level of competence in a number of skills. While many of rugby's skills are generalized, such as handling, tackling and passing, others are more specific to particular players (Williams, 1973). Two of the more specialised skills crucial to a successful team performance are the placekick and dropkick. Placekicks are used to score points following a penalty or from conversion attempts subsequent to the scoring of a try. The dropkick can also be used to score points from open field play, however, this occurs rarely and the main function of this skill is to restart the game from the half way line after a scoring play or from the 25 metre line if the ball becomes dead over the goal line.

The skill of placekicking for goal involves an athlete kicking the ball off the ground (usually from a tee), through two uprights and above a crossbar. Three points are given for a goal resulting from a penalty and two points for a conversion following a try. Many games are lost and won by margins of one, two or three points indicating the importance of one successful goalkick to the result.

Placekicking for goal is viewed as so critical to success that many teams have based their style of play upon providing field position for a proficient goalkicker. The dominant international team throughout the 1980's, the New Zealand "All Blacks", often relied on remaining within kicking distance for their "super boot" Grant Fox to win games. Similarly, from 1987, Australia followed New Zealand's example promoting a brand of rugby consisting of tactical positioning and reliance on their kicking ace Michael Lynagh (Fox & Veysey, 1992).

England of the 1990's developed an even less expansive game than New Zealand and Australia (who also used field position to score tries), employing a winning formula consisting of punting for field position, winning lineout ball with huge forwards, working the ball into centre field where a penalty would usually occur after a series of mauls and rucks, and taking advantage of a very accurate kicker, Rob Andrew (Fox & Veysey,

1992). Over the past five years England has won many games without scoring a try, including the1994 game against New Zealand in which the All Blacks scored two tries to none but lost the game to six Rob Andrew penalty goals.

A final example highlighting the importance of goalkicking in rugby occurred in the final of the 1995 World Cup between New Zealand and South Africa, in which all the points scored, including the overtime kick to win the game, came from the boots of the teams' goalkickers.

It cannot be argued that these examples hold true only for the importance of goalkicking within the elite game, for when a university team like the Victoria Vikings is considered, their placekicking for goal statistics demonstrate the need for an accurate and consistent goalkicker. In the 1994-1995 season three to five penalty misses were common in many of the Vikings' games corresponding to a loss of 9 to 15 possible points, a crucial result when considering that all but one of the Vikings' defeats prior to the study had margins of ten points or less (University of Victoria Rugby Club record, 1995).

The importance of the dropkick restart in rugby is less obvious than that of goalkicking where the gain or loss of points is immediately apparent. However the dropkick has great importance in general play, acting as the method of restart in two situations. In the first case, following a scoring movement (i.e. either a try or a penalty) the team which has just been scored against dropkicks-off from half-way to restart play, giving the scoring side's players an advantage because they have the ball kicked to them. Second, if the defending team has managed to press the ball down over their own goal line the dropkick is used as a defensive action subsequently awarded from the 25 meter line. Although the kicking team has the benefit of attempting to kick the ball to an advantageous position, if they are to be given any chance of regaining possession from the restart the kicker must land the ball in a small specific area of the field close to the touch-line. Therefore, while the dropkick is a skill which has to be performed at all levels of rugby, precision is needed for any benefits to be possible.

When the dropkick is used following a scoring movement (which *was* the concentration of the present study), play reverts back to centre field to begin a new

phase of play. Consequently in a majority of these situations it is crucial for both teams to win the ball because it can lead to the team in possession having good field position. It is important for a team to begin the next phase of play with ball control because this puts the initial pressure on the opposition, which can subsequently alter or support the momentum of the match prior to the scoring play. That is, the kicking team wants to halt the momentum of the scoring side by gaining ball control, and conversely the receiving team wants to regain the momentum created by scoring. If a skill is critical to the momentum of a match, then it will ultimately impact on further scoring (Davis & Ireland, 1985).

Placekicking for goal and dropkick restarts were skills that were seen by the coaching staff of the University of Victoria Rugby Club to be performed poorly relative to other skills and which needed specific attention (Douglas Tate, personal communication, 17 Nov. 1994). Little if any focus was given to these particular skills, however, because they were rarely incorporated into a team practice. Consequently, if those individuals who were required to perform the goalkick and dropkick tasks were to improve, time had to be spent practising outside of normal training sessions.

Kicking in rugby is an example of a precision skill which, like other sporting skills such as chipping in golf, are likely to be improved by repetitive practice. This particular skill enhancement technique can be monotonous and unrewarding as the benefits of it are usually not immediately apparent. When this is the case, some form of reinforcement may be needed to nurture the practice behavior until its natural reinforcers become apparent (Martin & Pear, 1988).

Several studies have employed operant conditioning techniques in attempts to increase the likelihood of athletes' practice behaviors. Scott (1991) successfully employed a lottery incentive system to improve team attendance at rugby training sessions. Similarly, Hume and Crossman (1992) increased the occurrence of productive dry-land pre-practice behaviors of competitive swimmers by continually reinforcing such behavior with music. Finally, in research highly pertinent to the present study because of its use of intermittent reinforcement, McKenzie and Liskevych (1983) attempted to improve the practice behavior of a volleyball skill. Subjects were placed on a fixed-ratio schedule of reinforcement for

correctly completing a set number of successful skills. Results demonstrated that in one of two intermittent reinforcement conditions the number of successful skill completions increased in comparison to a no-reinforcement condition.

While McKenzie and Liskevych (1983) examined the usefulness of a fixed-ratio schedule of reinforcement (FR), the present study differed by employing a variable-interval reinforcement schedule (VI). A VI schedule occurs when reinforcement is administered to the first instance of a desired behaviour that follows an interval varying around some mean value, and is characterized (in comparison to other schedules) by an effect on behavior of a fairly uniform high rate of response (Martin & Pear, 1988). Variable and fixed-ratio schedules of reinforcement, while acknowledged to have the capability of producing the greatest increases in behavior rate, are also characterized by pauses in behavior immediately following reinforcement. Such pauses in behavior were thought to be incompatible with continuous concentration, conducive to a high level of performance in the kicking skills examined in the present study. Subjects placed on a VI schedule are unaware of the interval length determining the next reinforcement's availability and consequently are less inclined to pause (or to pause for as long) in the desired behavior following reward because of the possibility that an interval may elapse while they are not engaged in any reinforceable behavior (Martin & Pear, 1988).

Based on these concerns, the purposes of this study were to employ a variable-interval schedule of conditioned reinforcement to increase the repetitive practising behavior and number of successful completions of subjects' placekick and dropkick skills.

Chapter II

Review of Literature

In this chapter some of the considerable literature on rugby goalkicking and dropkicking is reviewed with a view to conveying the importance of the two skills to a team's overall performance, and the benefits of practice to the successful completion of these tasks. This is followed by a review of behavior modification studies within the field of sport and exercise which is presented in two sections. The first section covers behavior modification of sport skills, including a review of studies largely comparing behavioral coaching packages to standard coaching procedures, and also an examination of single intervention research techniques, for example backward chaining and positive reinforcement. There will be a concentration on those studies inspecting the effects of reinforcement on practice behavior in sport. The second section focuses on research employing intermittent schedules of reinforcement, such as fixed-ratio, fixed-interval and variable-ratio, in modifying the performance of gross motor skills.

Importance of the Goalkick and Dropkick in rugby

General kicking within rugby, including the goal and dropkick, appears to be one of the most popular of rugby fundamentals, probably because of the ease with which most people can kick. Accurate, effective kicking, however, requires thought and much practice (Williams, 1962). Since very few players possess deftness in kicking capability, this skill is often performed poorly by the team in general. Rugby is often dependent upon tactical kicking and thus the skills involved are often assigned to those players who are most competent. Consequently, because kicking plays a very important role in team efficiency

and success, a side becomes limited if the players elected to carry out the kicking tasks are ineffective (Williams 1973).

The Placekick for Goal

Although successful placekicks for goal gain three points when taken for a penalty and two for the conversion of a try, in comparison to the five points awarded for the try itself, goalkicks often have more bearing on the outcome of a match than tries. This is because it is always easier to place the opposition under pressure which may lead to a penalty within kicking range, than it is to cross the opponents try-line. Dawes (1975) suggests that although rugby is essentially a handling game, many matches are often won and lost on placekicking for goal. Accurate goalkickers are essential as they can be such great compilers of points because of the number of opportunities to kick for goal which are present in every match (Dawes, 1975). The value of a proficient goal-scorer to overall team performance has risen to such an extent in contemporary rugby that many of the elite international teams have created a style of play based around the winning ability of an accurate goalkicker (Fox & Veysey, 1992).

The worth of a capable goalkicker has been apparent throughout rugby history, however Allen and McLean (1970), recounting the New Zealand All Blacks' 1949 tour of South Africa, suggested that if Bob Scott had been successful with half the goal attempts that hit the crossbar or uprights, those kicks would have won New Zealand at least two tests. Speaking of Don Clarke, the legendary All Black player of the 1950 - 60's and one of the most heralded goalkickers of all time, Allen and McLean described his feat of 781 points for the All Blacks in 87 matches as affecting the thinking of rugby players around the world permanently.

Don Clarke's kicking record is remarkable for that era, however, when looking at a contemporary counterpart, Grant Fox, who scored 550 points (503 from goalkicks) in just 35 test matches for New Zealand, the importance of placekicking for goal seems even more pronounced in modern rugby. Although Fox and Veysey (1992) say that rugby is ultimately a team game, Fox's performance as a goalscorer, providing an average of 15

points a test match for the All Blacks, also led them to suggest that Fox dominated games because both his own team and the opposition often created a game plan around him. Fox's kicking for goal was so accurate that it limited the opposition's attack to beyond his kicking range, and also allowed the All Blacks confidence in knowing that when pressure was put on opponents which encouraged penalties, they had in Fox a kicker who rarely missed (Fox & Veysey, 1992).

New Zealand was not the only country in contemporary rugby to recognise the win/loss importance of an accurate goalkicker. The South African "Springbok" Naas Botha was a player of such kicking stature that his presence caused South Africans outside the province he played for to view him as the death of the open running game the Springboks were noted for (Fox & Veysey, 1992). That is, the running style of rugby was becoming obsolete in South Africa because of the winning capability of one goalkicker. More positively viewed was the emergence of Hugo Porta a prodigious goalkicker and kicker in general, who bought the Argentine "Pumas" out of the international second class ranks and onto the world stage, leading Fox and Veysey to suggest that "he was everything to Argentina... he could kick goals in his sleep" (p.103). Other modern goalkicking stars include England's Rob Andrew, Michael Lynagh from Australia, and Gavin Hastings for Scotland.

Throughout rugby history there have always been kicking stars, but the dominance of the 1987 - 1991 All Blacks was so great that the influence of the brand of rugby they promoted, based upon creating opportunities to allow Fox to kick for penalty goal, caused other domestic and international teams' rugby philosophies to be annexed in favour of New Zealand's "winning" style, and consequently more importance was placed on the possession of a star goal-scorer. Never was this so apparent as with the French, traditionally the most flamboyant running and handling nation in the world. Fox and Veysey (1992) suggest Jacques Foroux's overt administration of a program which would create "a continental All Blacks" (p. 94), undermined everything which was French rugby. French players were chosen to fit the All Black model and conversely there were omissions of players who "exemplified the most devastating break back quality of French rugby" (p.

95). During the period of Jacques Foroux's leadership, the French sank from a second place finishing in the 1987 World Cup to a disastrous quarter final loss in the 1991 World Cup. However, the French persistence to play the 1987-1991 All Black style of rugby paid off, with the possession of the most proficient goalscorer in the 1995 tournament, Thierry Lacrouix, they were elevated to third place in the world.

The Dropkick Restart

The dropkick cannot be equated with the importance of the goalkick, obviously because goalkicking can directly provide points for the kicker's team. This reality, however, should not belittle the value of the dropkick restart to a side's overall performance. The dropkick restart's effect on the outcome of play is not as apparent as say handling movements which create tries or punting for field position, nevertheless without a restart in play of course there would be no scoring opportunities. Of more relevance is the fact that an advantage gained from the restart can allow a team to gain the initial momentum to begin the next phase of play, which consequently could lead to point scoring opportunities. In describing reasons why the All Blacks were eliminated in the semi-finals of the 1991 World Cup Fox and Veysey (1992) suggest:

> There was some criticism at the World Cup that our big men were not attacking our own kick-offs and drop-outs, something which had been a trademark of New Zealand rugby in that we were reestablishing attacking positions with the ball in hand immediately on the resumption of play (italics added). Other teams have picked up on its value. The Australians always used to kick long but now they kick short for giants like Eals and McCall. (p. 158)

The importance of the kick to initiate play is also commented on and confirmed by Davis and Ireland (1985). They suggest that it is imperative that the restart be a well organised drill, because for the receiving team it is a time when concentration can be at its lowest having just scored and it is vital that the advancement of the kicking team into the scoring side's territory is only temporary. It can also be argued that there is a similar need for the kicking side to gain possession to consolidate momentum.

With the recent changes to the laws of the game which were endeavouring to speed up play, dropkicks are now employed to commence every restart in play except to begin the

game and to restart the second half. Prior to the law changes, dropkick restarts were only applied to initiate play from half-way if a try was not converted. That is, following every successful penalty attempt and converted try, placekicks were employed to restart play. Now the dropkick begins play after each scoring movement and consequently the importance of this individual skill to a team's performance in a match is greater. The change to the restart law has been criticised because it is difficuilt to provide a ball which is even contestable for the scoring team from a dropkick. The difficulty of the dropkick restart skill and its importance led Fox and Veysey (1992) to say: "The dropkick is an extremely difficult kick... and this means it can be a problem using it as an attacking weapon from a kick off (italics added) (p. 206). With the emergence of the dropkick as a skill which has significant influence on a game's outcome, coaches and players alike must recognise this and react fittingly. That is, players must spend extra time practising the skill to improve and coaches must allow this to happen.

Practising Kicking

If the individual tasks of goalkicking and dropkicking to restart are merited with influencing overall team performance, how than do stars such as Grant Fox become so accurate in these skills? Williams (1962) and Williams (1973) agree that if kicking in general is to be effective a great deal of practice is needed. Testimony to this comes from Fox and Veysey's (1992) description of what is essential to be an accurate kicker: "you have desirably, but not essentially, that bit of natural feel for kicking. After that there are three major requirements... practice, practice and more practice" (p. 197). Fox and Veysey (1992) recount Fox's diligence to practise, his dedication in always being an hour early for training to enable individual kicking practice and his ritual of going to the playing venue for at least an hour's kicking on the eve of every match. Fox put himself through a goalkicking routine at least three times per week, consisting of 49 individual shots at goal from various positions on the field. Remarkably, he would not complete a goalkicking practice session until he had been successful at each of the 49 positions. The importance Fox places on practice is depicted in his explanation to aspiring kickers of what it takes to

become an All Black: "don't be like the talented player who thinks it is good enough to be a talented player when with the will and the work he could be a great one" (p. 198).

Behavior Modification of Sport skills.

There has been a range of behavioral strategies employed which have attempted to modify skills in sport, including positive reinforcement, shaping, cueing, feedback, punishment, avoidance, extinction, positive practice and self monitoring. These techniques have been employed as treatment packages either in unison or as single interventions.

Behavioral Packages

Often "behavioral packages" consisting of a number of treatments have been used to intervene in the area of sport, with a majority of these containing some form of positive reinforcement. Seven such studies have successfully improved the skills of athletes in a range of sports including football, gymnastics, tennis, swimming, ballet, track and rugby. In this area of research the most comprehensive study in terms of generalizability to sports, was conducted by Allison and Ayllon (1980). Employing a multiple-baseline design, Allison and Ayllon presented a behavioral package in an effort to develop football, gymnastics and tennis skills. The package contained systematic use of verbal instruction and feedback, continuous verbal reinforcement of the correct behavior, punishment, positive practice and time-out. Correct skill performance in all three sports dramatically increased with the implementation of the treatment.

In research involved with gymnastics only, Wolko, Hrycaiko and Martin (1993) investigated the effects of standard coaching versus standard coaching with either public self-regulation or private self-regulation, on the frequency of beam skills. Coach-written goal setting, public self-recording and graphing, coach feedback and a reward contingent upon goal attainment constituted the public self-regulation package. Private self-regulation was comprised of private self-recording and graphing without coach feedback and a reward

opportunity following goal attainment. Specific beam skills were conveyed to each subject and the number of repetitions required of each skill was individualized. The results demonstrated that of the three coaching techniques, private self-regulation was the most effective.

Related to the previous study is the research in swimming conducted by Critchfield and Vargas (1991) who constructed a multi-element research design to evaluate the effects of self-recording and public graphing on the number of lengths swum during a number of 10 minute training sessions. Subjects during the self-recording phase marked down completions of quadruple lengths on clipboards at the end of their lane. Throughout the public self-graphing sessions subjects plotted their lengths swum after each training session on graphs which were displayed on a portable bleacher before and after each training session. Self-recording increased and maintained swimming lengths above terminal rates, however public graphing of self-recording produced no further increases which was explained as a possible ceiling effect.

Swimming was also the focus of a study by Koop and Martin (1983) in which a behavioral package was compared to standard coaching practices when attempting to decrease stroke errors. The treatment consisted of modelling the correct stroke, concise verbal prompting (e.g. "hands in front"), feedback (i.e. tapping on the shoulder with a stick whenever the target stroke was performed incorrectly), and a fixed ratio of verbal reinforcement (i.e. after an errorless completion of one lap "good" was shouted out and after errorless completion of six laps, two or three sentences of verbal praise were given). A large reduction in swimming stroke errors resulted after completion of behavioral coaching.

In two studies employing behavioral packages similar to the one implemented by Koop and Martin (1983), Fitterling and Ayllon (1983) and Shapiro and Shapiro (1985) attempted to improve skills in ballet and track respectively. During intervention in both studies, subjects received continuous verbal praise for correct performance of a skill, modelling and prompting. Fitterling and Ayllon's package also included physical guidance and feedback. Performance in four ballet exercises was the dependent variable in the

research by Fitterling and Ayllon (1983) who utilised an AB design to discern the consequences of an operant-based coaching package and common coaching procedures. Results demonstrated that with the introduction of operant procedures, correct performance of the ballet skills increased from 13 percent to 88 percent. The results also indicated, however, that no form of replication strengthened the reliability of these findings. Shapiro and Shapiro (1985) placed treatment within a multiple-baseline design study which successfully increased the track skills of three competitive runners.

The final behavioral package-based study to be discussed is particularly pertinent to this review because of its intervention upon rugby skills. Gray (1989) constructed a behavioral package consisting of verbal instruction, feedback, positive practice and time-out, and contrasted it to standard coaching's effect on the skill of mauling and driving in rugby. The ability of five players to produce the ball in a five-on-five contact situation was the dependent variable, in a control group design. Two treatment groups received the behavioral package either with or without verbal calling. Verbal calling occurred when subjects initiated cue words immediately before acting on the forming maul (e.g. binders called either "left" or "right" before binding). The results indicate that behavioral coaching with verbal calling was the most effective coaching style.

Research reviewed thus far has demonstrated behavioral packages to be largely successful in sports skill enhancement. Behavioral packages are problematic, however, in the sense that it is unclear which of the components are enhancing, ineffective, or even detrimental to the behavior being modified, although a successful behavioral package can be considered to be a single-treatment unit in its own right. Critchfield and Vargas (1991) provided sound evidence for the use of a multi-element design when investigating the effects of more than one treatment. That is, with the addition of public self-graphing on top of self-recording in their study, no further skill enhancement was apparent.

Single Intervention Research

Backward Chaining

Of those studies which have treated sports skills with a single behavioral intervention, only one did not use positive reinforcement. In innovative research, O'Brien and Simek (1983) conceived a backward chaining method for teaching golf to learners and compared it to a standard coaching procedure. Subjects within the treatment group progressed to a higher level of difficulty (e.g. putting length) once a mastery criterion was reached on a subordinate level. Eighteen hole scores taken after the completion of coaching demonstrated that the backward chaining group had a mean score averaging 17.33 shots less than the control group.

Positive Reinforcement

Few studies have employed positive reinforcement alone to improve sports skills. In early field research, Heward (1978) utilised nine members of a professional touring baseball team to question the appropriateness of monetary rewards to enhance individual and team offensive production during games. Employing a "first-past-the-post" system of reinforcement, the three players with the highest efficiency average or EA (a calculated statistic combining performance in a number of offensive plays) after seven games received reinforcement. Six of the nine subjects increased their offensive efficiency over baseline levels and of these, four reverted to baseline levels with the withdrawal of treatment. A motivating factor not accounted for, other than the monetary rewards, may have been the posting of efficiency averages in locker rooms and other public places.

Buzas and Ayllon (1981) compared the effects of correcting errors in a typical tennis class to selectively ignoring those errors while praising appropriate tennis skills. The forehand, backhand and serve were assessed based upon form and ball placement after a shot. Skills were scored incorrect if one or more components of an extensive response definition were absent. Working within a multiple-baseline design, it was found that continuous verbal reinforcement for correct performance only, increased skill rate two to

four times over baseline rates. In a similar study by Komaki and Barnett (1977), checklists were used to break down three football offensive plays into basic components. Continuous reinforcement was given for correct skill performance. Successful play completion gains averaged 20 percent after the staggered introduction of treatment within a multiple-baseline-across-plays design.

Practice Behavior

Although few studies have employed positive reinforcement alone to improve a sport skill/s, the three studies which have examined the effects of behavioral treatments on the practising behavior of a sport skill/s have all used some form of reinforcement as a single intervention treatment. This may be because, if monotonous practice behavior is to come under the control of natural reinforcers, some form of initial reinforcement may be necessary so that the benefits of training can be realized. Positive reinforcement has been employed to increase the attendance at sports practices and the involvement in pre-training behaviors. Hume and Crossman (1992) examined the effect of musical reinforcement on the performance of productive dry land pre-practice behaviors (i.e. sit ups, stretching and running laps) of competitive swimmers. Although these behaviors are not skills per se, they are actions which are often not reinforcing initially (which is attested by the low behavior rate found during baseline) but nonetheless are important to performance. The ABAB design in this study demonstrated that a large and immediate increase in productive practice behavior occurred during the positive reinforcement phases. Scott (1991) investigated the effect of a lottery incentive system on attendance at rugby training sessions. Subjects were given playing cards for each training session attended. At the end of each treatment week a cash prize was given to the player with the best poker hand, hence the more practices attended the greater the chance of having a winning hand. Absenteeism decreased when the treatment was in effect and reverted to baseline conditions when the treatment was removed.

An intermittent schedule of reinforcement was constructed by McKenzie and

Liskevych (1983) in an attempt to elevate the practising behavior of volleyball players' service reception/passing skill. Monetary reward (one dollar) or a card entitling subjects to a one hour session of one-on-one practice with the coach, could be earned for a set number of correct performances of the skill. This number increased as the study progressed (i.e. subjects were placed on a fixed-ratio schedule of reinforcement with an increasing criterion). For a skill to be considered successful it had to be of a certain quality of performance, based upon the ball's placement after pass completion (i.e. correct height and within a certain boxed area). Results demonstrated no marked differences in passing accuracy under money incentive compared to baseline conditions, however, the one-on-one practice time reinforcement condition led to a greater improvement in the action when compared to the no-reinforcement condition.

Intermittent schedules of reinforcement are commonly employed to create an extensive increase in behavior rate, however, to use this system of reward to elevate the production of a sports action is problematic because skill level may deteriorate if quantity of the behavior, as opposed to quality, becomes imperative. McKenzie and Liskevych (1983) countered this problem by ensuring that the action was controlled by an outcome needing appropriate form to gain success. This concept was replicated in the present research.

Behavior Modification of Gross Motor Skills

Although McKenzie and Liskevich's (1983) research is one of few studies to have employed a schedule of intermittent reinforcement to increase the practice behavior of a sport skill, this treatment is common when attempting to increase gross motor exercise behavior such as running and stationary bike riding. These have occurred in fixed-ratio, fixed-interval and variable-ratio schedule form and are discussed below.

Fixed Ratio

One of the early works examining consequences of intermittent reinforcement on exercise behavior was conducted by Kau and Fischer (1974). In this experiment the first author, acting as subject, received money and social activities for appropriate exercise behavior. She gained 25 cents immediately following jogging and at the end of each week if she had jogged every day, one of several social activities with her husband could be engaged in. Thus a fixed ratio of reinforcement was used to increase exercise behavior. Intervention caused a sharp rise in exercise activity immediately following baseline, but the study is limited as motivating factors other than the reinforcement provided may have been in control of the author's exercise behavior.

Doleys, Crocker and Patton (1982) employed a fixed ratio of reinforcement to intensify the exercise of patients with chronic pain. Subjects had to perform a specific amount of exercise to receive verbal reinforcement following every training session. The ratio of reinforcement increased if the subject met the fixed amount of exercise on the previous occasion. Subjects responded to the changing criterion of fixed reinforcement by showing steady and gradual increases in the intensity of exercise activity. Bennett, Eisenman, French, Henderson and Schultz (1989) conceived a multiple-baseline design to appropriate the use of a token economy on the cycle ergometer behavior of individuals with *Down's Syndrome*. Subjects earned tokens toward a back-up reinforcer by surpassing a certain revolution rate over 15 minutes (i.e. a fixed-ratio of reinforcement). It was concluded that this type of reinforcement system was an effective method to increase exercise behavior for this delimited population. Decreases in resting and sub-maximal exercise heart rates after intervention provided the study with social validation.

Fixed Interval and Fixed Ratio

Consequences of fixed-ratio (FR) and fixed-interval (FI) schedules of reinforcement on subjects pedalling stationary exercise bicycles was examined by De Luca and Holborn (1990). Framed within an ABCB research design, subjects received points to

purchase one of twelve back-up reinforcers for completing a set amount or duration of exercise. An FI one-minute schedule of reinforcement was implemented in the first intervention phase, and an FR schedule based on the number of revolutions per minute was introduced during the second. An immediate increase in exercise duration occurred with the introduction of the FI one-minute schedule, but rapidly declined for obese subjects. Introduction of the FR schedule, however, demonstrated a stable response rate across all subjects. In a study attempting to discern the result of a fixed-interval schedule of token reinforcement on exercise bicycle pedal revolutions, De Luca and Holborn (1985) found that reinforcement after a one-minute interval signalled by a bell and a red light produced substantial increases in the duration of exercise. However, obese children within the group exercised at a lower rate.

Croce and Horvat (1992) evaluated the feasibility of a reinforcement-based exercise program emphasising aerobic and weight lifting activities to improve cardiovascular fitness, muscle strength and work productivity, in adults with mental retardation. Subjects received verbal reinforcement dependent upon time spent exercising, distance covered, or weight lifted. Verbal punishment was administered for performance decrement. In the aerobic portion of the study, token reinforcement was given to those subjects who exercised for a longer period than the previous session and for each 30 seconds beyond this criterion (FI). Subjects had to remain within established training intensities based upon their heart rates. During the weight lifting component of the program, reinforcement was applied if subjects surpassed the number of repetitions completed on the last training day (FR). Cardiovascular fitness, strength and work productivity improved during treatment in general, but the results were inconsistent from subject to subject and any gains demonstrated were not maintained following removal of intervention.

Variable Ratio

A number of variable-ratio schedules of reinforcement (VR) were constructed by Epstein, Smith, Vara and Rodefer (1991) to examine children's preferences between sedentary and vigorous activity. The choice of a moderately-liked vigorous activity under a

constant VR2 schedule was compared to a preference for sedentary activity with VR schedules ranging from 2 to 32. That is, subjects were given the choice between vigorous activity reinforced around a mean of two occurrences and sedentary activity which had a reinforcement rate initially averaging every two behaviors, but which decreased until, on average, only every thirty-second occurrence of the activity was reinforced. It was found that as the cost for sedentary activities elevated, that is as the VR schedule increased, then most children would prefer the vigorous activity, although obese children remained with the sedentary activity even when the price of this choice was high. De Luca and Holborn (1992) created a changing-criterion design to examine the consequences of a VR schedule of reinforcement on the stationary bicycle riding of obese and non-obese boys. Subjects gained points towards rewards of their own choice for pedalling at revolution rates averaging higher than those of the previous phase. The treatment resulted in a systematic increase in exercise rates for all subjects which was of a greater magnitude than work production found in prior research with fixed ratios.

Chapter III

Methodology

Subjects

Four male members of the University of Victoria Rugby Club served as subjects. Participants were individually asked to take part in the study and given an introductory letter containing an informed consent form (see Appendix A), and a brief explanation of what the subjects' role in the study would be (see Appendix B). Testing was administered on the club training field which contains standardized rugby goalposts and markings.

Practice Regimens and Kicking Assessment

The emphasis of the present study was to increase subjects' repetitive practice of the placekick for goal and dropkick re-start skills. Consequently the tasks undertaken promoted repetition.

The Place Kick for Goal

During the goalkick practice sessions participants were instructed to proceed through an eight-station, twenty-four-kick (three attempts per station) regimen, for an unrestricted period of time. The placement of kicking positions on the field was derived in part from the goalkicking routine employed by Grant Fox (Fox & Veysey, 1992), but modified in an attempt to suit the level of the subjects (see Appendix C). The success of a goal attempt was based upon the kick's point scoring worth in a game situation, that is, if a ball from a goal attempt passed through the two vertical goalposts and above the horizontal bar, it was considered successful.

The Dropkick Restart

During the dropkick training sessions, subjects were asked to practise kicking balls from the field center into a ten by seven meter rectangular area marked by cones near the touchline, for an unlimited length of time. The area's size and positioning on the field was chosen by the coaching staff, the determination of success being dependent upon where the ball would most likely be retrieved by the kicking team following a restart (see Appendix D). Each kick was assessed as successful based upon whether the ball landed in the rectangle or not, and if it was in the air a sufficient length of time to allow a kicker's teammate to run the distance from the center line to catch the ball (re-start balls must travel ten meters or more past the center line to be playable by the kicking team). Although the ball dropkicked from a restart should be in the air a certain length of time, this was not measured, because if a ball was going to land in the coned area then its flight trajectory was one which usually allowed enough time for runners to move from the center line into a contestable position. On the rare occasion a dropkick was miscued but landed in the rectangle, it was obvious that the kick was flat, therefore unplayable and consequently unsuccessful. All kicks including goal attempts were marked as successful or unsuccessful on observation sheets (see Appendix E).

General Procedure

Throughout the study the subjects were assessed either individually or in pairs, twice a week for six weeks. On one day of testing it was usual to observe the subjects practising behavior for both kicking skills. Baseline lasted two weeks and four weeks for the practising behaviors of goalkicking and dropkicking respectively, after which the reinforcement treatment was introduced for the remaining four and two weeks of the study.

Interobserver Reliability

Of the 96 total testing sessions interobserver reliability data were taken on 15 occasions. The secondary observer was independent of the primary observer and was not informed of which study phase was occurring. Interobserver reliability was determined by dividing the number of kicks both observers rated as either successful or unsuccessful, by the total number of kicks. Over the 15 sessions interobserver reliability data were collected interobserver reliability ranged from 82.0 percent - 100.0 percent with a mean of 93.84 percent. The standard 33 percent of sessions containing interobserver reliability measures was not adhered to in this study because it was felt that the clear, objective nature of measurement (i.e. either in the box or not and either through the posts or not) indicated that such diligence was not warranted.

Baseline

Baseline data for individual subject's goalkicking practice behavior were taken until these patterns appeared either stable or depicted a trend in the direction opposite from that expected with the introduction of treatment. Employing these guidelines, the practising of goalkicking without treatment for all participants was ceased approximately two weeks (four sessions) after the beginning of testing. Martin and Pear (1988) suggest that the multiple-baseline-across-behaviors design calls for the sequential introduction of treatment across two or more actions, therefore baseline data for the dropkick re-start practising behavior were collected for a further two weeks of observation.

Reinforcement Survey

Prior to the initiation of the reinforcement treatment subjects were interviewed to determine a reinforcer worth $40 or less which they envisioned as rewarding . All participants decided to accept $40 cash as a reward for compiling a total of 100 points

administered during practice sessions. Subjects were told that points would be awarded for practising goalkicking and dropkicking (see Appendix F).

Treatment

The intermittent reinforcement employed as treatment was chosen because it typically has those effects on behavior congruent with the behavior change desired. It was believed a variable-interval schedule (VI) would increase the number of kicks attempted and the number of successful skill completions while keeping behavior at a steady rate. Compared to other reinforcement schedules, a VI regimen is characterized by a less marked increase but more uniform effect on behavior rate, which is desirable for practising the two kicking skills in question because rushing and pauses in behavior are not conducive to the concentration levels usually needed to perform successfully. In an effort to emphasize further the importance of quality as opposed to quantity of skill performance, subjects were rewarded only for successful kicks. That is, following a determined interval of correct practising behavior (i.e. if subjects were engaged in kicking behaviors only) the next successful kick was reinforced.

(a) Goalkicking Treatment

After the second week of testing each subject was placed on a Variable Interval Schedule of Conditioned Reinforcement (VI) during the practice of goal attempts only. Interval schedules were drawn up prior to each practice session employing a random procedure (see Appendix G). If, for example, the subject was being reinforced employing a VI three minute schedule, then the reinforcement schedule would contain time periods varying around an average length of three minutes. A VI three schedule could have consisted of five minutes, two minutes, four minutes, one minute, three minutes and six minutes for instance. If this were the case then during the subsequent practice session the

first reinforcement point would have become available after five minutes of practice behavior. Subjects would be given verbal acknowledgment of point attainment after the first successful goalkick had occurred following the five minute period. The next interval would begin only after the first point had been administered. If a successful goalkick occurred after 30 seconds had elapsed following the first interval, for example, then the second reinforcement point would become available after a total practising time period of seven minutes thirty seconds (five minutes plus thirty seconds plus two minutes).

Initially subjects were placed on a VI schedule of three minutes, that is following an interval varying around three minutes, the next successful kick was immediately verbally reinforced. The average interval of reinforcement for each participant was increased once it was apparent that treatment behavior had improved as compared to baseline. Subject 1 remained on a VI three schedule for three weeks and was then placed on a VI four schedule for the remaining week. Subject 2's VI was increased to four minutes with three remaining sessions. Subject 3 was placed on a VI five regimen following five sessions of VI three and the reinforcement interval of Subject 4 was increased from three to four minutes after five sessions of treatment.

(b) Dropkicking Treatment

A VI schedule of reinforcement was also administered to subjects for the dropkicking task following four weeks (eight sessions) of testing. For the most part this replicated the treatment dispensed during goalkicking training sessions. During the treatment for dropkicking practice, subjects received immediate verbal reinforcement for the first successful dropkick following an interval initially varying around four minutes. It was perceivable from the initial treatment data collected, that all the subjects' practising behavior was increasing following the onset of intervention, consequently Subjects 1, 3

and 4 were placed onto a VI five minute schedule after three treatment sessions and Subject 2 after the second.

Reinforcement Attainment

In spite of only one subject attaining the necessary points to gain the conditioned reinforcer within the six week period of the study, all subjects received their chosen reward upon the completion of the study, although at no time were the kickers given any indication that they would gain reward if they failed to reach the pre-determined 100 points.

Experimental Design

A multiple-baseline across-skills design was employed in the present research. Baseline data were taken for both kicking skills until goalkicking practising behavior appeared stable to visual inspection, after which the initial VI schedule was introduced to goalkicking. Four sessions later the treatment was replicated with dropkicking.
A multiple-baseline design was used in the present research instead of an ABAB withdrawal design because it was felt that an ABAB design was unlikely to invoke the desired return to baseline levels of practice behavior. Reversal to baseline levels using an ABAB design was improbable if the treatment was successful in increasing practice behavior because (a) this may have led to a learning transfer and a consequent increase in kicking proficiency and subsequently the number of successful kicks would not revert to baseline levels following withdrawal of treatment and b) if accuracy in the skill increased within the game situation, it is probable that natural reinforcement of the practising behaviour would occur. The choice of a reversal design in this area has problematic implications, for if performance returns to baseline conditions with the removal of

treatment, this is indicative of the behavior being under control of the intervention but not under control of natural reinforcers and thus would not likely be maintained (Lee, 1993).

Several studies in the behavior modification of sport skills area have worked within a multiple-baseline across-skills protocol. Allison and Ayllon (1980) examined the effectiveness of behavioral tennis coaching compared to standard coaching, by staggering the introduction of intervention for the serve, backhand and forehand. Similar research designs have been employed to examine the effects of behavioral coaching on football plays (Komaki and Barnett, 1977), swimming skills (Koop and Martin, 1983), children's play skills (Hardiman, Goetz, Reuter and LeBlanc, 1975), track (Shapiro and Shapiro, 1985) and in classical ballet (Fitterling and Ayllon, 1983).

Chapter IV

Results

After four sessions of baseline the implementation of treatment on goalkicking practice behavior led to an increase per session both in the number of placekicks attempted at goal and those that were successful, for all four subjects. Similarly, after eight sessions of baseline, the introduction of the reinforcement schedule on the dropkicking practice behavior led to an increase per session both for the total number of attempts at this skill and also the number of kicks which successfuly landed within the rectangular target area.

Attempted Practice Behaviors

The average total number of goalkicks and dropkicks practised during baseline and treatment are presented for each subject in Table 1. For Subject 1 the mean total of goal attempts practised per session during baseline was 32.25 and increased to 65.75 with the introduction of treatment (see Fig. 1). Similarly, following the beginning of treatment, the average number of attempted goalkicks for Subjects 2, 3 and 4 increased from 28.25 to 58.25, 47.50 to 86.25 and 28.25 to 48.13, respectively (see Figs. 2, 3, and 4). The baseline average of Subject 1's dropkicking practice totals was 34.63 but increased to a mean of 70.00 kicks per session with the implementation of the reinforcement schedule (see Fig. 1). Likewise, the average number of attempted dropkicks per session during baseline for Subjects 2, 3 and 4 increased after treatment was introduced from 41.13 to 62.50, 35.25 to 87.75 and 28.00 to 74.25 respectively (see Figs 2, 3, and 4).

Table 1

Average Total of Goalkicks and Dropkicks

Subject	Skill	Average Total Kicks	
		Baseline	Treatment
1	GK	32.25	65.75
	DK	34.63	70.00
2	GK	28.25	58.25
	DK	41.13	62.50
3	GK	47.50	86.25
	DK	35.25	87.75
4	GK	28.25	48.13
	DK	28.00	74.25

GK= goalkick

DK= dropkick

Figure 1

Goalkick and Dropkick Totals for Subject 1

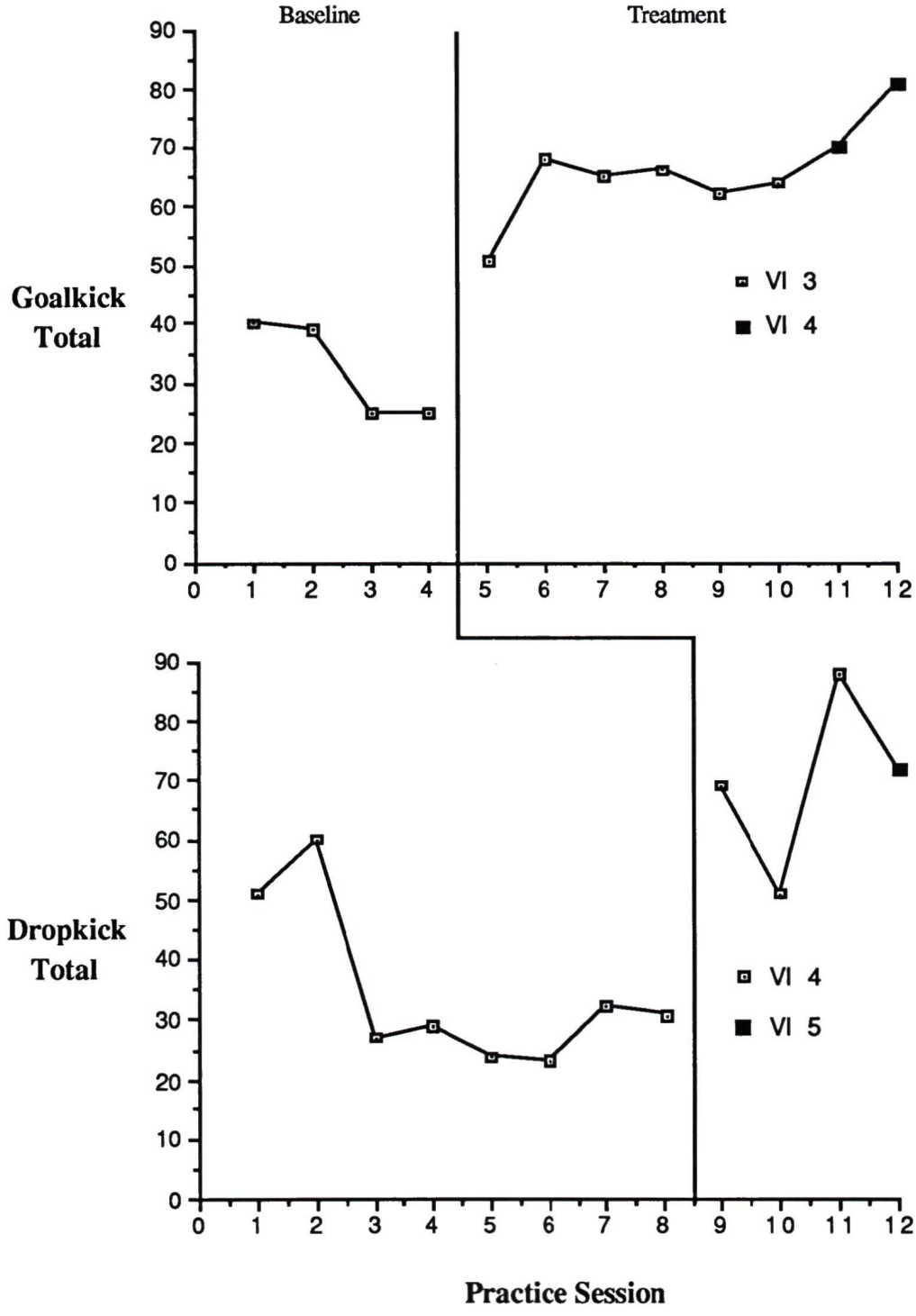


Figure 2

Goalkick and Dropkick Totals for Subject 2

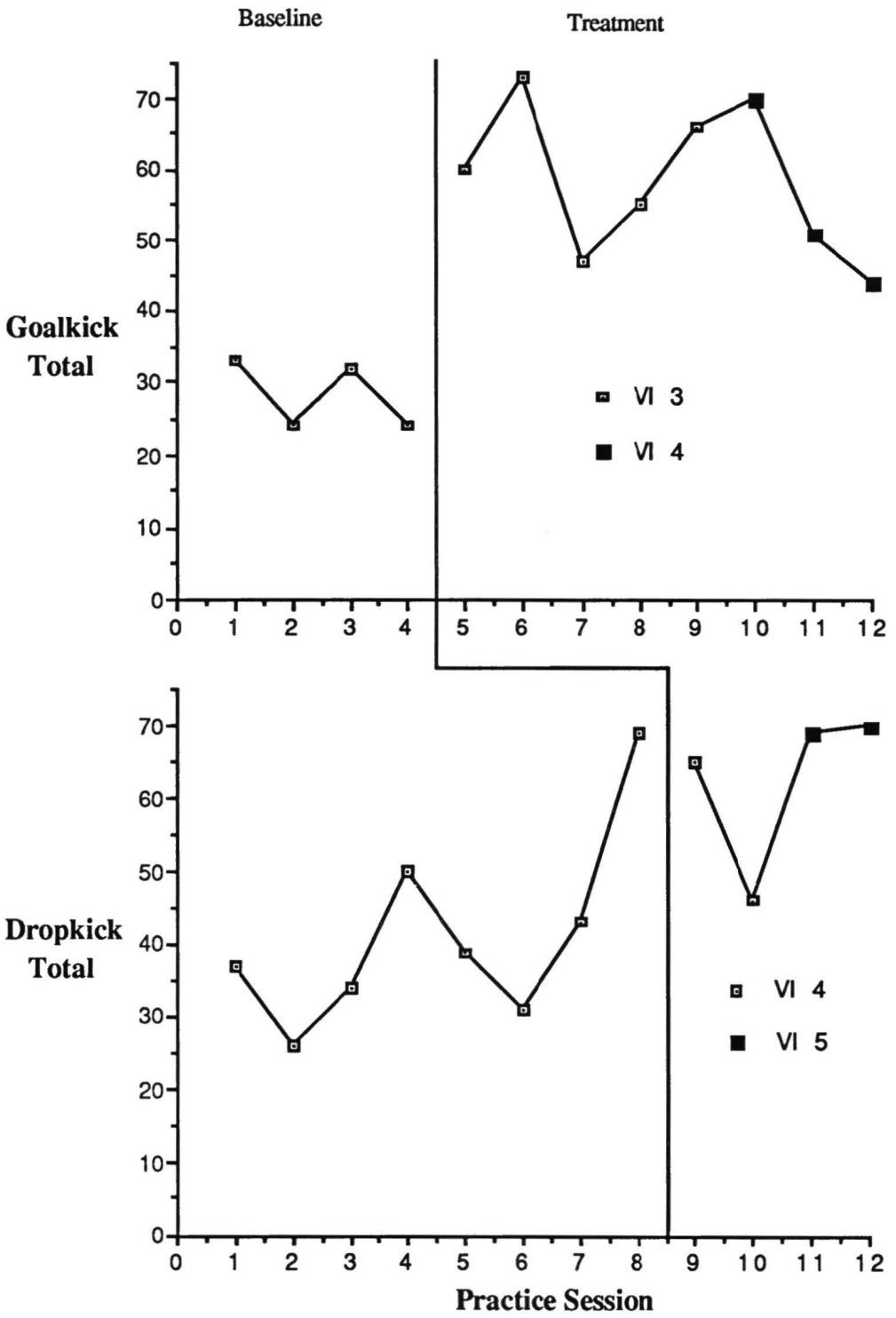


Figure 3

Goalkick and Dropkick Totals for Subject 3

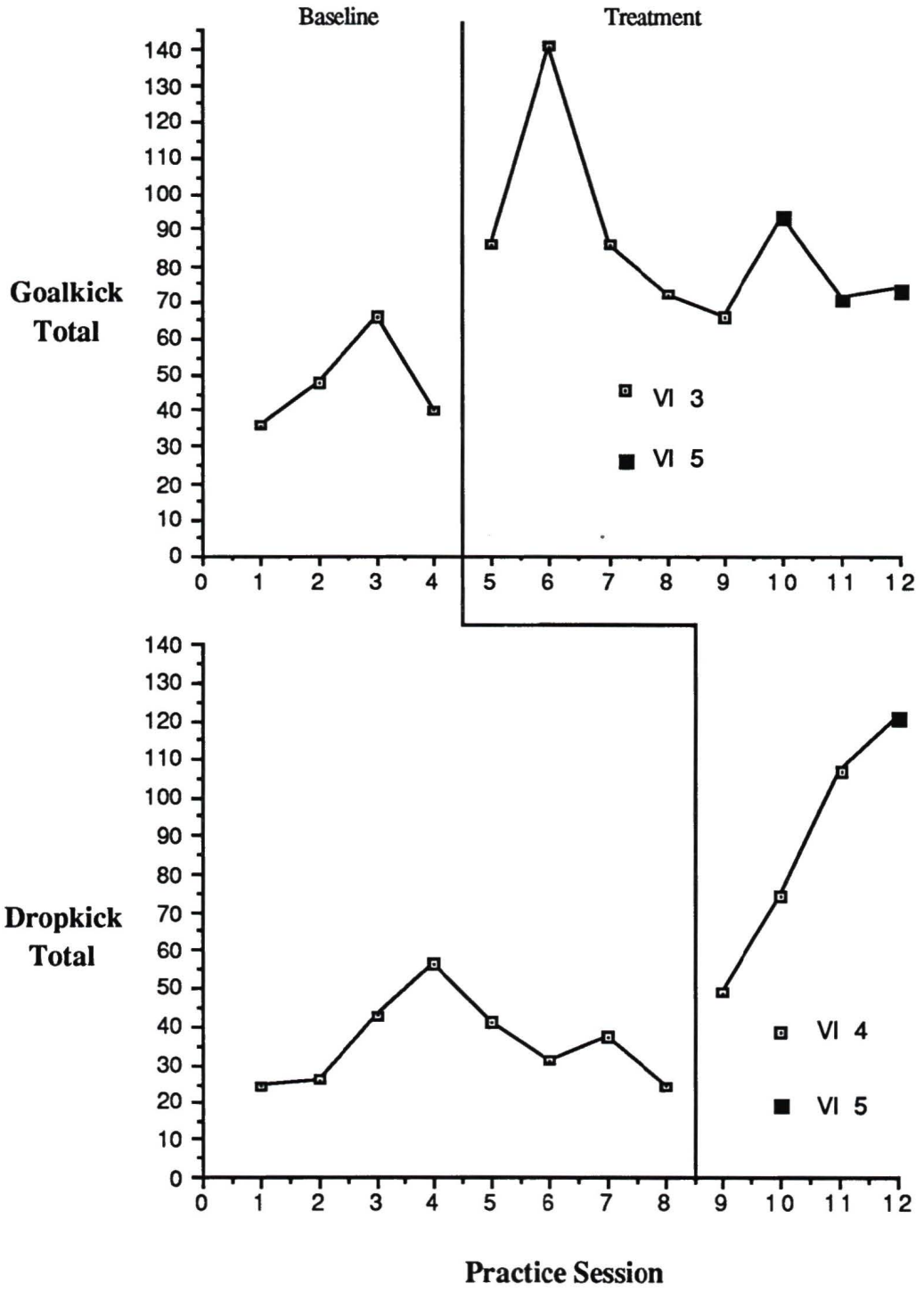
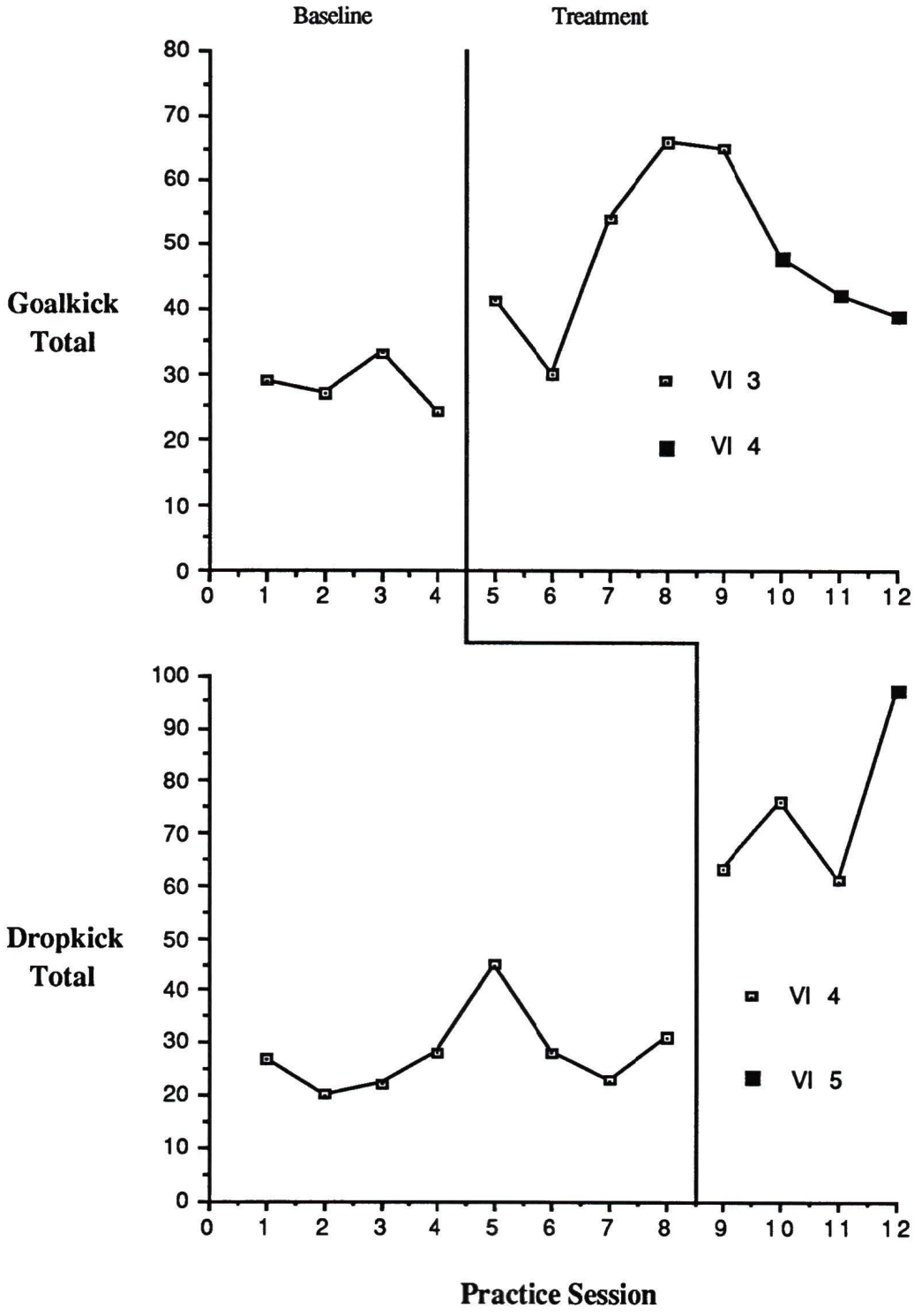


Figure 4

Goalkick and Dropkick Totals for Subject 4



Successful Practice Behaviors

Table 2 presents each subject's mean number of goalkicks and dropkicks observed to be successful during baseline and treatment. The average number of successful attempts at goal per practice for all subjects was greater during treatment as compared to baseline. Kickers 1, 2 and 4 increased their average number of successful goals per session more than two-fold from baseline to treatment, with Subject 1 increasing from 15.00 during baseline to 35.25 after treatment, Subject 2 from 13.25 to 30.50 and Subject 4 from 14.25 to 29.13 (see Figs. 5, 6, and 8). The average total of successful goalkicks during a practice session for Subject 3 during baseline was 25.25 increasing to 43.75 during treatment (see Fig. 7).

The increase in total successful kicks was not limited to placekicks for goal. All subjects successfully dropkicked into the rectangular target area a greater number of times in an average practice session during treatment compared to baseline. Subject 3's increase in the number of dropkick successes after the introduction of treatment was the most marked with a mean of 15.63 during baseline rising to a mean of 45.00 after treatment (see Fig. 7). Also following the introduction of the reinforcement schedule, Subjects 1, 2 and 4 increased their average number of dropkick successes from 20.00 to 44.00, 18.88 to 34.75 and 13.50 to 39.75 respectively (see Figs. 5, 6, and 8).

Table 2

Average Number of Successful Goalkicks and Dropkicks

Subject	Skill	Average Number of Successful kicks	
		Baseline	Treatment
1	GK	15.00	35.25
	DK	20.00	44.00
2	GK	13.25	30.50
	DK	18.88	34.75
3	GK	25.25	43.75
	DK	15.63	45.00
4	GK	14.25	29.13
	DK	13.50	39.75

GK= goalkick

DK= dropkick

Figure 5

Total of Successful Goal and Drop Kicks for Subject 1

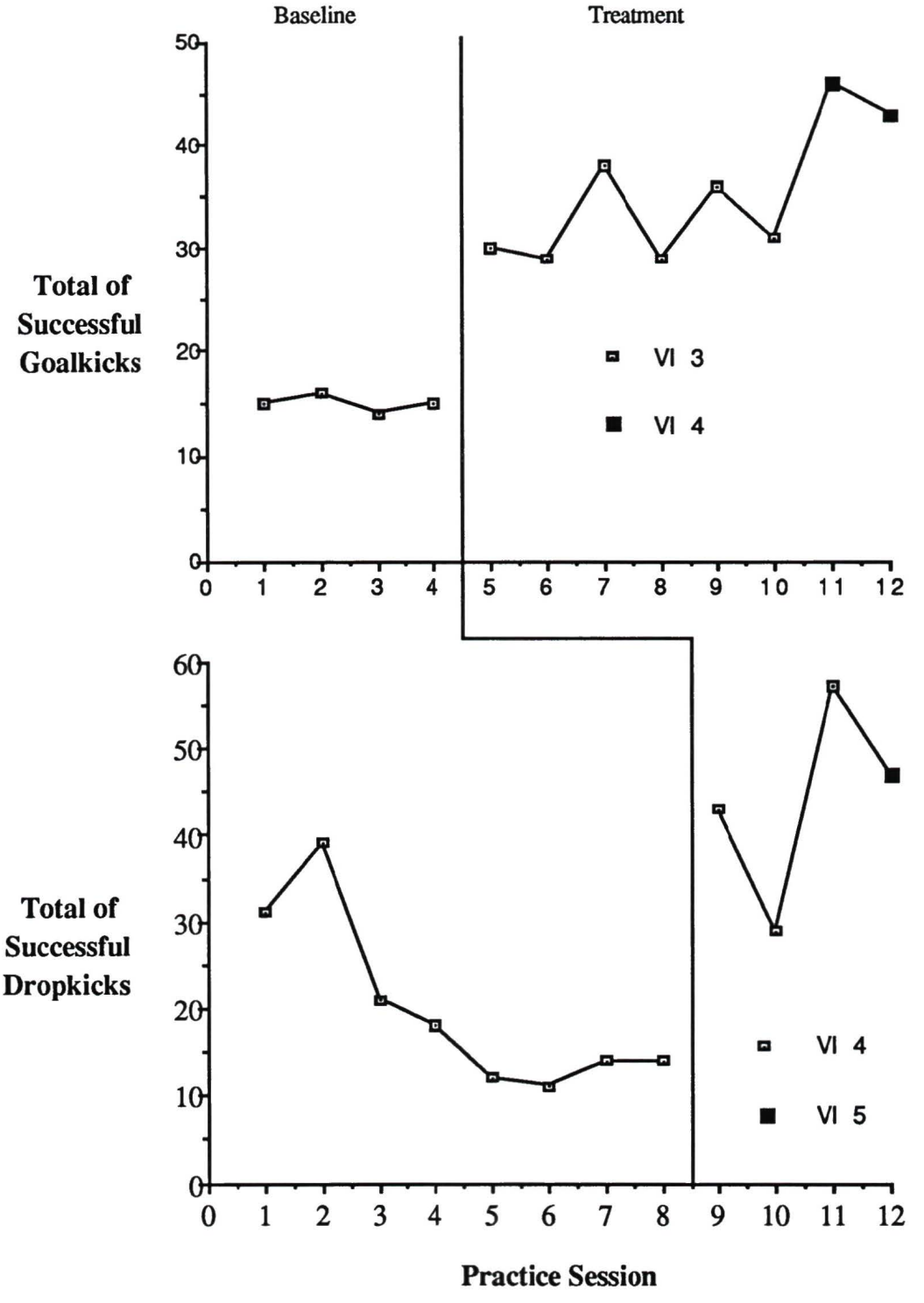


Figure 6

Total of Successful Goal and Drop Kicks for Subject 2

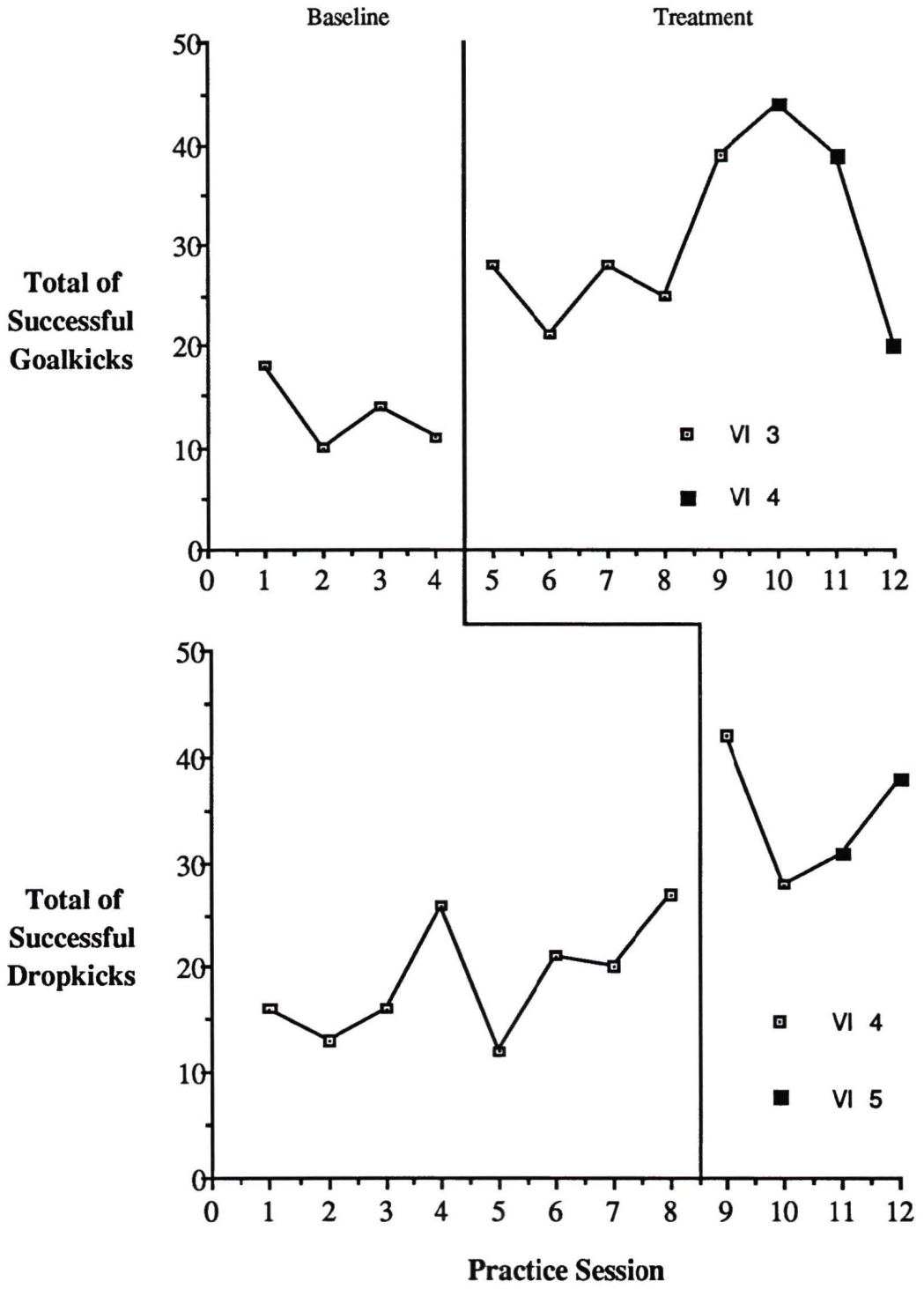


Figure 7

Total of Successful Goal and Drop Kicks for Subject 3

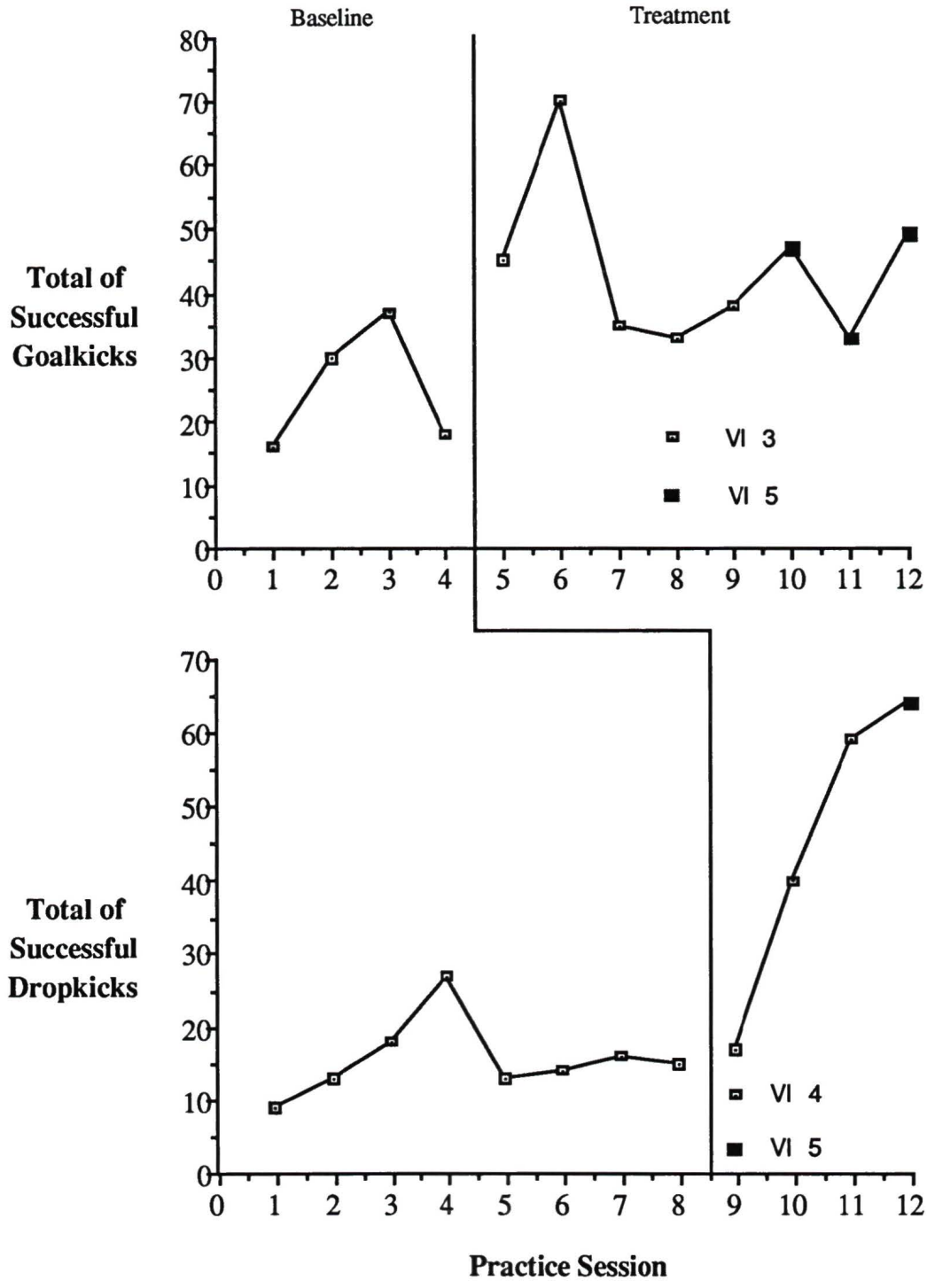
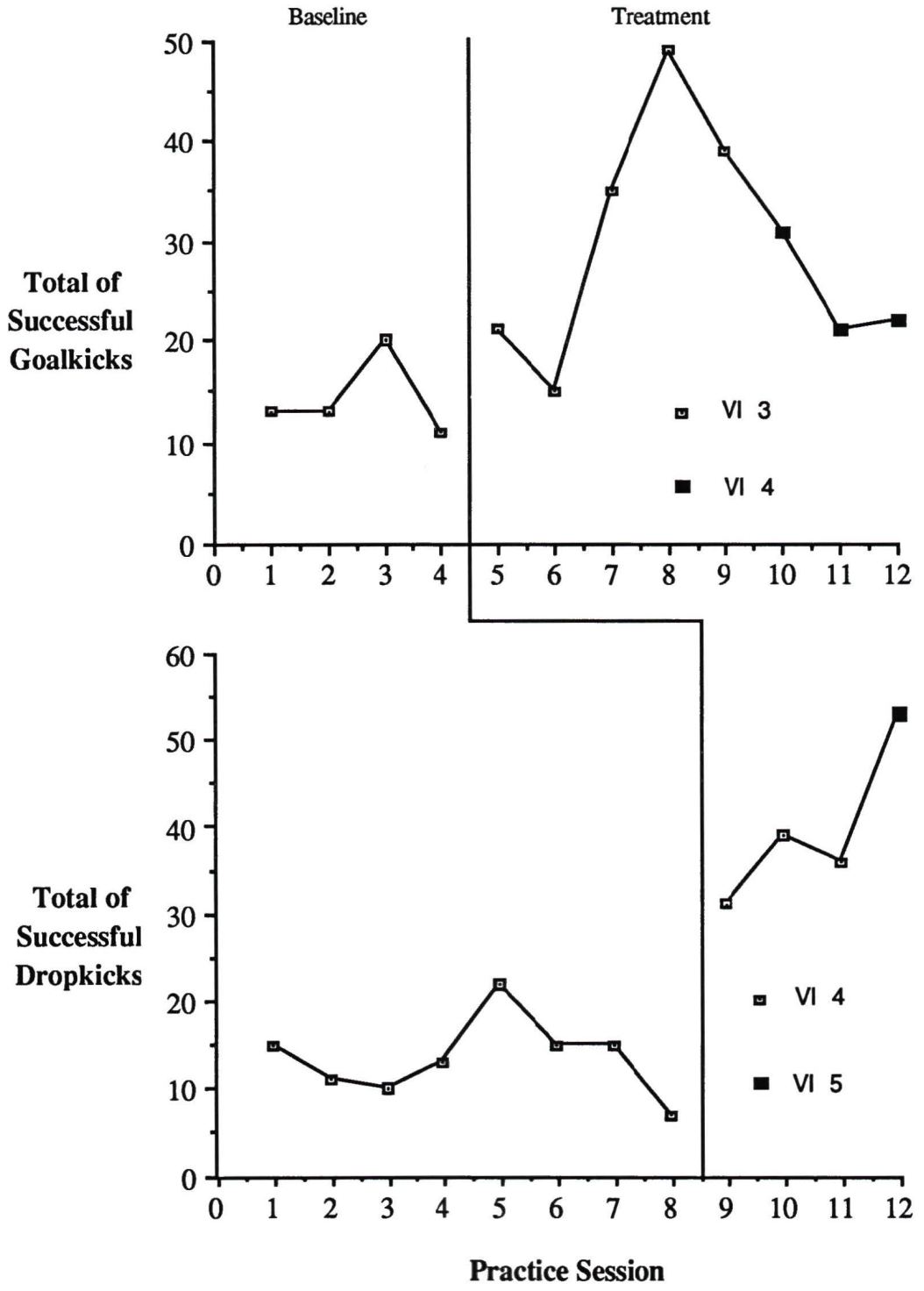


Figure 8

Total of Successful Goal and Drop Kicks for Subject 4



Percentage of Successful Practice Behavior

Table 3 presents the average percentage of successful goalkicks and dropkicks over the two periods of baseline and treatment, for each subject. Only one of the four subjects' average rate of successful goalkicks did not improve from baseline to treatment. The subjects' average percentage of successful goalkicks during baseline ranged from 43.01 percent to 52.00 percent; treatment scores demonstrate a mean ranging from 51.10 percent to 58.91 percent. All four subjects' average percentage of dropkicks successfully landing in the target area increased from baseline to treatment. The average percentage of successful dropkicks ranged from 45.02 percent to 56.55 percent during baseline, increasing to a range of 49.19 percent to 62.31 percent following the intoduction of treatment.

Table 3

Average Percentage of Successful Goalkicks and Dropkicks

Subject	Skill	Average % of Succesful Kicks	
		Baseline	Treatment
1	GK	43.01	53.79
	DK	56.55	62.31
2	GK	46.45	53.04
	DK	47.06	56.18
3	GK	52.10	51.10
	DK	45.02	49.19
4	GK	49.85	58.91
	DK	49.05	53.55

GK= goalkick

DK= dropkick

Chapter V

Discussion

The variable-interval schedule reinforcement treatment of the present research was demonstrated to be effective in increasing the total number of attempts and successful completions of the place kick for goal and dropkick restart rugby skills for the duration of the study. The following discussion will qualitatively analyse the data in an attempt to further explain these findings. The practical implications of the results will also be discussed with regard to previous research in sport and specifically to rugby. Finally, limitations of the present research will be taken into consideration and directions for future research will be suggested.

Qualitative Analysis of Results

The numerical results clearly suggest that the total number of attempted and successfully completed goal and dropkicks were greater during treatment sessions compared to baseline practices. To present a more complete portrayal of the effects of treatment on practice behavior, a qualitative analysis of Figures 1-8 is needed because certain treatment or baseline phases depicted within a number of the figures suggest patterns which refute a treatment effect.

When examining Figures 1-4, it is apparent that treatment had to a varying extent a positive effect on each subject's practice behavior, however this is not incontrovertible for every subject. The pattern of behavior depicted for subject 1 emphatically suggests a positive treatment effect because: (a) during baseline goalkick practice, behavior demonstrated a trend opposite to the desired behavior change and dropkick practising

stabilized around 25 kicks per session and (b) it is apparent that following baseline the total kicks per session for both skills during treatment had increased. Goalkicking treatment behavior went up with the increase in the VI schedule from three to four minutes following six intervention sessions. For Subject 3 the data are also indicative of a positive treatment effect, although baseline totals for goalkicking had probably not stabilized. The immediate peak in goalkicking with the introduction of intervention and the tapering off to less extreme yet stable values suggests either that reinforcement was initially highly rewarding but subsequently less effective (or the subjects were becoming bored), or conversely that the kicking during session six was effected to a great extent by extraneous variables.

Figure 2 demonstrates subject 2's goalkicking attempts per session were visibly elevated after the introduction of treatment, and baseline values seem to have stabilized. Conversely, dropkicking totals during baseline for Subject 2 appear to be augmented to levels seen after intervention was introduced. Without the disproportionate number of kicks during session eight, however, the trend of baseline would be stable, predictable and within a range lower than treatment. Furthermore, a trend should not be grounded on the behavior during one practice session because the effect of extraneous variables such as weather and time constraints on practice behavior may have caused variability from session to session.

The pattern of dropkicks attempted during baseline and treatment in Figure 4 is highly suggestive of a positive treatment effect because of a stable baseline and an elevated number of attempts following intervention. The effect of treatment on the goalkick totals for this subject is less apparent. Although goalkick totals during baseline were stable, the trend during treatment indicates that the initial impact of intervention was tapering off to near baseline levels. Figure 4 suggests that the capacity of the reinforcement schedule on this subject's behavior lacked the power to maintain the initial levels of behavior change

for a sustained period. This is not necessarily the case because the decrease in goalkicking practice was concurrent with an increase in the VI schedule for this participant. That is, the VI schedule was increased from three to four minutes after five sessions of treatment.

Figures 5-8 depict the subjects' total number of successful goal and dropkicks per session. Again, the patterns prevalent for the practising of Subject 1 classically resemble a positive treatment effect because of a stable or decreasing baseline, with a pronounced elevation of behavior following the initiation of intervention. The portrayal of Subject 3's goalkicking successes also suggests intervention led to the desired effect, however, the baseline values for goalkicking are evidently unstable and consequently the increase in successful kicks subsequent to baseline could be disputed.

When examining Figure 6 it appears that baseline values stabilized and treatment led to an increase in both the goal and dropkicking successes for Subject 2. Although there is some indication of a reduction in the influence of intervention over the closing stages of goalkicking treatment this would be imperceptible were it not for session 12. It would be inappropriate to conclude that treatment was ineffective based upon the value of one training session.

The dropkicking behavior of Subject 4 resembles a prototype of a positive treatment effect on practice behavior. The influence of treatment on goalkicking behavior, by contrast, is not apparent until the third session of intervention and following a large increase in successful behavior over sessions seven to ten, behavior reduces to near baseline levels. As stated in the discussion of kicking totals, during Subject 4's final three goalkicking practices the VI schedule of reinforcement was increased from three to four minutes. It is probable that the increased interval of reinforcement was too marked and resulted in the decrease in successful kicking behavior.

To review the qualitative analysis of results, it appears that treatment was largely effective in increasing the practice behavior of all four subjects, although there are possible incidents within particular figures which could be perceived as indicators which refute a treatment effect.

Practical Implications

Behavior Modification in Sport Research

The results of the present study suggest that a VI schedule of reinforcement increased the four subjects' practising of two sport skills. This analysis is congruent with the findings of previous research which have demonstrated the positive effect of reinforcement on the practising behavior of athletes (Hume & Crossman, 1992; McKenzie & Liskevych, 1983; Scott, 1991). In addition, the findings of this research extend the literature initiated by the research of Gray (1989), who demonstrated the positive effect of a behavioral intervention upon the learning of a rugby skill.

Probably the most important implication of the present study is that its findings support the concept of employing an intermittent schedule of reinforcement to increase the practising behavior of a sport skill, a question previously examined only by McKenzie and Liskevych (1983). Research in the sport and exercise area has employed intermittent schedules of reinforcement to increase the rate of automatic behaviors such as the gross motor skills of running and stationary bicycling (Bennett et al., 1989; Croce & Horvat, 1992; De Luca & Holborn, 1985, 1990, 1992; Doleys et al., 1982; Epstein et al., 1991; Kau & Fischer, 1974). The present study examined a sport skill which was more specific, involving several components needing certain levels of proficiency to be performed

concurrently for the behavior to be successful. Sport skills such as kicking in rugby, free-throwing in basketball, or service reception in volleyball are not as repetitive as the gross motor skill of stationary bicycle riding, yet practice for the required amount of time can be just as monotonous. If beginners and intermediate athletes are to enter the elite ranks a great deal of practising is necessary. An athlete's practice behavior should be initially reinforced early on so that the natural benefits of exercising a skill become apparent.

There was good reason to be concerned about the use of intermittent reinforcement to elevate the practising of sport skills because this type of treatment is most often employed to increase the rate of a behavior (Martin & Pear, 1988). If intervention causes an elevation in behavior rate without concern for the way in which the action is produced, then it is possible that the quality of the behavior which is not automatic, such as a sport skill, will deteriorate. McKenzie and Liskevych (1983) averted the possible decrease in quality of a sport skill with the use of intermittent reinforcement, by rewarding only successful behaviors. The findings of the present research support the results of Mckenzie and Liskevych (1983) because practice behavior of the two kicking skills increased, yet the quality of performance did not decrease and may even have improved.

The current study also contributes to this area of research because it used of a variable interval schedule of reinforcement as compared to the variable ratio schedule McKenzie and Liskevych (1983) employed. While the VR schedule may have been appropriate for the volleyball serve reception skill examined in the McKenzie and Liskevych study, it was suggested that the practice behavior of the kicking skills should be increased without the pauses in behavior characterized by ratio schedules. A VI schedule was thought to be more suited to the rhythmical, meticulous and concentrated nature of set kicking in rugby.

Finally, while the priority of the current research was to examine the feasibility of intermittent reinforcement's effect on the practice behavior of two rugby skills, there is some evidence to suggest that the elevation in practice behavior caused by treatment led to an increase in all subjects' dropkick performance and in all but one of the subjects' goalkicking capabilities (see Table 3). It is possible that the small increases in quality of performance from baseline to treatment would have occurred if baseline levels of practice behavior had persisted. However, had the treatment in the present study carried on for a longer duration than the two weeks for dropkicking and four weeks for goalkicking it is possible that the indications of performance improvement may have developed into real increases in capability. The rise of kicking legends such as Grant Fox did not occur over a matter of weeks, but took years of practice (Fox & Veysey, 1992)

Although the short length of the current research probably limited the benefits of treatment to the subjects, anecdotal reports suggest that the three kickers who performed the two skills within the game situation all improved. One subject won a kicking competition against fellow team-mates and was reinstated as goalkicker after he was dropped because of poor performances in the initial stages of the season. Subsequent to the kicker's reinstatement, his record was five successes from six attempts, four from six and an impressive nine from nine. These performances happened during treatment, but no kicking record was possible during baseline and consequently no comparison can be made. The coach of another subject strongly believed his player's performance in both the place kick for goal and the dropkick restart had improved in games over the middle and latter stages of treatment, although no numerical data could be provided. A third subject commented himself that his game performances in goalkicking especially had become more accurate and he was consistently "landing 'must get' goals" from positions where he would often miss prior to intervention.

Although anecdotal reports do not hold much weight because it is possible that the subject and coach said what they perceived the experimenter wanted to hear, there is also limited evidence in the present research that all but one kicker improved in both skills. If this is the case, the present findings support an extensive array of research which has found behavioral treatments to improve the quality of sport skill performance (Allison & Ayllon, 1980; Buzas & Ayllon, 1981; Critchfield & Vargas, 1991; Fitterling & Ayllon, 1983; Gray, 1989; Komaki & Barnett, 1977; Koop & Martin, 1983; O'Brien & Simek, 1983; Shapiro & Shapiro, 1985; Wolko et al., 1993).

Rugby

Obviously the present research has implications for the place kick for goal and the dropkick restart. In contemporary rugby the influential style promoted by the 1987-1991 All Blacks and the change to the restart laws have given added importance to the goalkick and dropkick respectively. Fox and Veysey (1992) advocate repetitive practice as the method of producing a kicker of Fox's stature, so the findings of the current study should be of some interest to national youth programs, clubs, international teams, and professional teams if they eventuate. It will be interesting to observe, as rugby emerges as a professional game, whether goalkicking camps and substitute place kickers (a player whose only function within a game is to goalkick) will become the norm for elite teams, as they have been for some time in American Football.

The current findings are relevant to other individual rugby skills apart from the two examined. Rugby is viewed largely as a team game because in most facets of play there is a need for players to unite their abilities for a side to be efficient, for example in scrums, rucks and mauls. Consequently, rugby is coached largely as a team game and drills most often have a team emphasis (Williams, 1973). The rugby practice typically involves firstly

having players warm up with general skills such as catching and passing, then the forwards and backs split and work on unit play, finally the units comes together to run as a team (Davis & Ireland, 1985). While the mentioned components of a practice are necessary, lesser emphasis should be placed on the unit drills because most players' roles within them are secondary. Lineout drills, for example, are set fixtures in rugby practices because they allow each forward to be involved to some degree, yet the function of winning ball which the lineout provides is fundamentally dependent upon the timing between only the thrower and catcher. Players should be given time to work on their primary tasks and unit drills should be incorporated into the team run to a greater extent. Loose forwards, for example, often spend up to half an hour practising the lineout with the forward unit, when some of this time should be spent working on specialized defensive and offensive patterns. For a team to play to its capability, individual and specialized skills must be honed and timing between players should be understood. Most teams, at the club level at least, probably perform below their capability because specific individual skills such as the goalkick and dropkick are executed poorly. Few players understand the importance and the benefits of practising those skills which distinguish their play within a game.

With the development of rugby as a professional game, concentration on individual skill will be increasingly highlighted because players' distinctive actions will become more accountable. It is probable that with the professionalization of rugby, a larger coaching staff will be afforded and therefore more emphasis may be placed on specialized practising. Goalkicking and dropkicking are just two of the many particular skills which players must be given incentive and time to practise if players are going to fulfill their potential.

Limitations of the Present Research

The present research had several possible limitations. First, a problem with the present research was providing a valid objective measure of practising behavior without effecting the natural occurrence of that behavior. Practising behavior during baseline was not truly reflective of normal behavior prior to the beginning of research. Had the study not occurred, then it is unlikely that subjects would have practised kicking to the extent of the practising demonstrated during baseline. By agreeing to meet twice a week for skill training, the practising behavior of the subjects during baseline was different from the usual pattern. Subjects were given incentive to practise because the experimenter was depending on them to be present at the stated times. Furthermore, unlike practising alone, there was a person present to help retrieve balls and to observe kicking behavior. While baseline levels are to a certain degree contrived, and this is a limitation of the present research, it is true that had there been an unaffected measure of baseline behavior, the treatment effect would most definitely have been greater.

A second possible limitation of the current research is that the impetus of intervention was on increasing the participants' practice behavior rather than the improvement of the subjects' skill level. Consequently there was a lack of social validation because the emphasis was on a behavior which was secondary to the subjects' basic want for improvement in the two kicking skills. It was hoped prior to the study that the effect of treatment on repetitive practice behavior would also lead to an increase in skill performance. Although it is possible the increase in repetitive practice behavior led to an improvement in skill, the results are unclear and consequently do not question the effectiveness of such recurrent practising. Fox and Veysey (1992) advocate the importance of practice, practice and more practice, yet with beginners or intermediate level athletes who lack successful

technique, what should probably precede, or run concurrently with repetitive practice, is training in form.

The timing of the present study was a limitation as it prevented the opportunity for the athlete to observe the benefits of the practice. Ideally, the research should have begun prior to the start of competition so that the subjects benefited from the practice going into the season, with the hope the subjects would be encouraged to continue individual practising throughout the length of competition. This was not the case as research began near the end of the rugby year and was, therefore, marginally beneficial to the subjects' performance in that season. For maximum benefit to the athlete, treatment could be held as a pre-season preparation and then individual practising could be rewarded and made a part of the remaining team training sessions.

Additionally, the choice of goalkicking routine in part was probably ill-suited to the subjects. Although each of the subjects has played, or will likely play, first division rugby in Canada, their kicking was only of an intermediate level. Stations six and seven of the kicking routine (see Appendix C) were too testing for the subjects' present capabilities, as was shown by the regular failure of five or more out of six possible kicks for these two stations. Such negative consequences cannot be positively reinforcing to practising behavior. In future research the kicking routine should be chosen to challenge the capacity of the subject, but should not be discouraging.

In similar vein to the limitation just discussed, the present research was problematic in that the determination of success was very rigid. Consequently, because subjects were of an intermediate skill level, the percentage of attempts at both kicking skills yielded negative consequences approximately 40 to 50 percent of the time. While the objective of the present research was to increase practice behavior via reinforcement, subjects were receiving negative feedback nearly every second occurrence of behavior. Furthermore, the rigid determination of success possibly did not allow more subtle improvements in kicking

performance to become apparent. Although during goalkicking practice, for example, subjects may not have significantly increased the percentage of kicks that went through the posts during treatment, the increased practice levels may have caused treatment misses to be closer in proximity to the posts. It could be argued, however, that closer misses are still misses and are therefore irrelevant. The rigidity of success will be further discussed in the directions to future research.

A further problem with the present study was the appropriateness of the interval schedule to increase dropkick practising behavior when considering quality of performance was of uptmost importance. Although only a successful kick was reinforced after the critical interval had elapsed during the data collection , the high rate with which subjects could dropkick a ball meant that even without concentration on the skill, a ball would land within the rectangular area before the passage of any substantial period of time. Consequently subjects could perform at vastly different levels of success yet still be similarly reinforced. The quality of dropkicking performance did not deteriorate, nevertheless it appeared that levels of concentration were not as high during the practising of this skill as they were during goalkicking treatment, and that dropkicking performance could have been of a higher quality. The practising of skills such as dropkicking in rugby, service reception in volleyball, and chipping in golf, which can be rapidly reproduced are possibly better suited to schedules other than the variable and fixed interval type. This issue will be further discussed in the section examining directions for future research.

Finally, a definite limitation of the current study was a lack of consideration of levels of practice behavior following increases in the VI schedule. It is probable that the decrease in reinforcement as a consequence of increasing the VI schedule, culminating in a lack of natural reinforcement from successful kicks and the high occurrence of negative consequences associated with the large percentage of failure, generated the decline in

goalkicking practice behavior of Subjects 2 and 4 over the later stages of treatment. In the last three treatment sessions for Subject 2 and the last two for Subject 4, it is perceivable in Figures 2 and 4 that the decline in practice behavior is concurrent with the change to treatment. Although it was appropriate to increase the VI schedule after it was apparent that intervention was positively effecting these two subjects' practice behavior, the VI schedule should have been reduced after the decline in practice behavior became overt.

Directions for Future Research

Several areas of research were suggested by the present study. Firstly, increases in the repetitive practice behavior may lead to the precision needed for success in other individual rugby skills which require timing and finesse, such as lineout throwing and jumping, up-and-under kick and pressure, and maneuvers in midfield. Of course it is not only rugby skills which could benefit from increases in repetitive practice. Other sport skills which may be monotonous and tiresome to practise such as training with a tennis ball machine or dribbling through cones in soccer, could be enhanced by reinforcing practice behavior.

Another direction for future research involves the type of reinforcement schedule to be employed. The treatment used in the current research was a variable-interval schedule of reinforcement. As already discussed, this intervention may have been more conducive to the slower, more meticulous preparation of the goalkick compared to the rapid dropkick behavior. It would be probably more suitable for future research dealing with a rapid sport skill to apply either a ratio schedule or an interval schedule with limited hold. A ratio schedule is suggested because subjects are given reinforcement only following the attainment of a certain criteria of successful behaviors, ensuring that subjects realize

reinforcement is dependent on quality of behavior. If an interval schedule is to be employed, then it should be with a limited hold, because after the elapse of the critical interval, if the successful behavior does not occur within a certain time period then no reinforcement is administered. This would probably decrease the likelihood of reinforcing a successful behavior which occurs following a high proportion of failures.

An aspect of the current study which has already been discussed as a possible limitation, but which is also relevant to future research, is the choice of task and success criteria to suit the subject. If the present research were to be replicated with subjects of similar capability, it would probably be advisable to make the tasks easier and the success criteria less stringent in order to avoid a high rate of negative consequences and to also allow a less restrictive gauge on performance. There are several strategies which could accomplish this. For example, it could be possible to have four or six goalposts and one or two further rectangular dropkick areas surrounding the original area, so that reinforcement of varying value can be administered for different levels of success (see Appendixes H and I). This strategy is probably suited to the beginning or intermediate athlete to allow behavior to be shaped to closer approximations of the target behavior, and to prevent avoidance of practice behavior because of the high occurrence of failure associated with stringent success criteria. However, it is a concern that reinforcing an elite athlete for lesser approximations of the target behavior could be detrimental to performance within the game situation where there is often no benefit for a near miss. Another method of decreasing the negative consequences associated with difficult practice behavior would be to make the task easier. For example, having eight goalkicking stations within stations five and six (see Appendix J) would have greatly reduced the unsuccessful goalkick attempts seen in the present research because kicking stations 6 and 7 would not be present (see Appendix C). Future research should balance the reinforcement schedule with the degree of negative consequence associated with the performance of the skill itself.

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Appendix A

Subject Consent Form

Consent Form

I,_____(full name) agree to take part in the study to be carried out by Mr. Brendan Hoko, a graduate student at the University of Victoria. Having read and comprehended the introduction, I understand that this study will attempt to improve two Rugby kicking skills, will last approximately six weeks, and participants will be involved in three training sessions per week. I clearly understand that skill instruction will not be given, instead reward will be administered for performing the skills correctly during practice sessions. It is also clear to me that kicking accuracy will be monitored during training sessions and in games I partake in during the study. I have a full understanding of

*The nature and purpose of this study and my role as a subject has been explained to my satisfaction. I also understand that participation in this research is entirely voluntary and I may withdraw from the study at any time without explanation.

*I understand that any data pertaining to me will be strictly confidential (i.e. any information personally connecting myself to data obtained will be stored in a locked filing cabinet and destroyed after completion of the study).

*I have been informed that my kicking accuracy will be monitored during the study and that anonymity of these results will be ensured by: (a) a coding system where participants will be known as Subjects 1, 2 or 3 for example, and: (b) this coding system will be carried over in any publication of findings.

*It is also my understanding there are no physical dangers and that my participation will have no effect on my grades, class study, participation as a team member, or employment opportunities.

Signature _____

Date _____

Appendix B

Letter Describing Subject's Role

University of Victoria
P.O. Box 3015, Victoria, B.C.
Tel. (604) 721-8375

Introduction

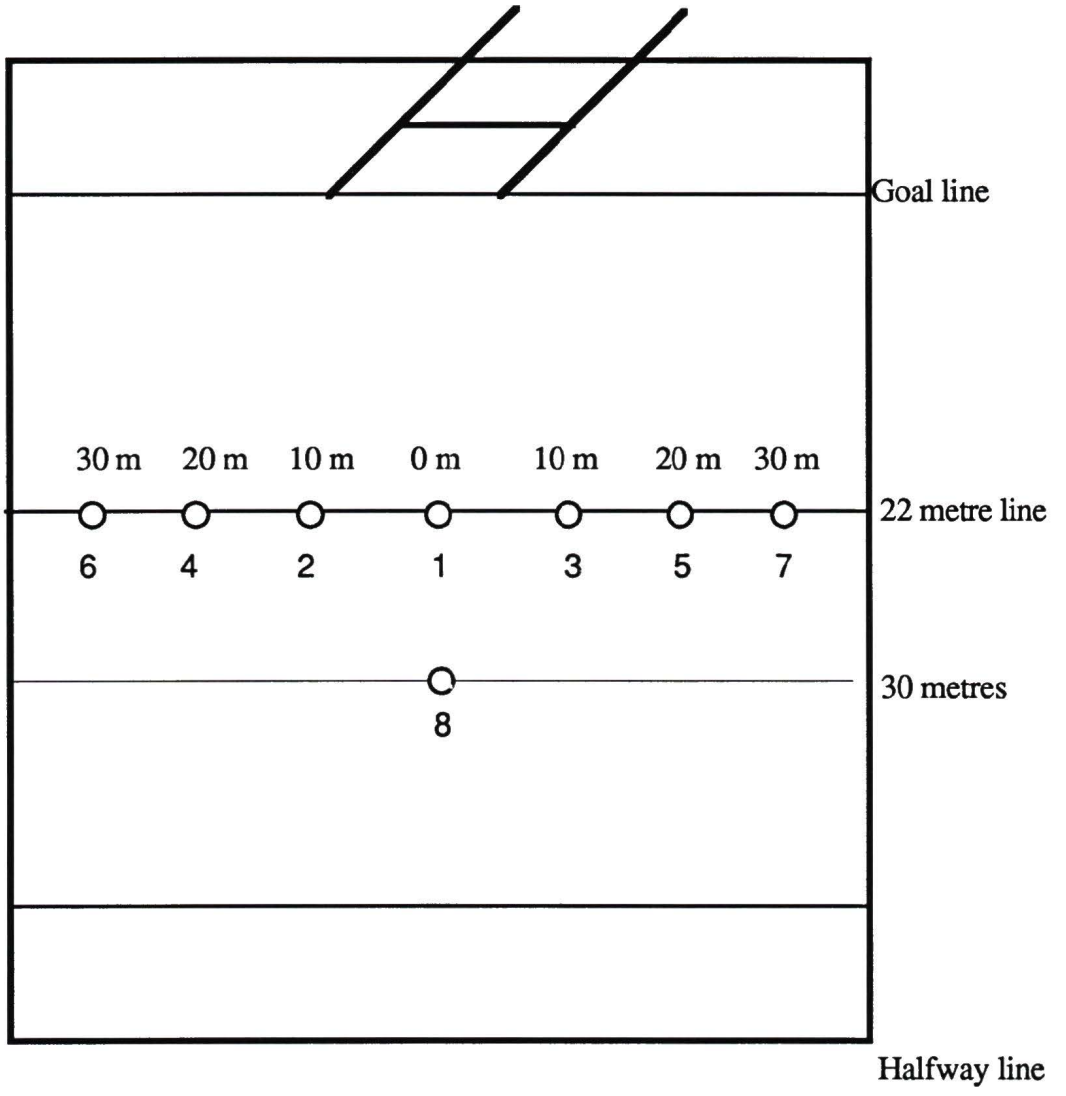
This study is concerned with attempting to improve the two Rugby skills of kicking for goal and drop kicking to start or restart a game. It will last approximately six weeks and participants will be involved in three training sessions per week. Instruction will not be given on how to better the skills, instead it is hoped the skills will naturally progress with an increase in practice. Points will be given towards a reward of your own choice for participating during practice sessions. Points are dependent upon practicing for a certain time period, after which the first successful kick will be rewarded. For a kick to be considered successful it will have to meet a number of criteria. That is, for the drop kick restart the ball will have to land within a certain boxed area and be a certain height and for the conversion attempts the ball must go through the uprights and over the horizontal bar. Your kicking accuracy will be monitored during training sessions and in games you partake in during the study.

Research of this type is governed by strict ethical standards. The data obtained from your participation will be treated as *strictly confidential* and this information will be destroyed following the completion of the study. No one who knows you will ever be able to identify your data in anyway as only the experimenter will have access to the data, and in the subsequent write up of the research, data provided will coincide with numbers only (i.e. subject 1 kicked...). Please remember you have the absolute right not to participate in anything you do not want to and if any time you wish to discontinue involvement feel free to do so. I would be grateful if you would agree to participate in this study by completing the informed consent form. This study forms part of my Masters of Arts and is under the overall supervision of Dr. Bruce Howe. Should you have any question regarding this research feel free to contact Brendan Hoko on 472-1965. Thank you for your time and cooperation, it's very much appreciated.

Brendan Hoko

Appendix C

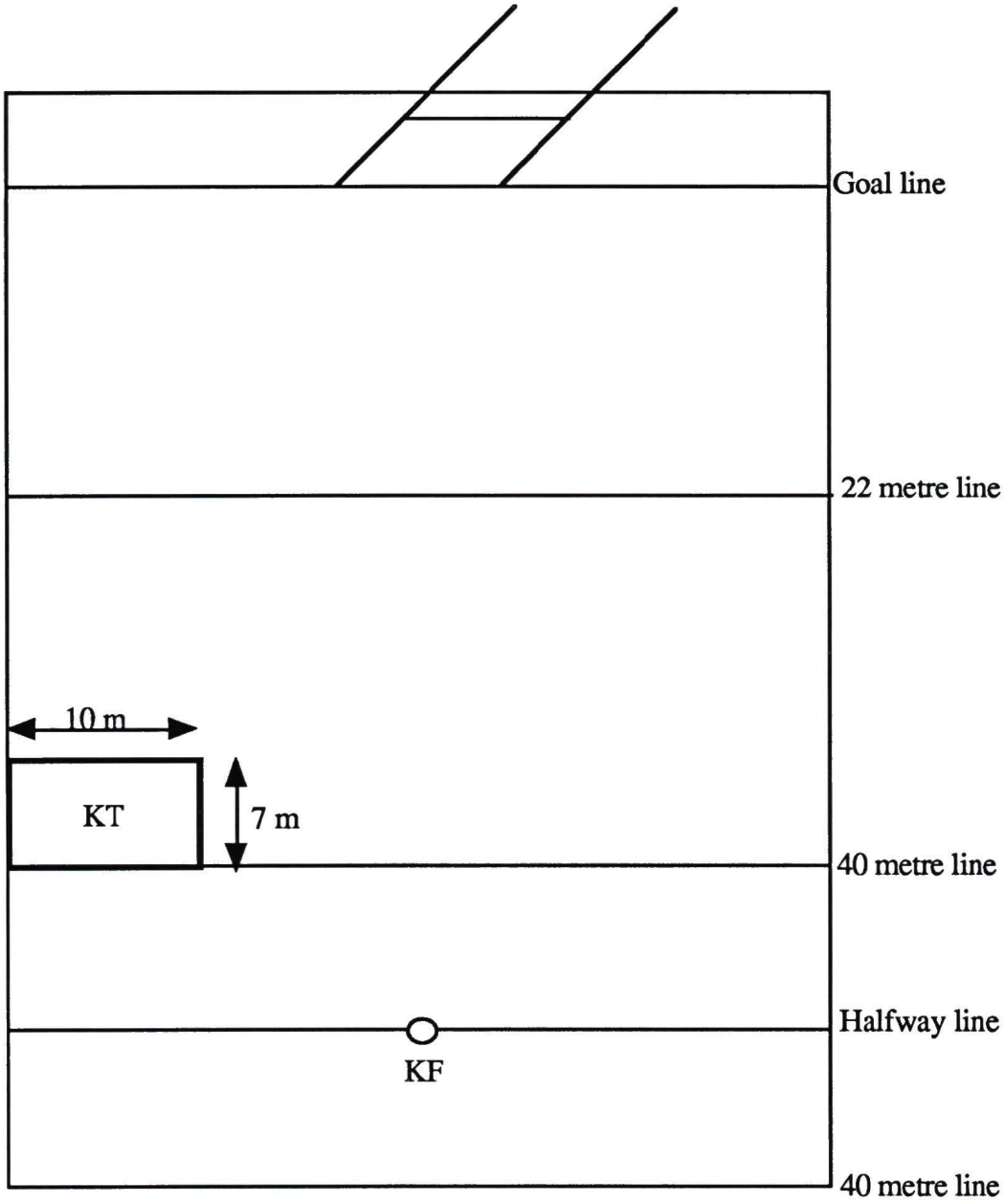
Goalkick Field Positions



1-8 = Station Numbers
m = distance from centre field

Appendix D

Dropkick Area and Field Position



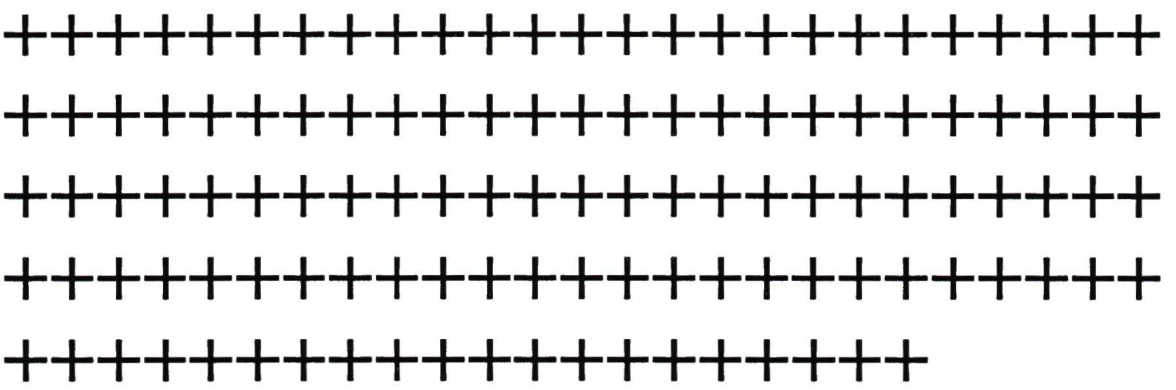
KF = kick from
KT = kick to

Appendix E

Observation Sheet

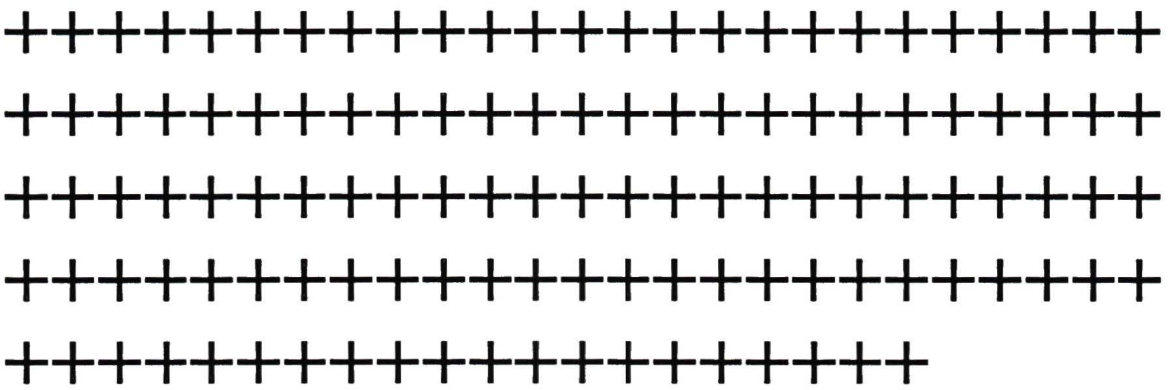
Name: Day: Time: : Kick: (P):
VI:

Minutes:



Name: Day: Time: : Kick: (P):
VI

Minutes:



Appendix F

Reinforcement Agreement

Introduction.

Points are to be administered to you for practising kicking for a certain length of time. Following this time period your next successful kick will be rewarded with a point. Brendan will notify you of point attainment immediately after the successful kick.

I_____agree to attempt to gain **100 points** which, once achieved, will be re-imbursed for a reward of your own choice. Your choice of reward is_____.

Appendix G

Example of Reinforcement Schedule

Subject 1 Goalkick Treatment day 3

Reinforcement Schedule: 1 (5 min.), 2 (2 min.), 3 (4 min.), 4 (3 min.), 5 (1 min.) 6 (6 min.), 7 (3 min.), 8 (5 min.), 9 (2 min.), 10 (6 min.) 11 (4 min.), 12 (1 min.).

Beggining of Practice Session: 3:30pm

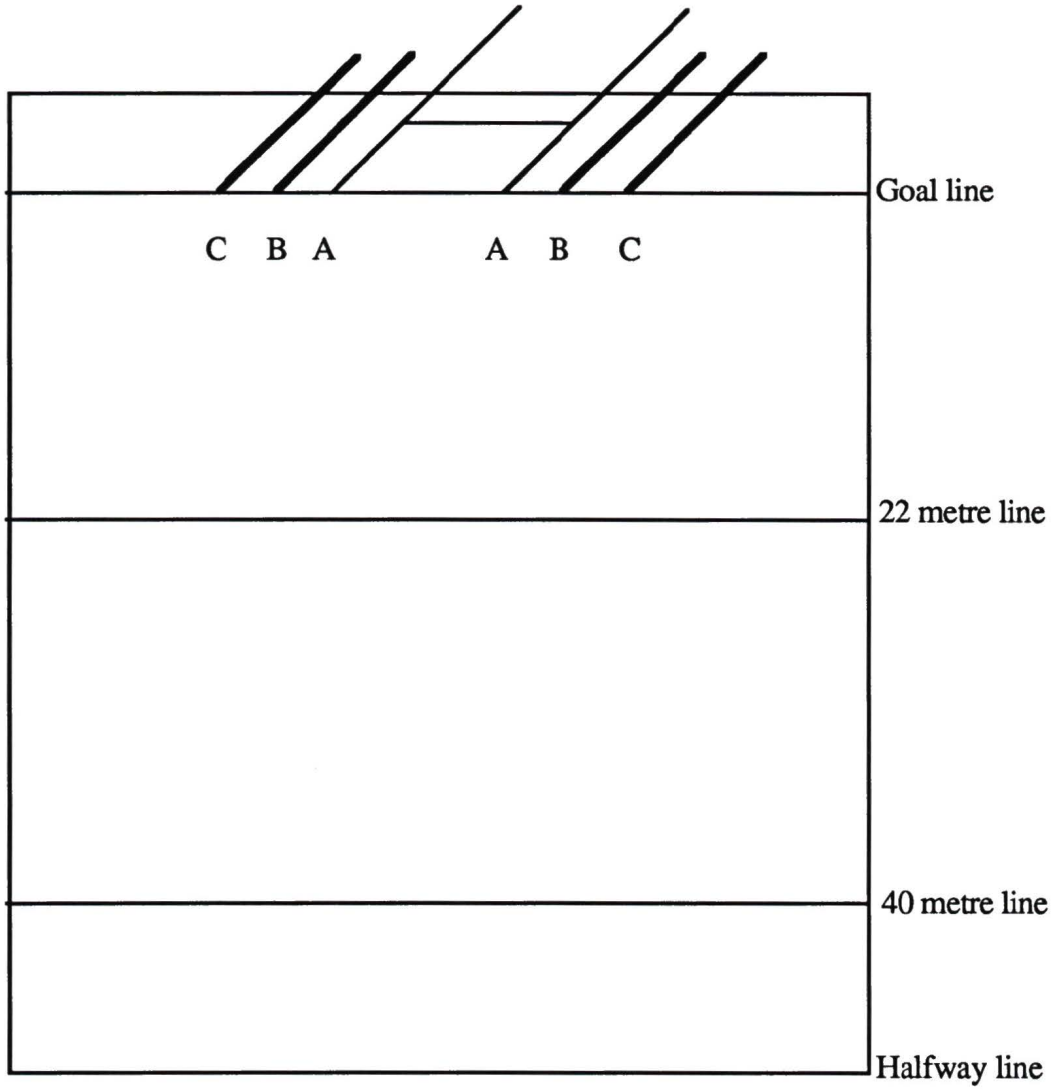
P.A1.	T.R.	P.A2.	T.R.	P.A.3	T.R.	P.A4.	T.R.
3:35	3:37	3:39	3:41	3:45	3:51	3:54	3:59

P.A5.	T.R.	P.A6.	T.R.	P.A7.	T.R.	P.A8.	T.R.
4:00	4:01	4:07	4:10	4:13	4:14	4:19	4:19

P.A9.	T.R.	P.A10.	T.R.	P.A11.	T.R.	P.A12.	T.R.
4:21	4:23	4:29	4:33	4:37	4:39		

Appendix H

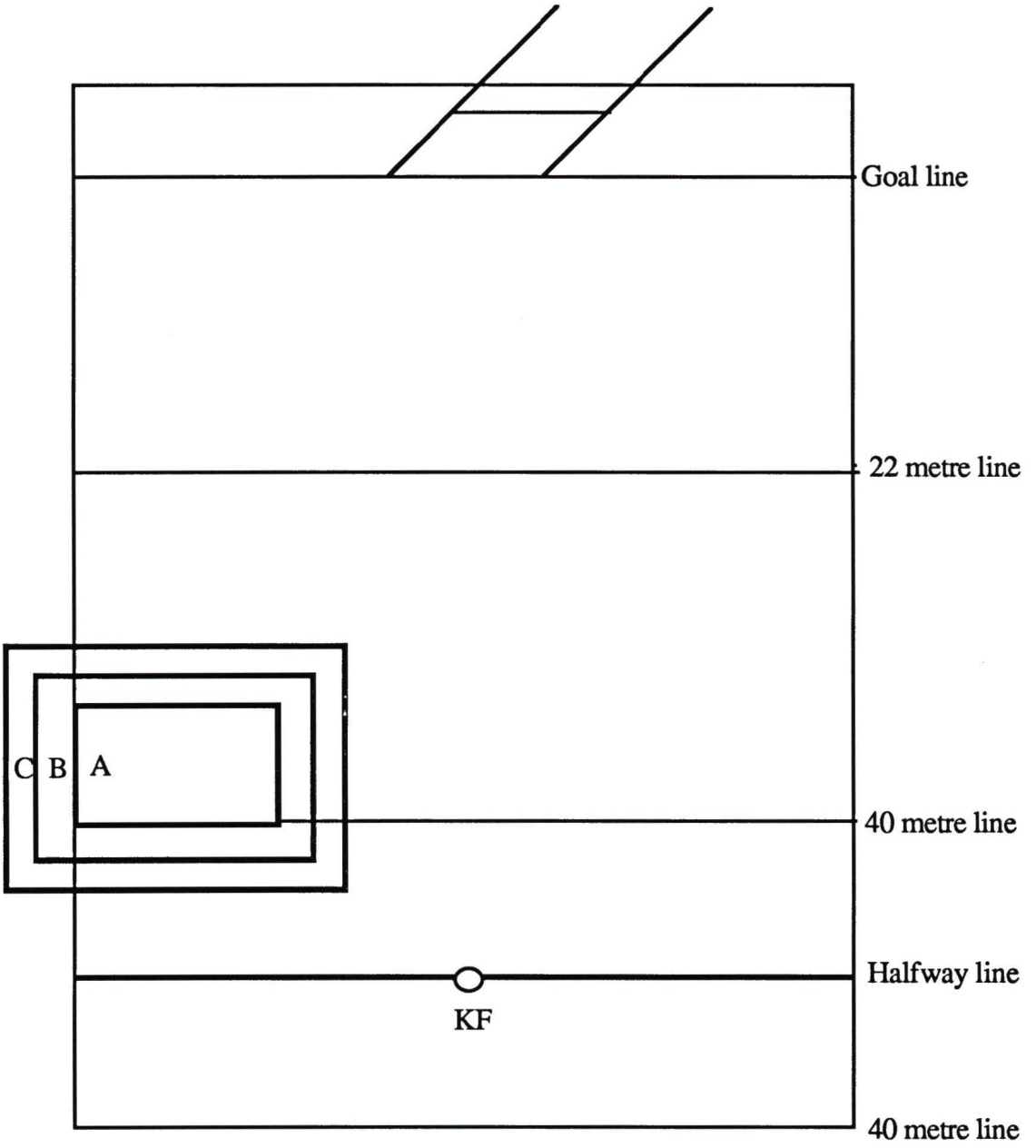
Field with Six Goalposts



A = posts worth three points
B = posts worth two points
C = posts worth one point

Appendix I

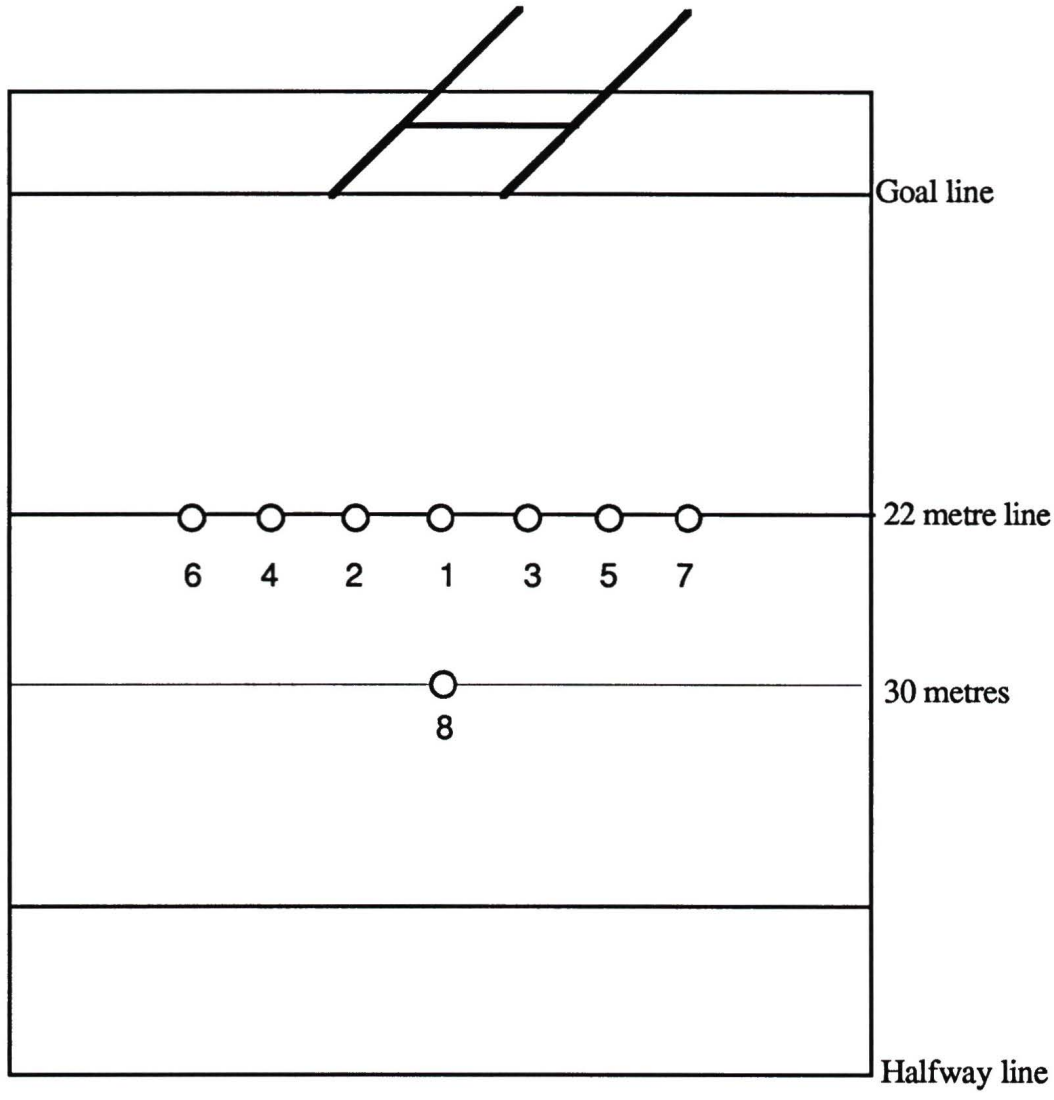
Tri-leveled Dropkicking Area



KF = kick from
A = box worth three points
B = box worth two points
C = box worth one point

Appendix J

Revised Eight Station Goalkicking Routine



1-8 = Station Numbers

VITA

Surname: Hoko Given Names: Brendan James

Place of Birth: Opotiki, Bay of Plenty, New Zealand

Educational Institutions Attended:

University of Waikato	1988
University of Otago	1989 to 1992
University of Victoria	1993 to 1995

Degrees Awarded:

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Honours and Awards:

University of Victoria Fellowship	1993 - 95

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Title of Thesis:

Variable-Interval Schedule of Conditioned Reinforcement and Practising Behavior of Two Rugby Kicking Skills.

Author 

Brendan James Hoko

September 26, 1995